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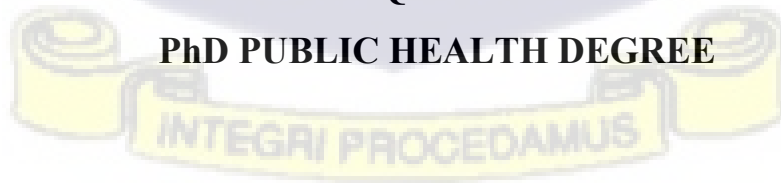
**SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA, LEGON**

**DRIVERS OF ADOLESCENT DIETARY BEHAVIOURS AND
NUTRITIONAL STATUS IN THE VOLTA AND OTI REGIONS OF
GHANA AND THE READINESS TO ADOPT SUSTAINABLE
HEALTHY DIET**

BY

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**A THESIS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON
IN FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF
PhD PUBLIC HEALTH DEGREE**



NOVEMBER, 2024

DECLARATION

I, Norbert Ndaah Amuna, hereby declare that this thesis is the product of my original independent research, conducted under the supervision of Professor Richmond Aryeetey, Dr. Deda Ogum Alangea and Professor Juliana Yartey Enos in the Volta and Oti regions. I certify that this work has not been previously submitted, in whole or in part, to any institution for any academic award. I also confirm that all references to the work of other researchers have been properly acknowledged and credited.



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ABSTRACT

Background: Adolescence is a pivotal life stage, presenting a unique window of opportunity to address early childhood malnutrition and foster the formation of lifelong healthy habits that optimise overall health and well-being. By identifying the key factors that shape dietary behaviours and nutritional status during this formative stage, we can significantly enhance public health strategies designed to improve nutritional outcomes and promote sustainable eating practices among this vulnerable population. This study investigates the factors influencing adolescent dietary behaviours, nutritional status and their readiness to adopt sustainable healthy diets in Ghana. The study seeks to understand how these factors influence adolescent dietary behaviours, nutritional status, and readiness to adopt sustainable healthy diets in the Volta and Oti Regions.

Materials and methods: A community-based sequential mixed method approach was used to collect data. First, a cross-sectional quantitative survey was carried out involving 667 adolescents aged 10-19 years living in the Volta and Oti regions of Ghana, complemented by in-depth interviews to gather comprehensive insights. A face-to-face data collection method was employed to collect data on adolescent sociodemographic and parental characteristics, nutritional knowledge, food insecurity and dietary diversity, dietary habits, adolescent perceptions of high in fat, sugar, and salt (HFSS) food advertisements and awareness, knowledge and the readiness to adopt sustainable diet behaviours using pre-tested questionnaires and interview guide. Dietary intakes were assessed using a 24-hour dietary recall and a food frequency questionnaire. The HFIAS tool was used to assess food insecurity. A freestanding stadiometer was used to measure height, and an Omron HBF 400 body fat monitor was used to measure weight. This was achieved through pre-tested questionnaires and an interview guide. Bivariate and Multivariate logistic regression models were used to analyse the data. The significance level was set at $P \leq 0.05$. Qualitative data were analysed using thematic analysis.

Results: Overall, 61% experienced food insecurity, with predictors including, regional disparities (aOR = 1.61; CI=1.09-2.39), urban-rural differences (aOR = 0.67; CI=0.46-0.97), maternal education [aOR=0.41; (95% CI=0.22-0.78)], and wealth (aOR=0.02; (95%CI=0.0-0.09)). Most adolescents (63.3%) had inadequate dietary diversity, consuming fewer than five food groups, and 16% had low DDS scores of fewer than four food groups. The mean DDS was 5.3 ± 2.5 on a scale of 0 to 12. Although 68.2% consumed plant-source proteins, only 53% ate vegetables and 43.2% ate fruits. Inadequate diets were associated with permissive households [OR=0.32, (95% CI: 0.16-0.63)], busy lifestyles [OR = 11.9, (95% CI = 1.99-70.91)], and lack of cooking skills [OR =0.35, (95% CI: 0.13-0.95)]. Urban adolescents [OR=2.08, (95% CI: 1.29-3.35)] and those with high nutrition knowledge [OR=3.77, (95% CI: 2.09-6.81)] had better dietary diversity. A majority, 65.7% of adolescents found fast-food advertisements fun, 60.7% enjoyed them, and over half found the products appealing (55.6%) and popular (57.0%); 50.1% considered them healthy. Positive perceptions were linked to residence, age, sex, nutritional knowledge, wealth quintile, and BMI. Adolescents residing in urban areas were more likely to perceive the fast-food advertisement, as popular (AOR 1.54, 95% CI 1.04-2.29), enjoyable (AOR 1.56, 95% CI 1.02-2.37) or tempting to try (AOR 2.32, 95% CI 1.59-3.39). Urban adolescents were more likely to find the fast-food advertisements popular (AOR 1.54, 95% CI 1.04-2.29), enjoyable (AOR 1.56, 95% CI 1.02-2.37), or tempting (AOR 2.32, 95% CI 1.59-3.39). Similarly, 66.5% liked sugar-sweetened beverage advertisements, 61.3% found them fun, and over half found them appealing (56.7%) and popular (56.2%); 50% considered them healthy. Female adolescents were more likely to find SSB advertisements fun and appealing [AOR = 1.95, (95% CI: 1.32–2.88)] and [AOR = 1.53, (95% CI: 1.05–2.22)], respectively. Most adolescents consumed three meals daily, though many skipped meals, especially breakfast. Higher adolescent and maternal education, fathers in farming [cOR = 2.0 (95% CI=1.09-3.65), p=0.024], being in the fourth wealth quintile [cOR = 2.39 (95% CI=1.42-4.04), p<0.001], and

medium [cOR = 1.61 (95% CI=1.08-2.41), p=0.020)] or high [cOR = 1.47 (95% CI=1.01-2.13), p=0.044)] nutritional knowledge predicted healthier dietary behaviours. Authoritative parenting correlated with healthier diets compared to neglectful parenting [aOR=0.44 (95% CI=0.29-0.68), p<0.001]. Adolescents in higher wealth quintiles [cOR = 3.44, (95% CI = 2.07-5.72)] and those with high nutritional knowledge [cOR = 1.67, (95% CI = 1.15-2.41)] had higher odds of being overweight, while food-insecure adolescents [aOR = 0.33, 95% CI = 0.21-0.53], those with authoritative parenting [cOR = 0.55, (95% CI = 0.38-0.79)], and authoritarian parenting [cOR = 0.56, (95% CI = 0.34-0.91)] had lower odds. Stunting odds decreased significantly with maternal education [cOR = 0.29, (95% CI = 0.17-0.53)], fathers who were farmers [cOR = 0.43, (95% CI = 0.23-0.7)], and higher wealth quintiles [cOR = 0.24, (95% CI = 0.15-0.41); cOR = 0.09, (95% CI = 0.05-0.15)]. A significant proportion of adolescents showed good understanding of sustainable dietary behaviours, with 57% exhibiting high knowledge and over 60% recognising substantial environmental benefits from reducing food waste, prioritizing plant-based proteins, consuming fruits and vegetables, and purchasing local food. Around 58% were considering adopting sustainable diet behaviours, while 17.4% were ready to implement them. Adolescents with high sustainability knowledge [aOR=8.13 (95% CI=3.05-21.64)] and a positive view of sustainability were twice as likely to adopt sustainable diet practices [aOR=2.69 (95% CI=1.06-6.84), p=0.038]. Food-insecure adolescents were less likely to be ready for sustainable healthy diet practices [aOR=0.33 (95% CI=0.13-0.87), p=0.025]. Parenting styles and parental role-modelling of healthy eating did not significantly influence readiness for sustainable dietary changes.

Conclusion: This study highlights a significant prevalence of food insecurity and inadequate dietary diversity among adolescents in Ghana's Volta and Oti regions, with many consuming fewer than five food groups. While plant-source proteins were common, fruit and vegetable intake were low. Parenting styles and socioeconomic factors significantly influenced dietary behaviours; adolescents from permissive households, those with busy lifestyles, and those lacking cooking skills had poorer diets. Higher education levels among adolescents and their mothers, along with authoritative parenting styles, were linked to healthier diets. Urban adolescents and those with high nutritional knowledge showed better dietary diversity. The study emphasizes the impact of marketing on adolescents' food preferences, especially in urban areas with high exposure to HFSS food advertisements. The appeal of fast-food and sugar-sweetened beverage advertisements among adolescents necessitates targeted public health interventions to counter unhealthy food marketing. Despite a good understanding of sustainable dietary practices, food insecurity hindered adolescents' adoption of these behaviours. Improving dietary diversity in low- and middle-income countries like Ghana requires addressing individual, household, socioeconomic, and environmental barriers, with key influences being parenting styles, adolescent nutrition knowledge, and food costs. To improve adolescents' nutritional status in Ghana, comprehensive nutrition education programmes should be introduced in schools and in the communities, involving students and parents to create a supportive home environment for healthy choices. Community-based interventions, such as food assistance programmes and local farmer partnerships, should address food insecurity. Promoting sustainable diets through awareness campaigns and stricter regulations on unhealthy food marketing will empower adolescents to make informed dietary decisions and develop healthier eating habits.

DEDICATION

To the memory of Robert Awugiya Aduko Amuna and Cecilia Akolgo Amuna



ACKNOWLEDGEMENT

I would like to express my heartfelt gratitude to those who contributed to this research. First and foremost, I extend my sincere thanks to my supervisors, Professor Richmond Aryeetey, Professor Juliana Yartey Enos and Dr. Deda Ogum Alangea, for their invaluable guidance and support throughout this project. I am also grateful to Mr. Timothy Akweh for his immense advice on data analysis, and Dr. Geoffrey Asalu for his insightful suggestions and comments. Special thanks to Mr. Martin Adjuik, Mr. Conrad Pwayirane and Dr. Takramah for their assistance in data analysis.

I would like to acknowledge the efforts of the data collectors and the study participants whose contributions were essential for this research. My appreciation goes to Millicent Appiah, who supervised the data collection process, ensuring its smooth execution.

I am thankful to all members of the Richmond Aryeetey Learning Lab (RALL) for their constructive comments and criticisms that enriched this work.

Lastly, I wish to recognize my peers: Charles Noora, Dominic Gadeka, Agbesi Pharin, Donne, Ken Konlan, Issah Ibrahim, Helena Baidoo, Emmanuel Donkor, Peter Yaro, Simon Peter Katangole, Adwoa Adu-Sarkodee, the late Margaret Adzim (whose presence is deeply missed), Wisdom Takramah, Hon. Sulemana Adama, and Jean Pierre Sacramento for their camaraderie and support during this journey.

Lastly, I wish to thank my family who through their sacrifices, support and prayers made the journey less burdensome. To Vivian, Yinmi, Joel and Maya, I say, God bless you. I am grateful to all my siblings (the Amunas) for the moral and material support. To God be the glory.

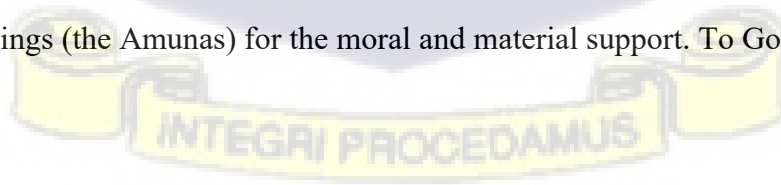


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1.0 INTRODUCTION

1.1 Background

Adolescence is the period between the ages of 10 and 19 and represents a critical phase of human development. It is typically characterised by rapid physiological, physical, psychological, emotional, and social changes (Christian & Smith, 2018a). During this crucial period, optimal nutrition is essential to support healthy growth and normal development and to address lingering early childhood undernutrition and micronutrient deficiencies (Canavan & Fawzi, 2019; Chaudhary et al., 2020; Micha et al., 2018).

Furthermore, adolescence offers a unique window of opportunity to optimise the health and well-being of current and future generations, laying the foundation for a healthy and productive life course (Patton et al., 2016a, 2018a). However, this life stage is also vulnerable to malnutrition, which can have lasting and far-reaching consequences for individual health and well-being. Paradoxically, despite the heightened need for nutritious food, many adolescents struggle to maintain a healthy diet and often resort to high-calorie and low-nutrient options (Amoateng et al., 2017; Doaa Abdel-Hady et al., 2014; Keats et al., 2018; Oktavianto et al., 2023). This unhealthy dietary pattern has contributed to an alarming increase in obesity and noncommunicable diseases (NCDs) among adolescents worldwide. Unhealthy dietary behaviour is particularly pronounced in low- and middle-income countries (LMICs), where the prevalence of these risk factors is increasing rapidly.

Globally, the adolescent population is approximately 1.3 billion, with 90% residing in low- and middle-income countries (LMICs) (UNICEF, 2024; United Nations, 2019). Sub-Saharan Africa (SSA) has the highest proportion of adolescents (23%) by 2050 (Agyepong et al. 2017; Sequeira et al. 2022). Ghana's adolescent population accounts for nearly one-fourth of its current total

population (Ghana Statistical Service, 2024). In light of these statistics, it is imperative to address the complex factors influencing adolescent well-being and its drivers, including dietary choices, nutrition education, and eating habits, to mitigate the risk of undernutrition, obesity, and NCDs. Thus, adolescents' productive potential can be harnessed to foster a healthier, more resilient, and more productive future.

Unhealthy dietary behaviour among adolescents, particularly in low- and middle-income countries (LMICs), is a growing concern (Fan & Zhang, 2020; Liguori et al., 2022a). This behaviour is characterised by consuming high-energy, high-fat, high-sugar, and high-salt foods and beverages, while neglecting nutrient-dense foods such as fruits and vegetables (Hormenu, 2022a; Madzorera et al., 2023a).

Despite recommendations from the World Health Organization to consume 400 g (five servings) of fruit and vegetables daily while restricting salt, sugar, and fat intake (WHO, 2020a), adolescents frequently exhibit eating habits that do not align with the WHO guidelines for healthy eating (Keats et al., 2018; Lassi et al., 2017a). In many LMICs, adolescent diets lack diversity; their diet predominantly includes high-calorie, low-nutrient density foods, such as starchy staples, sugary snacks, and processed meats (2023a; Madzorera et al., 2023a; Ogum Alangea et al., 2018; Surya Bali et al., 2022; Wiafe, Apprey, et al., 2023a). This unhealthy diet increases their risk of obesity, type 2 diabetes, and cardiovascular diseases (Teng et al., 2019; Vorster, Kruger, & Margetts, 2011; Willett et al., 2019). Furthermore, globally, physical activity levels among adolescents have declined, significantly (Kroll et al., 2019a; Monteiro et al., 2019a; Popkin & Ng, 2022; Turner et al., 2020). These shifts in diet and physical activity are thought to have contributed to an increase in overweight, obesity, and diet-related noncommunicable diseases (NCDs), such as hypertension, cardiovascular disease, and certain

cancers, (Abarca-Gómez et al., 2017; Kwan et al., 2016; Popkin & Ng, 2022; Teng et al., 2019; Turner et al., 2020; Willett et al., 2019a).

Decisions about individual food choices involve a complex array of behaviours, including procurement, preparation, storage, distribution, serving, consumption, cleaning up, and disposal (Sobal & Bisogni, 2009). These decisions are influenced not only by individual biological, psychological, and economic factors and taste preferences, but also by wider social, cultural, physical, resource, political, and environmental factors (Monterrosa et al., 2020). These complex decisions involve many considerations such as selecting what to eat, when, where, how much, and the social context (including with whom to engage in eating behaviour). Food choice is about why people eat the foods they eat (Monterrosa et al., 2020). Ultimately, food choice is determined by a dynamic interplay of individual factors, including biological, psychological, economic, and gustatory preferences, as well as broader social, cultural, physical, political, and environmental influences (Chen & Antonelli, 2020).

Food choice behaviours are an important determinant of nutritional status and health. Current global food policy discourse on sustainability and health recognises healthy diets as critical to preventing malnutrition in all its forms (Monterrosa et al., 2020). Fundamentally, the discourse emphasises the importance of aligning personal food choices with sustainable practices to achieve a healthier and more environmentally sustainable food system. Food choice behaviours play a critical role in determining nutritional status and health outcomes. The current global discourse on food policy emphasises the significance of healthy diets in preventing malnutrition and promoting sustainability (Monterrosa et al., 2020). Food choice is also considered important for achieving sustainability targets (Lindgren et al., 2018). By aligning food choices with sustainable practices, individuals can contribute to the development of healthier and more

environmentally conscious food systems, thereby supporting the achievement of sustainability goals.

Recent evidence suggests that environmental factors, including urbanisation, globalisation, marketisation, and media influences, have a significant impact on the quality of diets in many countries (Agyapong et al., 2022; Nanema et al., 2022). Unhealthy food environments, including the proliferation of fast-food chains and convenience stores which retail energy-dense, nutrient-poor foods, creates an "obesogenic environment" where unhealthy options are readily available and heavily marketed, creating a strong pull towards unhealthy choices (Fraser et al., 2012; Herforth & Ahmed, 2015). Unhealthy dietary behaviours also result from limited accessibility to healthy foods in low SES neighbourhoods (Díez et al., 2022). Peer pressure and household-level factors, such as parenting styles and parental role-modelling (Piatkowski et al., 2021a), family structure (Blaine et al., 2017; Sen et al., 2014), and nutrition knowledge, can either encourage or discourage the consumption of healthy food (Amoateng et al., 2017; Vidal et al., 2024).

Some studies have shown that authoritative parenting styles, which involve high levels of warmth and responsiveness as well as clear rules and expectations, are associated with a higher intake of fruits and vegetables among adolescents (Shannon Summers, 2014). Other studies have shown that parental role modelling of healthy eating influences adolescents' food preferences and eating habits (Mahmood et al., 2021a). However, parents who are overly controlling or have restrictive parenting styles can have negative effects on adolescents' dietary behaviours, including increased consumption of unhealthy foods when parents are not present (Mahmood et al., 2021a). The nutritional quality of family meals has been shown to be superior to that of meals consumed outside the home (Jones et al., 2023; Skafida, 2013). Socioeconomic status (Ranjit et al., 2015), food security status (McNamara & Wood, 2019), and cultural norms

shape adolescents' beliefs, values, and traditions regarding food, all of which can influence dietary diversity and quality. Social dynamics and rituals of the family dinner environment, including conversations between parents and children and the involvement of children in food preparation, offer the greatest benefits to a child's physical and emotional wellbeing (B. L. Jones et al., 2023).

Sub-Saharan African countries are currently experiencing rapid growth in supermarkets and other modern retailers, as well as changing market linkages and relations between food system actors (HLPE, 2017; Holdsworth & Landais, 2019; Mergenthaler et al., 2009; Rousham et al., 2020). Africa is also, currently, the region with the fastest urbanisation (Center for Strategic and International Studies, 2023). The urban population in sub-Saharan Africa is projected to reach 60% by 2050 (de Bruin et al., 2021). Such rapid transformations have profoundly altered food systems and the food environment by shaping the spatial patterns of food demand and affecting consumer preferences (OECD-FAO, 2016; Seto & Ramankutty, 2016; Tefft et al., 2017).

These shifts have contributed to increased availability, affordability, acceptability, desirability, and higher intake of processed foods, energy-dense foods, animal-source foods, and high-fat, high-sugar foods (Annan et al., 202; Holmes et al., 2018). These changes also constrain the accessibility and affordability of healthy food, especially for low-income households (Akparibo et al., 2021; FAO, 2023; Guiné, 2023; Herforth & Ahmed, 2015; Mockshell et al., 2022), resulting in reduced intake of complex carbohydrates, dietary fibres, fruit, and vegetables (Holdsworth & Landais, 2019; Popkin et al., 2012).

Current global dietary patterns are not only unhealthy (C. Chen et al., 2022; M. R. Harrison et al., 2022), but are also unsustainable, cause significant resource depletion, degrade the

environment through loss of biodiversity, deforestation, and pollution, contribute to climate change, and increasingly challenge food security and climate health (Culliford & Bradbury, 2020a; Holden et al., 2018; Willett et al., 2019a). Improvements in the health and nutritional status of adolescents in the long term will depend on adopting sustainable healthy diets. The concept of sustainable diets has gained increased attention in recent years, as it offers a holistic approach to addressing the complex challenges faced by modern food systems.

Sustainable diets, as defined by the FAO, are those that “minimise environmental impacts, contribute to food and nutrition security and promote healthy life for present and future generations” (FAO & WHO, 2019). This definition highlights the multidimensional nature of sustainable diets, which must balance social, economic, and environmental considerations. Sustainable diets are “protective and respectful of biodiversity and ecosystems; culturally acceptable; accessible; economically fair; affordable; and nutritionally adequate, safe, and healthy while optimizing natural and human resources” (Nelson et al., 2016a). These diets not only mitigate climate change but also enhance public health and support local economies. This alignment offers significant benefits, as sustainable healthy diets can prevent or reduce the risk of diet-related diseases, improve food security and sovereignty, support local food systems and livelihoods, and mitigate the impacts of climate change and biodiversity loss.

1.1.1 Adolescent Malnutrition in Ghana

Childhood and adolescent obesity in Ghana is a significant and rapidly increasing concern (Sackar et al., 2023a; Yarney et al., 2022). The prevalence of malnutrition among adolescents in Ghana varies depending on the specific type of malnutrition. Currently, there is limited evidence regarding the prevalence of malnutrition among adolescents in Ghana. Nonetheless, some studies have shown mixed trends over time, ranging from 5.5% to 26.1% (Abubakar et al., 2023; Wiafe et al., 2023a). Recent national data on undernutrition in adolescents are scarce,

but the 2022 Ghana Demographic and Health Survey (GDHS) revealed a stunting prevalence of 4% and thinness rate of up to 17% among girls aged 15-19 years (Ghana Statistical Service (GSS) & ICF, 2024). Among male adolescents in the same age group, 42% were noted as thin. In addition, 44% of girls in Ghana, aged 15-19 years are anaemic, including 52% in the Oti region and 43% in the Volta region.

1.2 Problem Statement

Ghana, like many other LMICs, grapples with the dual challenges of undernutrition, overweight and obesity (Akowuah & Kobia-Acquah, 2020; Ofori-Asenso et al., 2016). Ghana is in an advanced stage of the nutrition transition characterised by rising levels of overweight/obesity and nutrition-related chronic diseases (Ofori-Asenso et al., 2016b). Several studies have shown a high and increasing burden of overweight and obesity in Ghana, particularly among specific population groups such as women, men, people in higher-income households, and urban dwellers (Akowuah & Kobia-Acquah, 2020; Arnouk et al., 2023; Kolog et al., 2023; Ofori-Asenso et al., 2016). Overweight and obesity rates are increasing in rural settings in Ghana, particularly among women, men, and households in the highest wealth tertile (Arnouk et al., 2023; Mensah Bonsu et al., 2023).

Being overweight or obese is associated with various health risks (Arnouk et al. 2023). Interventions are required to address these issues (Mensah Bonsu et al., 2023). Despite progress in certain areas, such as improvements in child nutrition indicators, the country continues to grapple with the double burden of malnutrition, characterised by the coexistence of undernutrition and overweight/obesity. Additionally, interventions to address overweight and obesity in rural areas are limited despite their increasing prevalence (Konkor & Kuuire, 2023). In Ghana, factors such as poverty, inadequate access to nutritious foods, unhealthy dietary habits, and sedentary lifestyles contribute to the prevalence of malnutrition across different age groups.

Historically, nutrition initiatives in Ghana have focused, primarily, on infants, young children, and women, neglecting adolescents. Recent efforts have targeted adolescents, focusing on micronutrient supplementation for girls and combating schistosomiasis and soil-transmitted helminths in school-age children. However, existing research reveals prevalence rates of stunting (15-50.3%), underweight (7-19.4%), and overweight/obesity (6.9-17%) among Ghanaian adolescents, varying by context and location (Afrifa–Anane et al., 2015; Alicke et al., 2017a; Appiah Kubi Prince & Laar Amos, 2014; Aryeetey et al., 2017a; Azupogo et al., 2020). Several studies attribute the rising burden of overweight and obesity to unhealthy dietary habits, sedentary lifestyles, and physical inactivity (Afrifa–Anane et al., 2015; Alicke et al., 2017b; Amos et al., 2012a). Ghana is experiencing dietary shifts across all age groups, including adolescents, with a troubling trend towards consuming unhealthy diets. This poses a significant public health concern, with far-reaching consequences for both current and future generations. Diets high in energy-dense foods and low in essential nutrients, such as fruits and vegetables, contribute to malnutrition, obesity, and diet-related non-communicable diseases. Data reveal a surge in obesity and diet-related NCDs among Ghanaian adolescents, with a 2019 study reporting a 10.6% overweight and 3.9% obesity rate (Ghana Statistical Service, 2019). These numbers underscore the severity of the issue and the pressing need for further investigation. This crisis is compounded by the coexistence of malnutrition and widespread micronutrient deficiencies (Casu et al., 2021), creating a pressing double burden that demands urgent attention and action. Analysis shows that 19% of children in Ghana are either overweight or obese (Akowuah & Kobia-Acquah, 2020). A study in Ho, the Volta regional capital, also showed that 24.3% of adolescents were either overweight (15.8%) or obese (8.5%), and the majority did not meet the recommended dietary allowance (Akoto et al., 2022a). Although some studies have investigated adolescent diets and nutritional status in Ghana, significant gaps in knowledge still exist, highlighting the need for additional research to address this pressing public health concern comprehensively.

1.3 Main Objectives

To determine the factors influencing adolescent dietary behaviours, nutritional status and their readiness to adopt sustainable healthy diets in Ghana. The study seeks to understand how these factors influence adolescent dietary behaviours, nutritional status, and readiness to adopt sustainable healthy diets in the Volta and Oti Regions.

1.3.1 Specific objectives

1. To determine the prevalence and predictors of adolescent food insecurity in the Volta and Oti regions of Ghana.
2. To determine adolescent dietary diversity, dietary patterns and predictors in the Volta and Oti regions of Ghana
3. To identify the factors influencing adolescent perceptions and experiences related to advertisements for fast food and sugar-sweetened beverage brands that are high in fat, salt, and sugar (HFSS).
4. To explore adolescent dietary behaviours and related barriers and enablers in the Volta and Oti regions of Ghana.
5. To determine the factors influencing adolescent nutritional status.
6. To determine the awareness, knowledge, perceived benefits, and readiness of adolescents to adopt sustainable healthy diets in the Volta and Oti regions of Ghana.

1.4 Conceptual Framework

This framework illustrates the complex interplay between various factors that affect diet, physical activity, nutritional status, and health outcomes. This emphasises the need for comprehensive interventions that address multiple levels of influence to effectively address the rising prevalence of overweight and obesity among children and adolescents. This model is based on two fundamental concepts. The first is, “behaviour affects and is affected by multiple levels of influence.

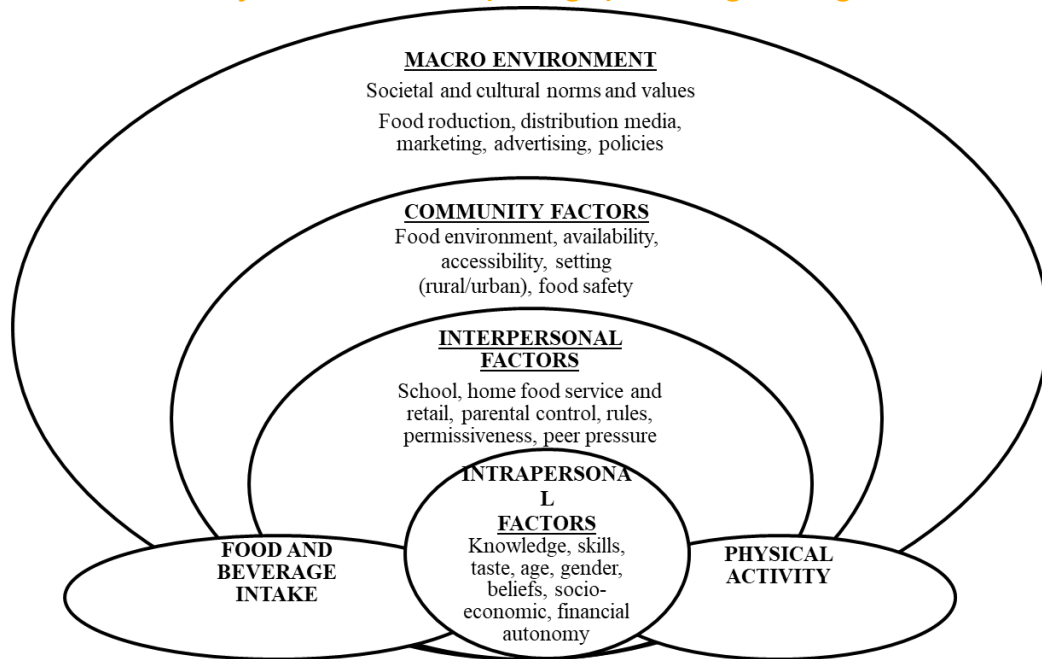


Figure 1.1: Social ecological framework for nutrition and physical activity

The SEM is grounded in the idea that behavior is produced by interacting influences across nested levels (individual, interpersonal, community/organizational, and policy/structural), and that interventions should therefore act at multiple levels to shape outcomes. SEM further assumes that social context and community systems enable or constrain individual psychosocial resources and behaviours, though it does not always specify causal ordering among levels (Dlamini et al., 2017; Sonia et al., 2023). SEM assumes bidirectional links: social/community context shapes individual coping and behavior, and individual-level changes can feed back into community systems; empirical multilevel work shows community trust can amplify individual psychosocial resource effects (Dlamini et al., 2017). The SEM emphasises multiple determinants and interactions but typically does not distinguish proximal versus distal causes or provide a formal level-of-causation taxonomy (contrast with frameworks that do), which leaves causal pathways relatively underspecified (Rukundo et al., 2023). Its multi-level complexity poses implementation challenges, including coordination difficulties and problems measuring impacts across levels. Practical delivery of multilevel interventions requires cross-sector collaboration and can be undermined by persistent social norms, limited local

capacity, and health-system issues such as confidentiality or commodity stockouts (Ottie-Boakye et al., 2025).

Broader household, social, cultural, community, physical environmental and macro level factors play a critical role in shaping individual behaviours related to diet, physical activity, and obesity (HLPE, 2017; Lakerveld & Mackenbach, 2017; Osei-Kwasi et al., 2020). Therefore, focusing solely on changing individual risk factors or behaviours may not be enough to reduce unhealthy dietary habits and the current levels of obesity. These environments can either support or impede healthy behaviours, underscoring the need to comprehend their influence in order to effectively address the obesity epidemic. Specifically, social factors such as family and peer groups, as well as physical environments like neighbourhoods and access to fast food outlets have been linked with obesity. Furthermore, the prevalence of fast-food restaurants and convenience stores in certain communities has been associated with adverse health outcomes, including cardiovascular diseases, diabetes, and certain cancers (Rosales Chavez et al., 2021).

1.5 Justification

Adolescents account for about 22% (6.7 million) of Ghana's nearly 31 million population (Ghana Statistical Service, 2021). Recent surveys reveal a troubling increase in childhood and adolescent nutritional problems in Ghana and other low- and middle-income countries (LMICs) in sub-Saharan Africa (Akowuah & Kobia-Acquah, 2020; Aryeetey et al., 2017b; Ganle et al., 2019; Ogum Alangea et al., 2018). The shift in adolescent nutrition imbalance in Ghana and many low- and middle-income countries (LMICs) is increasingly characterised by a transition from undernutrition to overweight and obesity. This phenomenon is driven by changes in dietary habits, urbanisation, and lifestyle factors, leading to significant public health concerns (Hormenu, 2022; Wiafe et al., 2023). This transition underscores the urgent need for targeted public health interventions aimed at promoting healthier eating patterns and addressing the underlying socio-economic and food environment factors that influence dietary habits. Given

that unhealthy diets have negative impacts on human health as well as planetary health, there is a need to shift food production and consumption patterns towards healthier and more sustainable food choices and better diets to alleviate health and environmental burdens (MacDiarmid et al., 2024). This means choosing foods that are produced in ways that minimise the environmental impact, such as organic, regenerative, or agroecological farming practices. This also means reducing food waste, choosing plant-based options, and consuming local and seasonal foods.

This study, therefore, seeks to identify the drivers of adolescent dietary behaviours, their nutritional status, awareness of sustainable healthy diets, barriers to adopting sustainable healthy diets, and their readiness to adopt sustainable healthy diets in Ghana. Such research can provide evidence-based information for designing and implementing effective interventions that can improve adolescents' dietary behaviours and health outcomes as well as planetary health. Such research can contribute to achieving the Sustainable Development Goals (SDGs) related to health (SDG 3), hunger (SDG 2), education (SDG 4), gender equality (SDG 5), climate action (SDG 13), responsible consumption and production (SDG 12), and partnerships for these goals (SDG 17).

The choice of the Volta and Oti regions for this research is strongly supported by a combination of epidemiological evidence indicating a notable burden of adolescent overweight/obesity and socioeconomic data that highlights the unique developmental context and disparities in these regions. Volta Region exhibits a documented prevalence of overweight and obesity among school-going adolescents, with a 2022 cross-sectional study in Hohoe reporting 15.1% prevalence among 400 adolescents aged 10-19 years, higher than some prior regional estimates and comparable to national trends in Ashanti Region (Agbemaflé, 2022). This peri-urban setting highlights emerging risks linked to physical inactivity and dietary patterns, such as meal skipping and sedentary behaviors, making it representative of transitional nutritional shifts in

Ghana. Oti Region, carved from Volta in 2018, shares similar ecological zones and lacks specific adolescent obesity data but shows high anaemia burdens (94.1% in Nkwanta), indicating broader nutritional vulnerabilities that may coexist with overnutrition in a dual-burden context.

1.6 Outline of the Thesis

Figure 1.2 depicts an outline of the thesis. **Chapter 2** presents a literature review of the research area. The review covers studies on adolescent dietary behaviour and dietary adequacy, nutritional status, sustainable healthy diets, and associated factors. In the review, determinants at the individual, household, and broader community levels, influencing adolescent diets, nutritional status, and the adoption of sustainable healthy diets were identified. **Chapter 3** is summary methods. **Chapters 4–9** present the results in the form of manuscripts. In **Chapter 4**, the prevalence and factors influencing adolescent food insecurity were analysed. In **Chapter 5**, the factors affecting adolescent dietary diversity and adequacy were analysed. **Chapter 6** is an analysis of adolescent perceptions of high fat, sugar and salt foods (HFSS). **Chapter 7** is a qualitative study on the factors influencing adolescent dietary behaviours. **Chapter 8 presents** adolescent nutritional status and associated factors. **Chapter 9** presents a study on adolescents' readiness to adopt sustainable healthy diets. Finally, Chapter 10 discusses the main findings and summarises all chapters in the thesis. It also includes policy implications based on the results and recommendations for future research. Figure 1.2 illustrates the focus of Chapters 2–10 in the thesis.



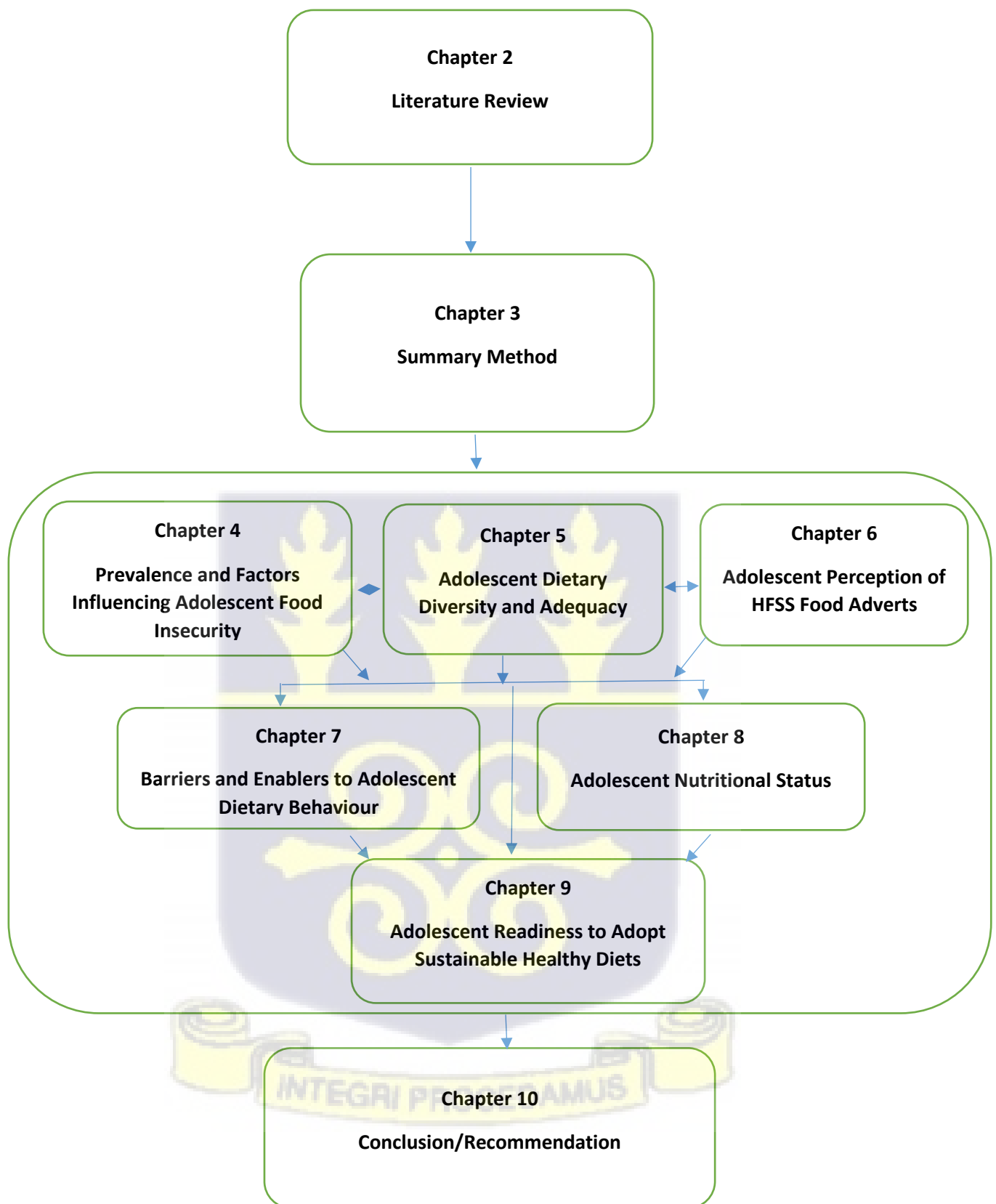


Figure 1.2: An outline of the thesis

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Background

The global nutritional landscape is characterized by a rapid transition in dietary habits, particularly in Low- and Middle-Income Countries (LMICs) such as Ghana. This shift has resulted in a complex challenge known as the nutritional double burden, where persistent issues of undernutrition coexist with a rapidly escalating epidemic of overweight, obesity, and Non-Communicable Disease (NCD) risks. Understanding the drivers and manifestations of Unhealthy Dietary Behaviours (UDBs) among Ghanaian adolescents, who represent a crucial demographic for future national health, requires an analysis that extends beyond individual choice to encompass the entire food system. Overweight and obesity have undergone a dramatic epidemiological transition. Once considered exclusive to high-income countries (HICs), these conditions now increasingly burden low- and middle-income countries (LMICs), challenging historical assumptions about the geography of malnutrition (Daran et al., 2023; González-Álvarez et al., 2020). This shift represents more than a simple relocation of health problems, it signals a fundamental transformation in how malnutrition manifests globally, with many LMICs now experiencing a double burden of malnutrition (DBM): the coexistence of undernutrition (micronutrient deficiencies, underweight, childhood stunting and wasting) alongside overweight, obesity, and diet-related non-communicable diseases (Ofori-Asenso et al., 2016; Popkin et al., 2020). This chapter critically examines the literature on overweight and obesity, with particular emphasis on LMICs and the role of dietary patterns. The review identifies and contrasts dominant paradigms in obesity research, synthesizes critical gaps in current knowledge, and builds a rationale for understanding dietary diversity as a key determinant of nutritional outcomes in resource-constrained settings.

2.1.1 Overweight and Obesity: Conceptual Foundations and Measurement

Obesity is defined as excessive body fat accumulation that poses significant health risks (WHO, 2025). While influenced by genetic, environmental, and lifestyle factors, obesity results from complex interactions between biological mechanisms and behavioural patterns (Masood & Moorthy, 2023; Proietto, 2023; Thibodeau & Flusberg, 2017). Body mass index (BMI) remains the most widely used anthropometric measure, serving as a practical indicator of nutritional status across the spectrum from underweight to obesity (Kushitor, 2023; WHO, 2021b).

2.1.2 Global Obesity Prevalence and Projections

The scale of the obesity epidemic is staggering. Notably, the highest absolute numbers of overweight and obese individuals now reside in LMICs (Manasa & Mahadevaswamy, 2023), with women in these contexts facing disproportionately higher risks, particularly in sub-Saharan Africa (Rocha et al., 2022). Worldwide, there are 1.2 billion adolescents, representing 16 per cent of the world's population. Adolescents constitute a significant portion of the population in sub-Saharan Africa, making up 23% of the region's demographic. This translates to over 249 million young people aged 10-19, reflecting the largest adolescent population globally (Partap et al., 2023). Despite their potential, this age group faces numerous public health challenges, including high levels of food insecurity, inadequate dietary diversity, and the dual burden of malnutrition characterized by both obesity and stunting. The influence of marketing, particularly related to high-fat, sugar, and salt foods, further complicates their dietary choices.

Globally, the prevalence of overweight among children and adolescents is increasing, with a substantial proportion of overweight adolescents going on to develop obesity in adulthood (WHO, 2024). The WHO defines overweight and obesity among adolescents as, “having a body mass index (BMI) one or two standard deviations above the median BMI-for-age and sex”, respectively (de Onis, 2007). Over the past three decades, there has been a significant rise in

the prevalence of adolescent obesity on a global scale. This increase has been more pronounced in most LMICs where there is also an additional challenge related to undernutrition (Mathew et al., 2023), resulting in the concurrent double burden of both undernutrition and overnutrition in these nations (Getacher et al., 2023; Ofori-Asenso et al., 2016). According to the WHO, the prevalence of obesity in children and adolescents aged 5-19 years has risen tenfold in the past four decades. In 2016, over 340 million children and adolescents worldwide were overweight or obese (WHO, 2021a). Currently, the global prevalence of obesity stands at approximately 18%, compared to just 4% in the 1970. The pooled prevalence of overweight and obesity among adolescents in various countries ranges from 10.12% to 34.66% for overweight and 4.96% to 34.66% for obesity (Mahumud et al., 2021). Furthermore, there is a significant upward trend in the prevalence of overweight and obesity among adolescents in many countries (Manoli et al., 2022). This trend is observed not only in HICs but also in LMICs. The rise in overweight and obesity has also been observed across all levels of socio-economic groups (Jaacks et al., 2017; Malik & Hu, 2017). (Jaacks et al., 2017; Malik & Hu, 2017).

2.1.3 Adolescent Nutritional Status in Ghana: Overweight and Obesity

The adolescent nutritional situation in Ghana presents a double burden of malnutrition, where the prevalence of overweight and obesity coexists with undernutrition (e.g., underweight and micronutrient deficiencies). However, studies consistently show a concerning rising trend in overweight and obesity among school-going adolescents, especially in urban areas, reflecting Ghana's progression through the nutrition transition. The prevalence of combined overweight and obesity among adolescents in Ghana has been reported to range widely, from 0.5% to 47.06% across different studies and regions, highlighting the non-uniform nature of the issue (Amoadu et al., 2024).

2.2 Contrasting Paradigms: Individual Behaviour versus Systemic Drivers of Obesity

2.2.1 Paradigm 1: The Individual Responsibility Model

Traditional obesity research has predominantly focused on individual-level factors, such as personal dietary choices, physical activity patterns, and lifestyle behaviours. This paradigm emphasises personal agency in terms of the conscious decisions people make about food consumption and exercise. Obesity results from consuming more calories than expended. Based on the individual responsibility model, behavioural interventions focus on education, motivation, and individual behaviour change. This perspective has generated valuable insights into proximate causes of obesity, including increased caloric intake, consumption of energy-dense foods, and sedentary lifestyles (Masood & Moorthy, 2023; Proietto, 2023). Individual level factors can affect the ability and willingness to make informed choices about health and food (Isobel R. Contento & Pamela A Koch, 2020; Stadlmayr et al., 2023a). Insights into such individual motivational determinants have informed health education interventions designed to encourage or promote healthier eating habits, including nutrition advice and counselling (Murimi et al., 2018). Such nutrition education approaches typically focus on informing individuals about the risks associated with unhealthy eating and providing healthful alternatives. However, critics argue this model inadequately accounts for structural constraints that shape individual choices.

2.2.2 Paradigm 2: The Systemic and Environmental Model

An alternative paradigm positions obesity as fundamentally shaped by systemic forces beyond individual control. This model focuses on the food environments (the physical, economic, and sociocultural contexts that influence food access and choices) (Hawkes et al., 2015; Turner et al., 2018), economic structures (market forces, trade policies, and food system industrialization that determine food availability and affordability) (Baker et al., 2020), and marketing and media (corporate strategies that shape dietary preferences and normalize unhealthy consumption patterns (Taillie et al., 2019; Zimmerman, 2011). This systemic view highlights how

globalization, urbanization, and nutrition transitions create “obesogenic environments” that make unhealthy choices the default option, particularly in LMICs undergoing rapid economic change (Hawkes et al., 2015; Popkin et al., 2012). However, while individual factors influence adolescents’ diets, they are not sufficient to explain the complex and dynamic nature of food choices and practices (Kelly et al., 2021; Sawyer et al., 2021). Nutrition education interventions that focused on changing individual behaviour have often yielded limited and short-lived outcomes at best because they do not address the broader environmental factors that shape dietary behaviour, such as availability, accessibility, affordability, acceptability, and desirability of food (Sawyer et al., 2021). Obesogenic environments significantly contribute to overnutrition and obesity (Góra, 2022; Purnakarya et al., 2020).

2.2.3 Synthesis: Toward an Integrated Framework

While these paradigms are often presented as oppositional, the evidence suggests they are complementary. Individual behaviors occur within systemic contexts that either constrain or enable healthy choices (Dover & Lambert, 2016; Short & Mollborn, 2015). The most productive research recognizes this multi-level causality, examining how macro-level forces (food systems, policies, economic development) interact with meso-level environments (communities, schools, workplaces) and micro-level factors (individual knowledge, preferences, household resources) to produce nutritional outcomes (Dover & Lambert, 2016; Short & Mollborn, 2015). Few studies adequately operationalise this integrated framework in LMIC contexts, where resource constraints, informal food systems, and rapid transitions create unique dynamics not captured by models developed in high-income settings.

2.2.4 The Socioeconomic Gradient: A Reversed Paradigm in LMICs

One of the most striking paradigmatic contrasts in obesity research concerns the relationship between socioeconomic status (SES) and body weight. In high-income countries, the poorest individuals exhibit the highest obesity rates, while overweight is widespread across all income

levels (Templin et al., 2019). Higher SES is generally protective against obesity. In contrast, in low- and middle-income countries, overweight and obesity are more prevalent among wealthier individuals (Doku & Neupane, 2015; Templin et al., 2019). In low-income countries with low Human Development Index (HDI), there is a positive association between SES and obesity for both men and women—higher affluence or education corresponds to higher obesity likelihood (Dinsa et al., 2012). In middle-income countries, the association becomes mixed for men and predominantly negative for women as countries develop (Dinsa et al., 2012).

As economies develop, the SES-obesity relationship undergoes a critical transition. Obesity prevalence increases among the poorest populations while stabilizing among the wealthiest (Templin et al., 2019). This shift reflects changing food environments, where ultra-processed foods become increasingly accessible and affordable to lower-income groups, while higher-income groups gain access to health-promoting resources and information. Gender significantly modifies the SES-obesity relationship. In most LMICs, women face higher obesity risks than men, with the greatest disparities in sub-Saharan Africa (Rocha et al., 2022). These gender differences reflect complex interactions between biological, cultural, and structural factors, including differential access to education, employment, and healthcare, as well as gender-specific cultural norms around body image and food allocation within households. While the SES-obesity gradient reversal is well-documented, the mechanisms driving this transition remain inadequately theorized, particularly regarding the role of dietary diversity and food system changes at different stages of economic development.

2.3 Determinants of Adolescent Overweight and Obesity

The increasing rates of overweight and obesity are multifactorial, stemming from a complex interplay of individual, household, and environmental factors.

2.3.1 Individual Dietary Practices and Habits

Adolescents in Ghana often exhibit dietary patterns characterized by low dietary diversity, meal skipping, frequent snacking on processed foods, and high intake of sugary drinks, which contribute to inadequate nutrient intake and increased obesity risk. Low physical activity levels combined with increased sedentary behaviors like watching television and playing video games further exacerbate the risk. Traditional diets (high in cereals, tubers, and fresh produce) are being replaced by Westernized diets that are high in calories, sugar, saturated/trans-fats, and processed foods (e.g., pastries, fast foods, and sugar-sweetened beverages). Key unhealthy dietary behaviors include, the consumption of unhealthy snacks like carbonated soft drinks, cookies, and toffees, high frequency of out-of-home eating (purchased meals), skipping meals, especially breakfast, often due to lack of time, lack of appetite, or saving money, and low consumption of fruits and vegetables (Akoto et al., 2022a; Wiafe, Apprey, et al., 2023). Unhealthy dietary patterns among Ghanaian adolescents are characterised by specific detrimental habits, coupled with an increasing reliance on modern processed foods, which are being normalised by economic and commercial shifts. A key feature of unhealthy dietary behaviours is the prevalence of disordered eating routines, particularly meal skipping. In studied adolescent populations, breakfast was identified as the most frequently skipped meal, affecting 47.9% of adolescents (Jonathan K. et al., 2024). Meal skipping, along with frequent snacking, is positively related to inadequate dietary diversity. This inconsistency in meal consumption contributes directly to poor overall dietary habits and insufficient nutrient intake. Compounding the problem of poor diet is an alarming rate of sedentary behaviour. The vast majority of adolescents (97.6%) reported spending between half an hour and five hours per day watching television when at home. This sedentary lifestyle, combined with inadequate dietary choices, significantly increases the risk profile for obesity and subsequent NCDs.

The globalisation of food systems and urbanisation have driven a marked change in Ghanaian dietary intake, moving away from traditional wholegrain and non-refined carbohydrate consumption toward significant amounts of highly processed foods, including pastries, pizza, and Sugar-Sweetened Beverages (SSBs). Fast food consumption is prevalent and frequent. Almost three out of five adolescents (59.6%) consume fast foods such as pizza, burgers, and ice cream one to three times per week (Akoto et al., 2022b). Furthermore, 38.5% of adolescents consume fast foods one to three times a week, and those who consume fast foods daily have the highest proportions of overweight or obesity (Akoto et al., 2022b). The concern is amplified by the fact that these detrimental patterns are established early in life. Studies in northern Ghana focusing on children aged 2 to 5 years found severe inadequacy in fruit and vegetable consumption, with only approximately 11% meeting WHO recommendations. Simultaneously, almost half of these young children reported consuming SSBs (46%) and the majority (87%) consumed sweet or salty snacks, though the frequency was generally low (less than three servings per week) (Becher et al., 2026). This trend indicates that unhealthy dietary behaviours are not simply temporary adolescent choices but are the normalised consequences of systemic economic development and the resulting changes in the food supply. Unhealthy options, such as candies, fast foods, and soft drinks, have become more accessible and financially feasible than healthier alternatives in both schools and communities, accelerating the emergence of obesity and type 2 diabetes risks in adolescence (Hormenu, 2022). This widespread normalisation of high-risk consumption underscores the need for structural interventions rather than solely relying on individual behaviour change. The prevalence and consequences of these behaviours are summarized in Table 2.1.

Table 2.1: Prevalence of Key Unhealthy Dietary Behaviours and Nutritional Outcomes in Ghanaian Adolescents

Indicator	Prevalence/Magnitude	Key Implication	Source
Inadequate dietary diversity	84.7%	Micronutrient deficiency	(Wiafe et al., 2023)
Meal skipping	77.1%	Major factor in inadequate dietary diversity and micronutrient gap.	(Jonathan K. et al., 2024)
Weekly Fast-Food Consumption	Up to 59.6%	High exposure to energy-dense, nutrient-poor UPFs.	(Akoto et al., 2022b)
Sedentary Time (0.5–5h TV/day)	97.6%	Risk factor for obesity and NCDs across the cohort.	(Akoto et al., 2022b)
Overweight/Obesity among adolescents in Ho, Ghana	15.8 and 8.5%	Emergence of the “excess” burden of malnutrition	(Akoto et al., 2022b)
Overweight/Obesity among adolescents in urban Ghana	46.9% were overweight of which, 21.2% were obese	Emergence of the “excess” burden of malnutrition	(Ganle et al., 2019)
Anaemia in rural Ghana	29.9%	Persistent “deficiency” burden, particularly critical for adolescent girls.	(Wiafe, Apprey, et al., 2023)

2.3.2 Dietary Diversification and its Impact on Health

Ensuring healthy dietary habits during adolescence is crucial as a poor diet can lead to suboptimal physical and cognitive development. A well balanced, diverse and nutrient-rich diet is essential for supporting optimal growth, enhancing immune function, promoting cognitive development and maintenance across all life stages (Gonete et al., 2020). Both the quantity and quality of food consumption play a significant role in determining overall health. Both the quantity and quality of food consumption play a significant role in determining overall health. Dietary diversification is a key strategy to promote healthy eating behaviours and ensure nutrient adequacy (Gonete et al., 2020). Unfortunately, many adolescents, particularly in low- and middle-income countries, face undernutrition and a lack of diversified diets, often relying on monotonous cereal-based meals (Goomany & Dickinson, 2015). This is particularly

concerning, as 90% of the world's adolescents live in these countries, and in some cases, nearly half of them experience stunted growth due to inadequate nutrition (Yoon et al., 2017). Dietary diversity refers to the number of food groups or items consumed over a reference period (Gonete et al., 2020). It is a key indicator of a nutritionally adequate diet. Dietary diversity refers to the variety and balance of different food groups consumed within an individual's diet (Chakravarti & Dutta, 2022; Wulan et al., 2023). It is typically calculated using a recall method and enumerating the number of unique food groups consumed. Dietary diversity is an indicator of nutritional adequacy, which plays a significant role in child growth and development (Ba et al., 2022).

Dietary diversity is categorised into low, medium, and high diversity, with adequate diversity defined as consuming five or more food groups, while inadequate diversity involves fewer than five (Sagbo & Kpodji, 2023). A higher score indicates greater diversity. A medium or high level of dietary diversity, with the inclusion of a wider variety of nutrient-dense foods, is generally associated with better nutritional status and a lower likelihood of undernutrition and, better health status (Zhu et al., 2024). A diverse diet is essential for adolescents to meet their nutritional requirements, supporting growth and development. It is an indicator of adequate consumption of essential nutrients. It is considered as an important indicator of dietary quality and access to a variety of food and a crucial indicator of overall dietary quality and nutrient adequacy (Ba et al., 2022; Bandyopadhyay et al., 2021; Wulan et al., 2023). An adequate level of dietary diversity, which typically includes a balanced intake of fruits, vegetables, whole grains, legumes, nuts, and animal-source foods, is considered the ideal for maintaining optimal health, better nutritional status and health outcomes (Bandyopadhyay et al., 2021). A more diverse diet is typically correlated with higher intakes of essential macro- and micronutrients, which are necessary for proper growth, development, and the maintenance of bodily functions (Bandyopadhyay et al., 2021). This is because different food groups provide unique

combinations of vitamins, minerals, and other beneficial compounds that work synergistically to promote overall wellbeing. Increased dietary diversity among adolescents is linked to improved nutrient adequacy, which is vital for physical and cognitive development. Several studies show that a higher dietary diversity is associated with better health and reduced risk of various chronic diseases (Chakravarti & Dutta, 2022). On the other hand, inadequate dietary diversity, marked by the overconsumption of a few food groups and the exclusion of others, can lead to micronutrient deficiencies and other adverse health outcomes. A diverse diet can help prevent deficiencies in essential micronutrients, such as iron and vitamin A, which are crucial during this growth phase.

Low dietary diversity, characterized by the consumption of a limited number of food groups, is often linked to nutrient deficiencies and an increased risk of various health problems, including stunting, anaemia, and infectious diseases (Bandyopadhyay et al., 2021). Low dietary diversity is directly linked to malnutrition, impairs physical capacities, cognitive performance, and can lead to stunting in adolescents, obesity and other health issues, particularly in low-income settings where nearly half of adolescents are affected (Bandyopadhyay et al., 2021; Joshi et al., 2023; Lathifah et al., 2024). Lack of adequate nutrition is associated with suboptimal brain development, lower school performance, and increased risk of mortality and chronic diseases (Ba et al., 2022). (Ba et al., 2022). Furthermore, poor dietary choices can lead to chronic diseases later in life (Joshi et al., 2023). This highlights the need for interventions that promote varied diets to enhance their overall health and well-being. It is thus essential to study the dietary diversity of individuals and households regularly so that necessary actions can be taken.

2.3.3 Lifestyle and Sedentary Behaviour

There is a notable rise in sedentary behaviors and a decrease in traditional physical activity. These include watching television, playing computer games, and long hours spent on screens

and the internet/social media (Amoadu et al., 2024). A large proportion of adolescents do not meet the WHO-recommended 150 minutes per week of physical exercise. Smoking cigarettes and late bedtimes have also been associated with higher odds of overweight or obesity.

2.4 Structural and Commercial Drivers of Unhealthy Dietary Behaviourss: The Food Environment

Beyond the individual level factors, adolescent dietary behaviours are highly influenced by the external environment, often overriding individual knowledge or intent (Story et al., 2002). In Ghana, powerful economic and commercial forces shape food choices, making SHDs difficult, and often impossible, to access for the majority of the population. The primary structural impediment to adopting healthy diets is economic constraint. The ability of individuals to access nutritious and safe food is overwhelmingly mediated by household income and wealth (Annan et al., 2022). Data confirming this constraint at the national level are compelling: 63% of the Ghanaian population currently cannot afford a healthy diet, meaning 21.1 million people face substantial affordability constraints (Darko & Martey, 2025). This profound economic barrier establishes affordability, rather than mere preference or ignorance, as the single most significant factor preventing the adoption of SHDs. Individual accounts from urban Ghana highlight that income, affordability, time constraints, convenience, and seasonality act as explicit barriers to eating healthily (Annan et al., 2022; Ofori et al., 2025). For instance, discussions with mothers revealed that while fruits are recognized as beneficial, the fluctuating prices depending on seasonality often make them prohibitively expensive, preventing consistent purchase (Stadlmayr et al., 2023b). Furthermore, economic development exhibits a correlation with increased meat consumption, which can exacerbate environmental impacts and further strain affordability for low-income households attempting to diversify their protein sources sustainably.

2.4.1 Household level Factors Influencing Dietary Behaviour

2.4.1.1 The Influence of Parenting Styles on Adolescent Dietary Behaviour and Obesity

Research highlights several key household factors, including consumption expenditure, food prices, educational attainment, and information dissemination, which affect dietary diversity in LMICs (Agrawal et al., 2019; Dzudzor et al., 2024). Parenting styles and parental role-modelling of healthy eating behaviours can also shape the dietary diversity of children. Parenting style refers to the approach that parents take to raising their children, including their attitudes, beliefs, and behaviours. Parenting style is a dynamic process, which is influenced by socio-cultural factors (Sahithya et al., 2019). Parenting styles are characterised based on the levels of 'responsiveness' and 'demandingness.' Parenting styles and practices within the domains of structure, coercive control, and autonomy support significantly influence the development of children's eating patterns, highlighting this as a key area for intervention structure (Chen et al., 2021; Pearson et al., 2010; Vaughn et al., 2016). According to Baumrind's taxonomy of parenting styles, there are three main types of parenting: authoritative, permissive, and authoritarian (Baumrind, 1971). While Baumrind's original framework identified three primary parenting styles, subsequent research has expanded on this to include a fourth category, which distinguishes between two different types of permissive parenting: Indulgent parenting, which is similar to Baumrind's permissive parenting style and neglectful parenting (Maccoby & Martin, 1983).

Parenting styles play a crucial role in shaping a child's development and well-being (Kattelman & Doddivenaka, 2011; Rhee et al., 2006; Sokol et al., 2017). The influence of parenting styles on adolescent eating habits is significant, with various styles leading to different dietary outcomes (Reicks et al., 2023). Authoritative parenting styles, characterised by high levels of support, warmth, responsiveness, along with consistent rules, expectations, demands and positive communication, are associated with healthier eating and better health outcomes for

children structure (Chen et al., 2021; Pearson et al., 2010; Savage et al., 2007; Thomson & Jaque, 2017; Vaughn et al., 2016). Conversely, parenting styles that are permissive/indulgent, authoritarian, or neglectful may lead to poorer eating habits and poorer health outcomes (Philips et al., 2014; Sanvictores & Mendez, 2024). Authoritative parents often model healthy eating and provide structure, which positively impacts adolescents' food choices (Ardakani et al., 2024). Studies show that adolescents with authoritative parents are more likely to adhere to dietary guidelines, particularly in fruit and vegetable consumption (Ardakani et al., 2024). In contrast, authoritative parenting has been shown to reduce fruit intake adherence, while authoritarian and monitoring practices increased it (Ardakani et al., 2024).

Authoritarian parenting, which emphasises strict rules and control, can lead to increased vegetable intake but may negatively affect overall dietary adherence due to a lack of autonomy (Ardakani et al., 2024). This style can also correlate with higher emotional eating in adolescents, leading to unhealthful food choices (Mason, 2024). Indulgent parenting, characterized by high responsiveness but low demands, can result in increased consumption of junk foods and sugary beverages (Reicks et al., 2023). Neglectful parenting often leads to a lack of guidance in food choices, contributing to unhealthy eating patterns among adolescents (Ardakani et al., 2024). Conversely, while authoritative parenting is associated with positive outcomes, the complexities of adolescent emotional eating and external influences can still lead to unhealthy eating behaviors, regardless of parenting style (Mason, 2024).

2.4.1.2 Home Food Environment and Parental role-modelling of healthy eating

Parental healthy diet role modelling is a specific aspect of parenting style that can significantly shape children's and adolescents' dietary intake, preferences and the level of physical activity (A Loth et al., 2014; Draxten et al., 2014; Webber & Loescher, 2013). Role modelling refers to the behaviour of parents and caregivers that children observe and imitate, and it can have a

significant impact on children's attitudes and behaviours towards food and physical activity.

Food parenting techniques are specific actions or guidelines parents use to regulate what, how much, or when their child eats (Horst & Sleddens, 2017). Role modelling occurs through direct consumption in shared settings, which reinforces healthy eating behaviours (Kiggwe et al., 2023).

The availability of fruits and vegetables at home is crucial; however, studies suggest that mere availability does not guarantee increased consumption without active parental modelling (Irma Handayani et al., 2024; Serasinghe et al., 2023). Access to healthy food at home directly impacts adolescents' dietary choices, with limited access leading to more unhealthy food consumption (K. S. N. Liu et al., 2021; Verstraeten et al., 2016). Research indicates that adolescents are likely to mirror their parents' dietary choices, with the association between parental and adolescent fruit and vegetable intake being particularly strong during late adolescence. This modelling effect persists even after adolescents leave the parental home, highlighting the long-term impact of parental dietary habits (Braune et al., 2024). Parents who regularly consume fruits and vegetables positively influence their children's intake, with studies showing a positive correlation of portions/day during different adolescent stages (Braune et al., 2024). Research suggests that parents who consistently model healthy eating behaviours, such as eating a variety of fruits and vegetables, choosing healthy snacks, and limiting sugary and high-fat foods, set a positive example for their children to have healthier diets (Bere & Klepp, 2004; Draxten et al., 2014). Family mealtime provides an opportunity for parents to model and reinforce healthy eating habits, shaping children's dietary preferences (Linde et al., 2022). Parental role modelling for healthy diet encompasses consuming healthy foods and regularly incorporating a variety of nutritious foods into their own diets (such as fruits, vegetables, whole grains, lean proteins, and low-fat dairy products) (Draxten et al., 2014; Noort et al., 2022), selecting healthy food choices

and guiding their children in making healthful food choices by involving them in grocery shopping and meal planning.

Parental role modelling also involves adopting healthy food preparation methods and demonstrating healthful cooking methods by using techniques such as boiling, baking, broiling, steaming, or grilling instead of frying (Draxten et al., 2014; Webber & Loescher, 2013). Parents who involve their children and adolescents in meal planning, preparation and cooking, and who provide positive feedback and reinforcement for healthy eating, may further encourage healthy eating habits in their children (Kiggwe et al., 2023). Food parenting techniques can be categorised into three main types: Coercive Control: This involves using force or pressure to dictate a child's eating habits, such as making them finish everything on their plate or using punishment/reward to influence their food choices (Di Pasquale & Rivolta, 2018; Vaughn et al., 2016). Structure: Parents establish routines around meals and snacks, including set mealtimes, offering healthy food options, and avoiding sugary and fatty foods (Vaughn et al., 2016). Autonomous Support: Encouraging a supportive environment where children can make their own healthy food choices by offering a variety of options and involving them in meal planning (Vaughn et al., 2016). Research indicates that a combination of structure and autonomous support is most effective in promoting healthy eating habits among adolescents, while coercive control should be avoided. Studies have shown that creating a supportive and structured environment with varied healthy options leads to better long-term outcomes in terms of eating habits (A Loth et al., 2014; Philips et al., 2014; Reicks et al., 2015). This underscores the importance of interventions targeting the home food environment to promote healthier food choices among early adolescents (Reicks et al., 2015). While parental role-modelling is vital, it is essential to consider that adolescents may also be influenced by peers and external factors, which can sometimes counteract parental guidance.

2.4.1.3 Influence of Household Food Security on Adolescent Eating Habits

Household food security plays a crucial role in shaping the dietary behaviours of adolescents. Food security refers to the state in which all people at all times have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and preferences for an active and healthy life. In contrast, food insecurity, defined as limited or uncertain access to adequate food, can significantly impact adolescents' consumption patterns, particularly regarding fruits and vegetables (Kohanmoo et al., 2024). Indicators of food security include food availability, access, utilization, and stability of supply, and these are linked to livelihood security (de Pee & Pérez-Escamilla, 2023). Food security is influenced by political, social, economic, and natural factors (Brimbetova et al., 2023; Vassilopoulou, 2023). The achievement of food security requires the availability of food, adequate incomes, and increasing agricultural productivity (Kerr, 2023), especially as the world population is projected to increase significantly in the coming decades (de Pee & Pérez-Escamilla, 2023). Availability refers to the presence of sufficient food to meet the needs of the population. Adequate income is required to ensure access nutritious food (Shebanina, 2023). Availability, access and utility work together to ensure that all people have physical and economic access to sufficient, safe, and nutritious food for a healthy and active life (FAO et al., 2021). The COVID-19 pandemic and other emergencies have exacerbated food insecurity, leading to increased malnutrition and multiple forms of food insecurity worldwide (Bubis et al., 2023; Nkwonta et al., 2023a).

Household food security considerably affects adolescent eating habits, particularly fruit and vegetable intake, leading to poorer dietary choices and more processed food consumption (Dubois et al., 2023; Shanafelt et al., 2016). Evidence shows that adolescents living in food-insecure households tend to consume fewer fruits and vegetables than their food-secure counterparts. Research further shows food insecurity correlates with lower dietary diversity, leading to insufficient essential nutrient intake (Dubois et al., 2023; Shanafelt et al., 2016). Food

insecure adolescents may choose calorie-dense, low-nutrient foods due to cost and availability, resulting in diets lacking necessary vitamins and minerals (Dubois et al., 2023; Kohanmoo et al., 2024). Adolescents in food-insecure households show reduced intake of fruits and vegetables, opting instead for cheaper, less nutritious foods (Kohanmoo et al., 2024). Food insecurity is associated with unhealthy eating habits, including meal skipping and increased intake of nutrient-poor fast foods (Kohanmoo et al., 2024).

Adolescents facing food insecurity are at a heightened risk of obesity and related non-communicable diseases later in life (Dubois et al., 2023; R. Islam et al., 2024). A lack of access to essential nutrients, particularly fruits and vegetables not only affects immediate health but also sets the stage for chronic health issues as they transition into adulthood (Dubois et al., 2023; R. Islam et al., 2024). Food insecurity often leads adolescents to choose inexpensive, ultra-processed foods high in sugar, fat, and salt but low in nutrients (Dubois et al., 2023; Trübswasser et al., 2021). These foods are more accessible where fresh produce is limited or costly, resulting in a preference for unhealthy options and reduced consumption of fruits and vegetables (Dubois et al., 2023; Trübswasser et al., 2021). Food insecurity is associated with lower nutritional status, which encompasses insufficient fruit and vegetable intake (Akter & Mohammad Kurshed, 2024). This trend is evident across various studies, highlighting the detrimental effects of food insecurity on nutrition. Food insecurity is associated with higher stress levels, lower resilience, and decreased academic motivation among college students (Bubis et al., 2023; Yılmaz & Günal, 2023). Food insecurity not only affects access to nutritious food but also perpetuates a cycle of stress, anxiety, and emotional distress. This psychological burden can further exacerbate poor dietary choices, lead to emotional eating or reliance on comfort foods that are often unhealthy and contribute to weight gain and obesity (Dush, 2020; Shanafelt et al., 2016). Food insecurity has wide-reaching effects on health, education, and overall well-being. It can lead to malnutrition, causing stunted growth, weakened immune

systems, and increased susceptibility to illness (Osei Bonsu et al., 2023). Additionally, food insecurity can lead to malnutrition, which impairs physical and cognitive development, reduces economic productivity, and undermines social stability (Yılmaz & Günal, 2023). Children who face food insecurity often find it difficult to concentrate and perform well in school, which can result in decreased attendance and poorer educational outcomes (Upasana, 2023). Food insecurity also contributes to increased stress and anxiety levels, negatively impacting mental health (Bubis et al., 2023).

Research shows that adolescents facing food insecurity often develop resilience by learning to make the most of available ingredients, leading to resourcefulness and creativity in meal preparation, leveraging available ingredients to create nutritious solutions (Bubis et al., 2023). Moreover, the necessity to stretch limited food supplies encourages experimentation with diverse cooking techniques and recipes, thereby enhancing their culinary expertise (Barreiro-Álvarez et al., 2024). Coping strategies such as food seeking strategies, substance use, and stopping school have also been associated with food insecurity among adolescents (Young et al., 2023).

2.4.1.4 Measurement of Food Insecurity

Measurement of food insecurity involves assessing indicators of e household-level calorie adequacy, dietary diversity, and experience; food utilisation and stability dimensions are often overlooked in food security measurement. The majority of studies rely on secondary data for calorie adequacy and dietary diversity indicators, while eating experience indicators are more commonly measured using primary data. Integrating food consumption and anthropometry data in regular household surveys is recommended for comprehensive food security analysis. There is a need for better data collection methods and the development of culturally specific food security measures, especially in countries like India and Malaysia where food insecurity is

prevalent (Manikas et al., 2023; McKay et al., 2023; Piperata et al., 2023; Sumsion et al., 2023).

The Household Food Insecurity Access Scale (HFIAS) is a tool developed by USAID to measure the prevalence of food insecurity (D. Maxwell et al., 2023). It assesses food accessibility based on experiences and behavioural responses common among low-income households (Pervaiz et al., 2022). The HFIAS has been validated and found to have good internal consistency (Calloway et al., 2022). It has been used in various contexts, including Pakistan, where it was found to be a valid and reliable tool for measuring food accessibility (Marques et al., 2021). Another study in the United States developed and tested novel self-administered measures of household resilience to financial shocks, which can increase food insecurity risk (Edwards et al., 2021). These measures, including Absorptive capacity, Adaptive capacity, and Transformative capacity, were found to be reliable and valid within the sample (Calloway et al., 2022). Additionally, a modified version of the Brazilian Household Food Insecurity Measurement Scale has been proposed to assess adults' recall of food insecurity at age 12, showing good performance in initial psychometric evaluation (Montalbano & Romano, 2023). These scales and measures contribute to a better understanding of household food insecurity in different contexts and can aid in the development of targeted interventions to improve household resiliency to food system shocks.

The food insecurity experience scale (FIES) is a measurement tool used to assess food insecurity at the individual level. It has been adopted by the United Nations in the context of the Sustainable Development Goals (SDGs) and is designed to ensure comparability across countries (Onori et al., 2023). The FIES has been validated and found to be globally applicable for assessing the food insecurity of children and adolescents, as reported by them (Frongillo et al., 2022). It has also been used to measure food security status among Venezuelan migrants and asylum seekers in Trinidad and Tobago, demonstrating its consistency in assessing food security status (Saint Ville et al., 2022). Additionally, the FIES has been used to analyse the

effect of formal education level on food security status in Togo, showing a significant difference between education level and food security status (Gnedeka & Wonyra, 2023). In the Bahamas, the FIES has been validated and used to determine the prevalence of moderate and severe food insecurity, as well as the sociodemographic factors contributing to increased food insecurity (Karpyn et al., 2021).

2.5 Commercial Determinants of Health (CDoH): Unregulated Marketing and Persuasion

The rapid proliferation of unhealthy dietary behaviours is intrinsically linked to the Commercial Determinants of Health (CDoH), facilitated by Ghana's permissive regulatory environment. The Ghana Food and Drugs Authority (FDA) of the Ministry of Health is mandated by law to regulate food advertising activities through the Public Health Act 2012 (Act 851) and its accompanying guidelines. However, while many countries regulate food advertising to protect consumers and encourage healthy eating, Ghana has none (Boncyk et al., 2025). The FDA regulates mainly food safety issues. The consequence is a highly saturated media environment designed to influence food attitudes, beliefs, and eating behaviors. An analysis of Ghanaian television advertisements revealed that nearly two-thirds (66.8%) promoted foods categorized as unhealthy. Sugar-sweetened beverages (SSBs) were the most frequently advertised category (22.6%), followed by grains high in sugar and low in fiber (13.2%) (Boncyk et al., 2025). These advertisements extensively utilize persuasive marketing techniques, employing hedonic goal frames (appealing to pleasure) for unhealthy foods. A particularly concerning observation involves the strategic use of actors in these advertisements. The analysis found that most actors featured were classified as underweight (72.1%). Underweight actors frequently appeared in advertisements for unhealthy foods (68.3% of unhealthy advertisements) (Galbraith-Emami & Lobstein, 2013). This strategic casting serves a dual purpose: it capitalizes on cultural preferences for thinness and may subconsciously neutralize the perceived health risk associated with products known to cause overweight and obesity. By decoupling the consumption of

energy-dense, processed foods from the eventual consequences of weight gain and NCDs, the persuasive power of the advertising is amplified, directly undermining public health efforts and making it exceptionally difficult for adolescents to perceive the long-term dangers of these products.

2.5.1 Influence of Food Marketing and Advertising on Adolescent Dietary Behaviour

Food marketing refers to “any communication or strategies designed to increase recognition, appeal and/or consumption of specific food products, brands and services” (Cairns et al., 2013). Children and adolescents are an important part of the market, as effective marketing to them can create early positive relationships and long-term consumer and brand relationships that extend into adulthood (Haryanto et al., 2016). Aggressive marketing of unhealthy foods, particularly to young people, exacerbates the obesity crisis (Sambu et al., 2024; The Lancet Diabetes & Endocrinology, 2022). Products high in fat, sugar, and salt (HFSS) and low in nutritional value (i.e., unhealthy foods) are a big part of children’s and adolescents’ food environment. Research shows that the marketing of foods high in energy but lacking in essential nutrients is a significant contributor to an environment that promotes childhood obesity (Zimmerman, 2011). Food marketing and advertising play an important role in shaping eating behaviour, especially in children and adolescents (Smith et al., 2019). Indeed, children and adolescents can buy food directly, which makes it a “primary market;” furthermore, they can determine family purchasing decisions, thus constituting an “influence market.” Finally, their loyalty to the brand at an early age promises continued sales into adulthood, i.e., as later consumers they represent a “future market” (Mello, 2010).

Children and adolescents are exposed to a variety of traditional media platforms, including television, billboards, radio, print media, charitable donations by food and beverage companies, which play a crucial role in identity development, peer relationships, and learning (Valentine & Holloway, 2002). Children and adolescents are also exposed to food marketing through new

online media platforms including the internet, movies, videos, videogames, advergames, mobile phones, and social media and social networks, messaging, interactive games, mobile phones, and virtual 3D environments can take many forms, including images, videos, and games that promote specific brands (Bragg et al., 2018; Tsochantaridou et al., 2023). The influence of social media on adolescents' reactions to HFSS food advertisements is undeniable, with these platforms used as powerful tools in promoting HFSS foods and creating an environment that encourages the frequent consumption of such products (Critchlow et al., 2020). These platforms not only provide a wide audience for HFSS food advertisements but also allow for personalization and targeting based on user preferences and behaviours. At the same time, the growth of peer-to-peer social networking platforms is creating what some scholars consider a powerful new form of “mass interpersonal persuasion.” By shaping and delivering a “convincing experience” at high speed to many users, behaviours and attitudes can be changed on a massive scale (Fogg, 2008). In this environment, digital food marketing brings novel opportunities and poses new challenges. It has been estimated that children and adolescents are exposed to food marketing on social media to an impressive extent, namely 30 and 189 times per week for children and adolescents, respectively (Potvin Kent et al., 2019). Televised food commercials strongly influence children's food choices, with evidence suggesting activations in the ventromedial prefrontal cortex correlating with their exposure to food advertising, contributing to a higher calorie intake and an increased risk of obesity (Bruce et al., 2016; Yeum et al., 2023). According to multiple studies, food commercials influence children's and adolescents' food choices, preference and requests for advertised foods (Bruce et al., 2016; Leonard Atawugeh Kubaloe, 2018; Yeum et al., 2023). For example, a study found that children were more likely to choose foods that were advertised on television commercials compared to non-advertised foods, regardless of their taste or nutritional value (Bruce et al., 2016).

Regarding the persuasive techniques used, those linked to food advertising focus on the taste, smell, texture, nutritional quality, competitiveness, uniqueness, and novelty of the product, while emotional appeals are also occasionally used, such as in the focus on family ties in some TV commercials (Busse, 2018). Heavy marketing of HFSS products often incorporate emotional appeals and are associated with more frequent consumption (Pretorius et al., 2021). Adjei et al. discuss the persuasive marketing techniques employed in these advertisements, such as visual appeal, catchy jingles, and celebrity endorsements. These techniques create positive associations between consuming HFSS foods and emotions such as happiness, excitement, social acceptance, and preference. One key mechanism is their ability to induce positive emotional responses, leading to a higher consumption rate due to the emotional benefits perceived from eating these foods. HFSS food advertisements often leverage appealing visuals, catchy music, and testimonials from celebrities to elicit positive emotional responses in adolescents, leading to increased consumption of these products due to the perceived emotional benefits associated with their consumption (Richonnet et al., 2021).

The three most common food-related categories advertised to children and adolescents, according to Busse et al., are sweets, sugary drinks, and fast-food restaurants (Busse, 2018). Similarly, Amson et al., examining digital food and beverage-related content, noted that the most frequently promoted food and beverage categories were fast food, energy drinks, and sweets (Amson et al., 2021). Nutritional value analysis of advertised foods on TV during scheduled children's television shows reveal that the majority fall into the unhealthy food category, being high in sugar and fat (e.g., confectionary snacks and chocolate products) (Busse, 2018; Montaña et al., 2019). Exposure to HFSS food marketing and advertising is linked to various negative outcomes for children and adolescents. Numerous studies discuss the potential impacts of HFSS food advertisements on adolescent dietary habits and obesity risk (Critchlow et al., 2020; Lauber et al., 2021). As children are highly susceptible to advertising, food

commercials can shape their perceptions of what is considered desirable and appealing (Critchlow et al., 2020; B. Kelly et al., 2019; Naderer, 2021).

Children may develop a preference for foods that are heavily advertised, regardless of their nutritional value (Bruce et al., 2016; Elliott, 2019). This can lead to a biased decision-making process, where taste and appeal become the primary factors influencing food choices, rather than considering nutrition and health (Ares et al., 2022; Coon K.A & Tucker K.L., 2002). This can lead to an increased consumption of unhealthy food options and contribute to the growing problem of childhood obesity. Exposure to unhealthy food advertising has been associated with an increase in immediate calorie consumption in children, potentially contributing to the pervasive issue of childhood obesity (Abolfathi et al., 2022). Another finding is that food marketing can influence the preferences of adolescents, leading them to develop a liking for unhealthy food products (Abolfathi et al., 2022). Also, the marketing strategies used and the social pressure to consume widely advertised HFSS foods lead to a higher risk of obesity and other health issues among low-income families (Burns et al., 2013). Food marketing not only influences individual eating choices, but also shapes societal norms and perceptions around food, which in turn impact the dietary behaviour particularly among children and adolescents (Bassi et al., 2021).

2.5.2. The Effects of Advertising, Marketing and Media on Dietary Behaviours in Ghana

In Ghana, studies show that unhealthy foods, including sugar-sweetened beverages, snacks, and processed foods, are frequently advertised through traditional and digital media (Amevinya et al., 2020, 2022). The use of promotional characters, animation, and billboards are common strategies for food marketing and advertisement in Ghana (Colecraft et al., 2022). Exposure to food and nutrition information through various communication channels influences dietary perception, behaviour, and nutritional status (Parbey & Aryeetey, 2022). Overall, research

suggests that the advertising and marketing of HFSS foods have significant effects on adolescent food choices, preferences, behaviours, dietary habits, and health outcomes, particularly in low- and middle-income countries like Ghana where socioeconomic challenges often limit access to healthier food choices (MoFA et al., 2020). These foods are aggressively marketed and offered at unusually low prices adolescents (Amevinya et al., 2020; Tandoh et al., 2023). Concurrently, there is a diminishing availability and reduced market share for healthy foods, which tend to be relatively expensive and less accessible. These shifts have altered the food environments across SSA, limiting access to affordable, healthy foods and, consequently, influencing dietary behaviours, including food acquisition and consumption patterns (Dake et al., 2016; Liguori et al., 2022; World Bank Group, 2017). However, there is also not much data on the role of marketing and advertising in shaping dietary choices of children and adolescents. Policies that regulate the marketing and availability of unhealthy food and beverage options, as well as those that promote access to healthy foods and physical activity, can play a crucial role in shaping adolescent health outcomes in Ghana.

2.6 Influence of Macro-Level Factors on Adolescent Dietary Behaviour

Macro-level influences, comprising broader societal forces, such as government policies, economic systems, cultural norms and traditions, and marketing and advertising practices, play a significant role in shaping adolescent food choices and eating behaviours. Effective policies can shape adolescent eating habits. For example, policies that mandate the inclusion of fruits and vegetables in school meals can encourage healthier eating habits among adolescents, the absence of regulations on unhealthy food marketing to children can contribute to unhealthy dietary patterns (Shaw, Barrett, et al., 2023). Additionally, economic conditions, such as household income and food prices, play a crucial role in shaping adolescents' food choices. Limited financial resources often lead families to prioritise inexpensive, calorie-dense foods over healthier options due to affordability concerns. When healthy foods are priced out of reach,

adolescents may resort to cheaper processed foods that are often high in sugar and fat (Hantira et al., 2023).

Macro-level factors, such as food and agricultural policies and regulations (food labelling, advertising restrictions), fiscal policies and taxation (sugar-sweetened beverage taxes), marketing, and advertising, food importation and international trade agreements, as well as national and local programmes and initiatives (such as school meal programmes, community-based interventions) can have a significant impact on adolescent dietary behaviours and obesity. Fiscal policies, such as taxes on sugary drinks or subsidies for healthy food options, can also influence adolescent dietary behaviours and obesity. By making healthier choices more affordable and accessible, these policies can encourage adolescents to adopt healthier eating habits (The Lancet Diabetes & Endocrinology, 2022). Policies that regulate the marketing and availability of unhealthy food and beverage options, as well as those that promote access to healthy foods and physical activity, can play a crucial role in shaping adolescent health outcomes. For instance, research has shown that the extensive marketing of unhealthy foods and beverages, often targeted at adolescents, can contribute to the normalization and overconsumption of these products, leading to increased obesity rates (Caruso et al., 2024). National food policies often fail to address the specific needs of adolescents, leading to a disconnect between food governance and health outcomes (Sambu et al., 2024).

2.6.1 Influence of Socio-Cultural Factors on Adolescent Dietary Behaviour

Cultural norms, beliefs, and practices can lead to the acceptance and promotion of unhealthy behaviours among adolescents. Socio-cultural issues are based on shared beliefs within a specific cultural or social group (National Academies of Sciences, Engineering et al., 2018). Cultural beliefs about food and body size can influence dietary practices, with some cultures valuing larger body size as a sign of wealth, health and prosperity (Jaroszewski & Wilhelm,

2022). Factors such as traditional and cultural food practices and preferences, meal preparation methods, and the social value placed on certain foods or body types, the social norms and expectations around food and body image, as well as stigma and discrimination related to obesity and media and societal influences on dietary behaviours can all influence adolescent eating habits and weight status (Senkyire et al., 2022). Sociocultural factors strongly influence individual behaviour in a broad variety of contexts, including food selection, eating practices, food-purchasing behaviours, and dietary and physical activity behaviours (Haghighian Roudsari et al., 2017; M. R. Islam et al., 2019). Some cultural beliefs can lead to the consumption of energy-dense, nutrient-poor foods such as traditional Ghanaian dishes, which can contribute to adolescent obesity. For example, research has shown that in some Ghanaian communities, there is a cultural preference for larger body sizes, which can discourage healthy eating and physical activity among adolescents (Senkyire et al., 2022). Societal attitudes towards food and health can dictate dietary practices. For example, traditional beliefs may conflict with modern dietary recommendations (Amoadu et al., 2022). Lack of education regarding nutrition can perpetuate unhealthy eating patterns among adolescents (Amoadu et al., 2022).

People from diverse cultural backgrounds eat different foods and they often use food to maintain their cultural identities (Vatika, 2018). Families' dietary preferences and dislikes are influenced by the places they call home and by where their ancestors came from. A cultural or regional group's food consumption pattern is the outcome of these dietary preferences. Most often, immigrant groups tend to adopt or incorporate the cultural norms, values, beliefs, and practices of the majority culture or their new host country—a phenomenon known as acculturation (Bhugra et al., 2021). However, culture is constantly evolving, particularly in multicultural societies. As a result, cross-cultural food practices and eating behaviours are often present (Reddy & van Dam, 2020). Additionally, cultural beliefs and norms about physical

activity may influence the level of physical activity that individuals engage in, with some cultures placing a greater emphasis on sedentary activities and leisure time (Bauman et al., 2012; Harrington et al., 2016; Sterdt et al., 2014). According to Swinburn et al., the socio-cultural environment is community's or society's attitudes, beliefs, and values connected to eating and physical activity that may have a strong effect on the behaviour of individual members of the community group (Swinburn et al., 1999). The home is one setting where these factors may play a direct role in shaping children's and adolescents' physical activity, as parents give their children the social support, opportunity, motivation and the resources to be active through providing things like equipment, transport, and encouragement for physical activity (Harrington et al., 2016). While socio-cultural factors can promote healthy eating, they may also reinforce unhealthy dietary habits, particularly in settings where fast-food and sugary snacks are more readily available, accessible, and culturally accepted (Melnik et al., 2022). This duality highlights the complexity of addressing adolescent dietary habits through socio-cultural perspectives (Melnik et al., 2022). Addressing socio-cultural factors that influence diet quality and physical activity behaviours requires a comprehensive approach that includes health promotion, education and awareness campaigns, community-based interventions, and policy changes, as well as efforts to engage and involve community members in the design and implementation of these programmes.

2.7 Awareness, Knowledge, and Readiness to Adopt Sustainable Healthy Diets (SHDs)

While structural barriers are dominant, assessing the individual capacity and willingness of adolescents to adopt SHDs is essential for designing effective future interventions. Evidence suggests that while adolescents can acquire the necessary knowledge, external barriers consistently impede sustained behavioral adoption. Adolescents demonstrate a strong ability to learn and respond to targeted nutrition education. Studies using participatory video (PV) interventions among adolescent girls in rural Ghana showed significant cognitive and

behavioral shifts (Ghadirian et al., 2022). This intervention, which included a nutrition curriculum and activities designed to help adolescents plan, film, and screen nutrition-related videos, resulted in a significant increase in food knowledge (Ghadirian et al., 2022).

National data reveals a significant over-reliance on staple foods, which are consumed at 279% of recommended levels (Darko & Martey, 2025). Conversely, the consumption of protective foods critical for health and dietary diversity is severely inadequate: fruits are consumed at only 57% of recommended levels, vegetables at 43%, and legumes, pulses, and nuts at a mere 20% adequacy (Darko & Martey, 2025). Furthermore, unhealthy dietary patterns carry a substantial environmental footprint. Ghana's existing diets generate 46 million metric tons per year of greenhouse gas (GHG) emissions (Darko & Martey, 2025). This linkage between diet and climate establishes that the transition to healthier eating is an environmental imperative. Shifts toward healthy diets must focus on the dual goals of protecting and improving the nutrition and health of populations while also meeting environmental goals in an equitable way. Modeling studies demonstrate that policy interventions promoting SHDs, such as aligning national guidelines with EAT-Lancet recommendations, could achieve superior environmental and economic outcomes, offering up to 70% lower emissions compared to current consumption patterns, alongside 47% lower costs than some government-guided dietary goals emissions (Darko & Martey, 2025). Therefore, the push for SHDs is necessary not just for adolescent health, but for national food security and climate mitigation goals, reaffirming the global consensus that food systems must transition to be more sustainable and resilient.

2.7.1 Sustainable Healthy Diets

There is now a growing recognition that healthy diets must be sustainable for the planet. This means that the foods we eat must not only promote human health but also be produced and consumed in a way that does not harm the environment and contribute to climate change (Clark et al., 2019; Culliford & Bradbury, 2020; Joyce et al., 2012). Achieving sustainable healthy

diets and better nutrition is recognised as a goal in Sustainable Development Goal (SDG) 2, which aims to end hunger, achieve food security, and promote sustainable agriculture. Additionally, unhealthy diets and food production have implications for poverty reduction (SDG1), health and well-being (SDG3), cognitive development and learning (SDG4), reduced inequality (SDGs 5 and 10), and improved work and productivity (SDG8). According to the UN committee on economic, social and cultural rights, the right to adequate food implies that food should be available in a quantity and quality sufficient to meet individuals' dietary needs, considering cultural preferences and free from harmful substances (UN Committee on Economic, 1999). Furthermore, it emphasises that such food should be accessible in a sustainable manner, without interfering with the enjoyment of other human rights (Domingo-Cabarrubias, 2023; UN Committee on Economic, 1999).

Food production and consumption account for 25% of greenhouse gas emissions, contributing to environmental degradation and human health risks. Current diets exacerbate climate change, biodiversity loss, and freshwater depletion while promoting poor health (Garnett, 2011). The Intergovernmental Panel on Climate Change (IPCC) estimates that food system emissions may range from 21% to 37% of total anthropogenic emissions (IPCC, 2019b, 2019a). The livestock sector alone contributes nearly half (14.5%) of food system emissions, predominantly from the farm stage, which is a significant but often overlooked source. Estimates by Tubiello et al., also show that food system emissions of GHG may be as large as 20%–40% of total anthropogenic emissions (Crippa et al., 2021). Emissions from the food industry are primarily found in the farm, manufacturing, and post-production stages, with the farm stage often overlooked but making a significant contribution to overall emissions (Cerutti et al., 2023). However, limited attention has been paid to emissions from food systems in low- and middle-income countries. Global food consumption alone could contribute nearly 1°C to warming by 2100, with 75% of this warming driven by high methane sources such as ruminant meat, dairy, and rice.

Agriculture is the single greatest cause of eutrophication in water bodies (~78% contribution), loss of biodiversity, and air pollution through increased atmospheric fine particulate matter (Domingo et al., 2021). Food production and processing lead to greenhouse gas emissions, such as CO₂ and methane, soil erosion, increasing water use and a reduction in biodiversity. These factors, in turn, affect human (and animal) health (Feskens, 2023). Furthermore, diets and food production interact with patterns of consumption and waste, impact the global climate, and affect the use of marine and terrestrial resources (SDGs 12, 13, 14, and 15) (Feskens, 2023; Yaneva, 2023). However, simultaneous improvements to production practices, adoption of a healthy diet, and food waste reductions could avoid over 55% of anticipated warming (G. Liu et al., 2023). Mitigation strategies for food system emissions should consider regional and country-specific actions, including dietary changes, technology improvements, and reductions in food loss and waste (Ivanovich et al., 2023).

Sustainable diets, as defined by the Food and Agriculture Organization (FAO), minimize environmental impacts, contribute to food and nutritional security, and promote a healthy life for present and future generations (FAO, 2010b). They support local food systems, improve food security and sovereignty, and are accessible, culturally acceptable, economically fair, affordable, safe, and healthy (Fulgoni et al., 2018). Sustainable Diets are those diets with low environmental impacts that contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets protect biodiversity and ecosystems, are nutritionally adequate, and optimize natural and human resources (Burlingame, 2012; Visser et al., 2023). They cover health, environmental, social, and economic aspects of food production, distribution, and consumption. Transitioning to plant-based diets is recognized as a pathway to sustainable consumption (Downs et al., 2023). A sustainable diet adheres to planetary boundaries, conserves natural and social capital, is financially viable, nutritious, and promotes positive health outcomes (Holden et al., 2022). Historically, sustainable diets were standard

until modern agriculture and industrial food systems emerged, impacting human and ecosystem health. The renewed focus on sustainable diets underscores the importance of nutrients, ecosystems, biodiversity, and the negative effects of ultra-processed foods on chronic diseases (Burlingame et al., 2022). These diets are crucial for mitigating climate change impacts on food systems, emphasizing nutrient density and health benefits while considering environmental effects like greenhouse gas emissions and water use (Fanzo et al., 2021).

Linked to sustainable diets is food sovereignty. Food sovereignty, the right of people to define their own food systems, is critical in combating climate change. It empowers communities to localise their food systems, support ecologically sound agriculture, and ensure access to healthy and culturally appropriate foods. This leads to greater control over food sources, resulting in more sustainable practices that reduce the dietary carbon footprint, mitigate climate change impacts, and enhance food security. A transition toward a diet that is mindful of the environmental impact of our food choices or plant-based and low-meat diets can be a great way to eat healthy whilst reducing our carbon footprint and contributing to reducing climate change (Rust et al., 2020). Currently, we do not know whether adolescent consumers in Ghana are ready to make food choices based on what is environmentally sustainable. There is also a paucity of data on Ghanaian adolescent consumers' perception of the environmental impacts of food consumption and their willingness to change their food consumption in a more climate-friendly direction. To promote sustainable healthy diets, insight is needed on awareness, barriers and the readiness to adopt sustainable healthy diets. Currently, not much data exists on the awareness, barriers and readiness to adopt sustainable healthy diets among adolescents in Ghana. Also, there is a lack of data on the barriers that adolescents face in adopting sustainable healthy diets and their readiness to adopt sustainable healthy diets in Ghana. This research could inform the development of interventions to promote sustainable healthy eating among adolescents. It is essential to understand which drivers have the most significant influence to

develop targeted interventions effectively. To achieve sustainable diets, it is necessary to make drastic changes in both food production and consumption. Increasing the consumption of plant-based foods and decreasing the consumption of meat and dairy is more environmentally sustainable and healthy (Irazusta-Garmendia et al., 2023). Shifting towards plant-based diets is considered a key factor in promoting sustainable consumption patterns (United Nations Department of Economic and Social Affairs, 2023). Additionally, promoting the consumption of fruits and vegetables is associated with deeper knowledge and more favourable attitudes towards sustainable diets (Downs et al., 2023). Overall, adopting sustainable diets is crucial for feeding the growing population while ensuring the sustainable use of natural resources and protecting biodiversity (Arrieta & Aguiar, 2023).

Sustainable healthy diets have been conceptualised as a way to produce and consume food that is both healthy and sustainable (Downs et al., 2023). Sustainable healthy diets are diets that encompass health, environmental, social, and economic dimensions of food production, movement through the food system, and consumption. Sustainable diets address environmental, social, economic, and health-related challenges and involve dietary changes such as increasing fruits, vegetables, legumes, nuts, seeds, and whole grains while reducing ruminant meats and discretionary foods (Leonard, 2022). Implementing sustainable diets requires a calorie-balanced diet based on plant foods, low protein intake from animal foods, and the consumption of fresh, seasonal, locally produced, and minimally packaged products. Shifting towards plant-based diets is considered a key component of sustainable diets, as it leads to more sustainable consumption patterns (Leonard, 2022). Adopting plant-based diet patterns has been found to benefit both the environment and population health (Agyemang et al., 2022). These diets require both consumer-facing and upstream food system interventions to support their consumption (Nishi, 2022). However, the implementation of sustainable healthy diets faces challenges and bottlenecks that need to be addressed.

2.7.2 Adoption of Sustainable Healthy Diets

Adolescents are a group to target with behaviour change interventions as they are developing their lifelong beliefs and behaviours that influence health into adulthood (Simmonds et al., 2016). Individual behaviour-change interventions, along with structural changes to food production and distribution systems, are essential for achieving sustainable healthy diets, especially in high-income countries. Adolescents' readiness to adopt healthy and sustainable diets is influenced by several factors. Research suggests that adolescents have little interest in adopting a more plant-based diet because of a lack of knowledge about what constitutes such a diet and the perceived poor taste of plant-based foods (Hashim et al., 2023). Additionally, limited food preparation and cooking skills, low food literacy, and lack of availability and accessibility of environmentally friendly food options hinder their ability to adopt sustainable dietary practices (Jenkins et al., 2023). Adopting a sustainable, healthy diet has several benefits. It can contribute to both public and planetary health by reducing greenhouse gas emissions, soil erosion, water use, and biodiversity loss (Feskens, 2023). Plant-based diet patterns have been found to benefit the environment and the health of the population (Agyemang et al., 2022). Changes towards sustainable diets, such as increasing fruit and vegetable consumption and decreasing ruminant meats and discretionary foods, can help address environmental, social, economic, and health-related challenges (Leonard, 2022). Shifting dietary consumption away from foods with high greenhouse gas emissions can lead to health and climate co-benefits (Cleghorn, 2022). Additionally, incorporating sustainable strategies such as seasonal eating and choosing organic and/or plant-based diets can promote wellness and mindfulness in nutrition choices.

2.8 Creating a Policy Framework for Sustainable Healthy Diets: The Nuffield Ladder of Policy Intervention

There is an urgent need for policy interventions that promote sustainable, healthy diets among adolescents in Ghana, considering the increasing rates of diet-related diseases and environmental degradation caused by current food production methods. However, policies on sustainable diets have remained weak, with focus on output, consumer choice, and cheaper prices (Patra et al., 2023). There is a need to address this gap between what evidence suggests and what society delivers. Several strategies can be implemented to promote sustainable, healthy diets. An essential approach to achieving sustainable healthy diets is behaviour change interventions at the individual level (Holden et al., 2022). At the individual level, policies can focus on promoting education and awareness of healthy diets, ensuring access to accurate and reliable information, and facilitating behaviour change through nudging interventions and pricing policies (Pais et al., 2023). However, nudges, adjustments, or tweaks on their own are insufficient to achieve healthy diets from sustainable food systems (Bellamy et al., 2023). Another approach is to develop interventions targeting families and their practices, as parents play a crucial role in influencing the dietary behaviours of children and adolescents (Patra et al., 2023). These interventions can include subsidies for fruits and vegetables, nudging strategies in grocery stores, mobile applications providing healthy and sustainable recipes, and easily accessible shopping lists (Pancrazi et al., 2023). Another strategy is to use eco-labelling and social nudging to influence food choices. Eco-labelling, which provides information on the environmental impact of food products, can encourage individuals to choose more sustainable options (Vos et al., 2022). Social nudging, such as highlighting others' choices, can also influence sustainable food choices (De-loyde et al., 2022). Additionally, implementing subsidies on fruits and vegetables financed through progressive taxes can help make these healthier options more affordable and accessible to families (Leonard, 2022). Attempts to create policy frameworks for sustainable diets are limited, and there is reluctance to change. However,

there have been developments at various policy levels, suggesting that the "business-as-usual" framework may be fraying at its edges (Lang & Mason, 2019). For example, Ghana has developed Food-based Dietary Guidelines and the Ghana Food Systems Guidelines to promote healthier and more sustainable diets. Initiatives such as those outlined in the EAT-Lancet report are crucial for prompting the necessary changes (Willett et al., 2019). Policymakers should adopt multi-criteria approaches to sustainable diets and consider implementing price policies to shift dietary intake towards healthier and more sustainable foods (Cleghorn, 2022). By incorporating clear sustainable healthy diet indicators and using composite tools or indices to evaluate outcomes, future interventions can raise awareness and maximise impact in the community (Kongats et al., 2020).

The Nuffield ladder of policy intervention provides a comprehensive framework for understanding the various levels of policy interventions that can be used to promote sustainable healthy diets and address any challenges in creating a sustainable food system (Patra et al., 2023). The ladder includes a range of interventions, from less intrusive measures, such as providing information and raising awareness, to more intrusive measures, such as regulation and taxation (Nuffield Council on Bioethics, 2007). It consists of eight rungs that can be used to guide policy interventions related to sustainable healthy diet. These rungs include: 1) Do nothing, 2) Provide information, 3) Enable choice, 4) Guide choice through incentives, 5) Guide choice through disincentives, 6) Guide choice through restrictions, 7) Guide choice through bans, and 8) Mandate choice (Nuffield Council on Bioethics, 2007). These rungs represent a continuum of policy interventions ranging from minimal intervention to coercive measures. In the second rung, knowledge dissemination can be achieved by delivering the correct messages and information to the target groups, preferably in their local language and through appropriate media channels, such as local radio, video or drama, and social media (Haines et al., 2019). In the third rung, knowledge utilisation can be facilitated through the effective monitoring of

corrective action and further learning. This can involve monitoring the implementation and impact of nutrition programmes and adjusting as needed. In the fourth rung, we can implement economic and social policies that address poverty, trade, and agriculture to support sustainable healthy diets (Bryce et al., 2008). The ladder recognises that different interventions may be more appropriate for different contexts and that a combination of interventions may be needed to achieve the desired outcomes.

The ladder can be used to determine the appropriate level of intervention based on the desired outcomes and the feasibility of implementation. For sustainable healthy diets, these interventions can be used to promote changes that address environmental, social, economic, and health-related challenges (Cleghorn, 2022; Leonard, 2022). For example, interventions targeting children and adolescents can play a crucial role in educating the community and promoting sustainable, healthy diets (Patra et al., 2023). The Nuffield ladder of policy intervention recognises the importance of various levels of intervention, ranging from individual behaviour change to systemic changes in food production, marketing, and governance (Fresán et al., 2023). At the community level, policies can support local food systems, promote sustainable farming practices, and encourage the availability of healthy and affordable food options (Barbour et al., 2023). At the organisational level, policies can incentivise food industry stakeholders to prioritise sustainability and health in their production and marketing practices (Singh et al., 2023). At the societal level, policies can shape the broader food environment by implementing nutrition standards or rules, restricting unhealthy food marketing, and providing direct food in schools and other public institutions (Carrillo-Alvarez, 2022). These interventions should be integrated and coordinated across sectors, including government bodies, academia, civil society organisations, and the private sector (Mattei & Lano, 2022). The Nuffield ladder is intended to help policymakers and other stakeholders think carefully about the ethical implications of different types of interventions and consider the

potential benefits and drawbacks of each approach. It is essential to integrate nutrition programmes with larger policies and initiatives such as the national health policy, national nutrition policy, multisectoral nutrition plan, and Sustainable Development Goals to ensure a comprehensive approach to promoting sustainable healthy diets. Table 2.1 applies the Nuffield Ladder of Policy Interventions to address sustainable healthy diets, outlining various measures.



Table 2.2: Applying the Nuffield Ladder of Policy Intervention to sustainable healthy diets in Low- and Middle-income settings.

Rung	Policy option	Level of intervention	Description	Comment in relation to sustainable
1	Do nothing or monitor	None	Simply observe and gather data on dietary trends and their impact on health and sustainability.	Provides baseline information but does not actively address the issue. An all-too-common current government position.
2	Provide information	Low	Public awareness campaigns, nutrition education, food labelling. Use of the Ghana Food-based Dietary Guidelines.	Empowers individuals but effectiveness depends on existing knowledge, preferences, and marketing influences.
3	Enable choice	Moderate	Enable individuals to change behaviour. Subsidies for fruits and vegetables, school meal programmes promoting healthy and sustainable choices, restrictions on unhealthy food marketing to children, promoting community gardens and farmers markets.	Nudges individuals towards healthy and sustainable choices without direct restriction. Requires careful implementation and may face industry opposition. E.g., restrictions on unhealthy food marketing to children.
4	Guide choice by changing default policy	Moderate-High	Provide better options. Defaulting to water in restaurants, portion size reduction.	Subtly steers individuals towards healthier options. Raises concerns about autonomy and potential unintended consequences. Hard to do in supermarket context but possible in food service settings by menu planning.
5	Guide choice through incentives	Moderate-High	Use regulations or financial incentives/tax breaks for purchasing sustainable food options, loyalty programmes rewarding healthy and sustainable choices, subsidies for composting food scraps.	Requires active government and a willing consuming public. Encourages healthy and sustainable choices through positive reinforcement. Effectiveness depends on design and potential administrative burden.
6	Guide choice through disincentives		Apply taxes or charges on unhealthy and unsustainable food options, higher tariffs on imported unsustainable food products.	Discourages unhealthy and unsustainable choices through economic pressure. E.g., "sin taxes" on sugary drinks and carbon taxes on emissions. Raises concerns about equity and potential unintended consequences.
7	Restrict choice	High	Remove inappropriate choice options, e.g., bans on trans fats, regulations on sugar content in beverages, limitations on unhealthy food marketing across all media, bans on unsustainable food production practices, restrictions on portion sizes in restaurants.	Highly effective but raises concerns about individual freedom and potential economic impacts. Sustainability considerations need careful integration.
8	Eliminate choice	Very high	Complete bans on specific unhealthy ingredients or unsustainable food production practices.	Extremely intrusive and raises serious ethical concerns. Only in exceptional circumstances and with strong justification. Limited consideration in promoting sustainable diets due to challenges in implementation and potential unintended consequences.

2.8 Philosophical Underpinnings and Theoretical Basis for the Research

A research study is conventionally guided by specific research paradigms or philosophical underpinnings, which represent the researcher's underlying philosophical views concerning the nature of truth and reality in general and the research issue in particular (Dawadi et al., 2021). A paradigm is a basic belief system, a way of thinking, a theoretical framework, a worldview or philosophical position about the world or the nature of reality and how we approach it to understand it (Mackenzie & Knipe, 2006; J. A. Maxwell, 2005; Terhoeven, 2009). This includes the researcher's assumptions about the ontology, epistemology, methodology and the methods that guide the research process (Rehman & Alharthi, 2016). In other words, it is our way of understanding the reality of the world and studying it. Paradigms serve as a foundation for the research process, influencing the choice of methods, data collection and analysis techniques, the interpretation of findings and ultimately informing the conclusions and implications drawn from the study. Ontology refers to "the nature of our beliefs about reality", that is, what is the nature of reality? whereas epistemology refers to the nature and forms of knowledge, i.e., how do we know what reality is; how can knowledge be acquired and how can it be communicated to other human beings" (Cohen et al., 2007).

A researcher, based on their purpose, may adopt different research paradigms including positivism, interpretivism, and pragmatism to uncover the truth and/or knowledge. One of the most prevalent research paradigms is positivism. The positivist approach is a quantitative research method that emphasizes the use of empirical data to test hypotheses and theories (Cohen et al., 2007; Kivunja & Kuyini, 2017). Positivist researchers typically adopt a deductive approach, beginning with a theory or hypothesis and conducting empirical testing to either confirm or refute it (Kivunja & Kuyini, 2017). Positivist researchers seek to discover universal laws and causal relationships through the use of quantitative methods and statistical analysis (Kivunja & Kuyini, 2017). They aim to establish a cause-and-effect relationship between

variables and generate generalizable findings. They often collect quantitative data through surveys, experiments, or secondary data sources, and analyse it using statistical techniques to draw objective conclusions (Creswell, 2009). This approach assumes that there is an objective reality that can be measured and observed through scientific methods. The positivist approach is often used in research studies that aim to identify causal relationships between variables. This approach assumes that the world is made up of observable and measurable phenomena, and that these phenomena can be studied using scientific methods (Creswell, 2009).

Interpretivism, in contrast, is rooted in the belief that reality is subjective, socially constructed as well as culturally and historically situated, based on people's experiences and their understanding of them (Ryan, 2018). This means that it is shaped by individuals' beliefs, feelings, interpretations and meanings (Levers, 2013). Interpretivist researchers strive to comprehend the subjective experiences and meanings attributed to phenomena, placing emphasis on the context and social interactions influencing these interpretations. Interpretivists prioritize qualitative methods such as interviews, observations, and document analysis to collect comprehensive and detailed data (Creswell et al., 2006). Techniques like thematic analysis or grounded theory are utilized for exploring and interpreting data with the goal of revealing intricate meanings and subjective viewpoints of participants. Moreover, interpretivist researchers acknowledge the researcher's role in shaping the research process while acknowledging that knowledge is co-created through interactions between researcher and participant (Rehman & Alharthi, 2016).

This study aims to investigate dietary behaviour using a pragmatic philosophy. Pragmatism is a research paradigm that embraces flexibility and practicality. Pragmatist researchers acknowledge the merits and constraints of both positivist and interpretivist approaches, advocating for the use of multiple methods to address research questions comprehensively

(Dawadi et al., 2021). Pragmatism is a philosophical underpinning that supports mixed-method research designs (Pokhrel, 2019). According to Tashakkori and Creswell, mixed methods research is “research in which the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or a program of inquiry” (Tashakkori & Creswell, 2007). A pragmatist approach offers more potential to reveal a deeper understanding of life experiences than the use of either qualitative or quantitative research methods on their own (McBeath, 2022). They prioritise aligning research with the practical needs and objectives inherent to the research problem rather than adhering strictly to a particular paradigm (Tashakkori & Teddlie, 1998). In pursuit of producing rigorous yet contextually relevant research, pragmatists emphasize integrating quantitative and qualitative methods to gain deeper insights into intricate phenomena (Kaushik & Walsh, 2019). Pragmatism emphasises selecting the most appropriate method for the research question and acknowledges multiple ways of knowing, allowing for complementary insights into dietary behaviour through mixed-method research. In adopting a pragmatist philosophy, the study on dietary behaviour is guided by the belief that research questions should be the driving force for selecting the most appropriate methods to answer those questions. This approach enables us to examine dietary behaviour from multiple perspectives and consider contextual factors that may influence individuals' eating habits. Rather than being limited to a positivist or constructionist perspective, we view pragmatism as the most appropriate philosophy for our mixed method study (Pokhrel, 2019). By taking a pragmatic approach, we can address the complexities of studying dietary behaviour and gain a comprehensive understanding of the topic.

2.9 Critical Research Gaps and Future Research Agenda for Ghana and LMICs

To effectively address the complex food system challenges driving UDBs and inhibiting the adoption of SHDs in Ghana and similar LMICs, the current research agenda must expand

dramatically in scope, methodology, and focus. Current research on adolescent diets in Ghana often suffers from a quantitative bias and a tendency to address unhealthy diets in a siloed manner, viewing them primarily as behavioral or nutritional issues disconnected from their systemic drivers. This approach fails to capture the intricate, multi-scalar dynamics of the contemporary food environment. To bridge this deficit, future research requires a more interdisciplinary and multi-scalar approach. This necessitates incorporating mixed methods, combining large-scale epidemiological data with qualitative, participatory practices that capture the lived experiences of adolescents and stakeholders. A significant conceptual gap is the limited integration of environmental sustainability metrics into public health nutrition research. Current studies acknowledge that Ghana's national diets fail sustainability targets, yet insufficient research exists that measures the full range of sustainability indicators (e.g., GHG emissions, water footprint) across different dietary scenarios for adolescent populations. Future work must explicitly investigate the relationship between economic growth, increased consumption of environmentally intensive foods like meat, and resulting environmental impacts. Future research must be explicitly designed to unpack the influence of the food industry on adolescent consumption of UPFs in Sub-Saharan Africa. This means investigating regulatory structures at the macro level to identify institutional weaknesses that facilitate industry lobbying and result in policy failure.

2.10 Conclusions

This literature review establishes that unhealthy dietary behaviours among Ghanaian adolescents are widespread, rooted in early life, and structurally maintained by powerful economic and commercial determinants. Adolescents demonstrate a capacity and willingness to learn and adopt healthier diets, exemplified by high gains in nutrition literacy and specific positive food choices following interventions. However, this individual readiness is overwhelmingly negated by systemic constraints. The transformation to Sustainable Healthy

Diets (SHDs) cannot be achieved solely through individual health education. It requires a fundamental shift in political commitment to enforcing regulations, addressing the structural affordability crisis, and proactively countering the influence of the commercial food sector. The observed stagnation in overall dietary quality following successful educational interventions confirms that the core challenge lies in the political and economic environment, not in the adolescents' awareness or motivation.



3.0 STUDY METHODOLOGY

3.1 Introduction

This chapter summarises the methods that were followed to collect, analyse and present data in this study. The methods are described in detail in each of the results chapters. The section describes the study site, study design, the sampling techniques that were used to sample respondents and the criteria for inclusion in the study. It further gives details about sample size determination, data collection procedures, the instruments that were used for data collection and a description of how the data were analysed. The section also discusses the ethical issues that were followed in the process.

3.2 Study design

This was a community-based study. A mixed methods sequential design involving quantitative data collection and analysis, followed by qualitative data collection and analysis (explanatory sequential) was used for this study.

3.3 Study site description

The spatial scope of the study covered the Volta and Oti regions of Ghana, located at the eastern border of Ghana. The Volta and Oti regions are two of the sixteen administrative regions of Ghana. The two regions were one (Volta region) until northern Volta was carved out of the Volta region by constitutional instrument (C. I. 112) in February 2019 to form the Oti region. The two regions cover a total land area of 20,570 km², representing 8.6% of Ghana, and lie between latitudes 5° 45'N and 8° 45'N. The Volta and Oti regions are located west of Republic of Togo and to the east of Lake Volta. The area is bordered by the Gulf of Guinea to the south, the Northern Region to the north, Bono East Region to the west, and on the northwest by the Savannah Region (Figure 3.1). The regions are shown in Figure 3.1.

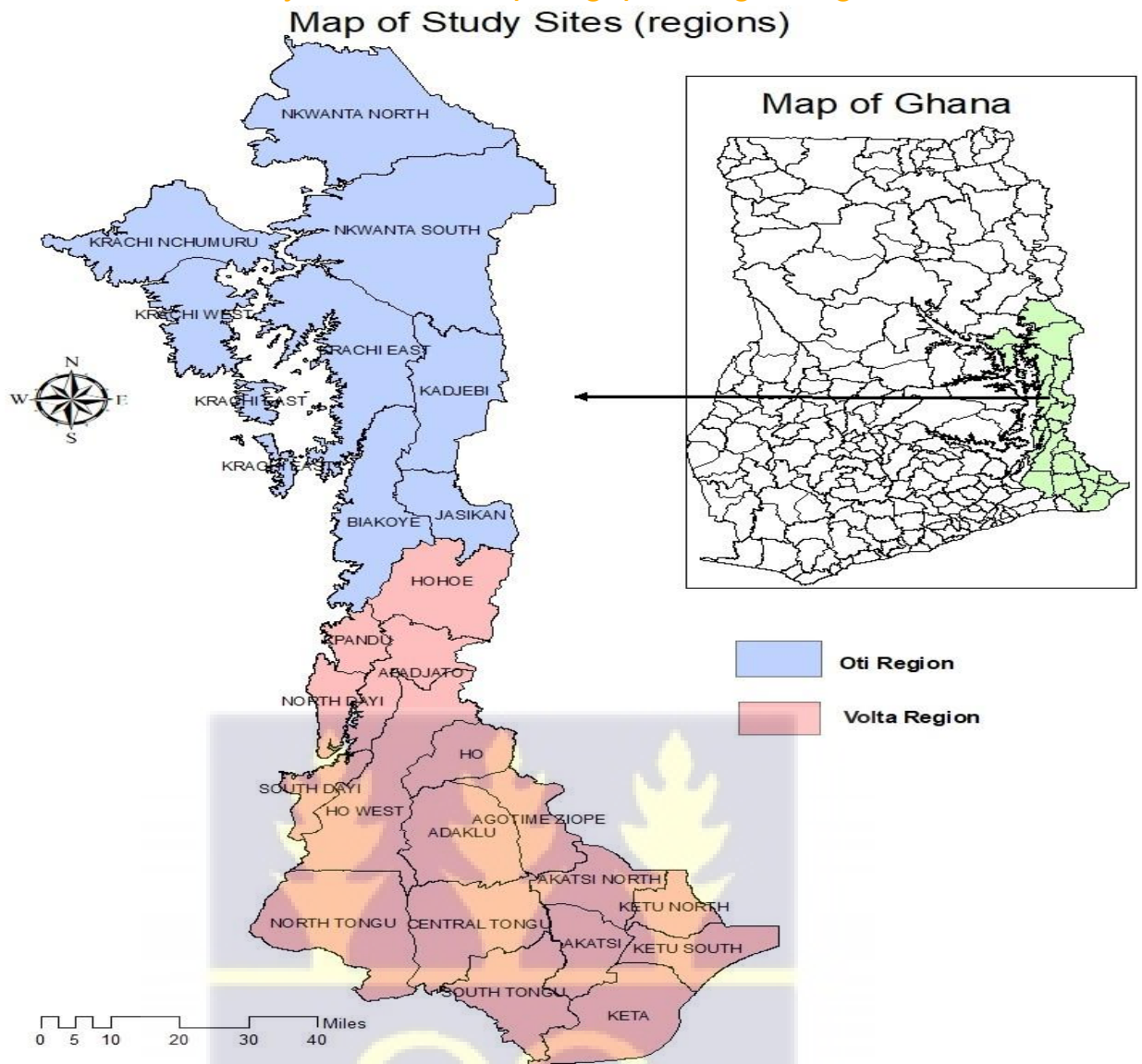


Figure 3.1: Map of Ghana showing the Volta and Oti regions

Volta region: The Volta Region has Ho as its administrative capital. The region is divided into 17 administrative Municipal and Districts assemblies (Table 3.1). It is multi-ethnic and multilingual, including groups such as the Ewe, the Guan, and the Akan peoples. The Guan people include the Lolobi, Likpe, Akpafu, Buem, and Nkonya people. The estimated 2019 population of the region according to the Ghana Statistical Service is 1,865,332 (population density of 196.3/km² inhabitants per km²).

The Oti region

The Oti Region is one of the six newly created regions of Ghana. The new region was created on the 15th of February, 2019 by an Act of Parliament (Constitutional Instrument 112) after the people in the catchment of the region voted YES in a referendum to separate from the Volta region. Oti Region has its capital as Dambai and has eight administrative Municipal and District Assemblies. The Oti Region is multi-ethnic and multi-lingual. The estimated 2019 population of the region according to the Ghana Statistical Service is 742,664 (population density of 67.11/km² inhabitants per km²).

3.3.1 Socio-demographic characteristics

The preponderant ethnic groups in the Volta and Oti Regions are the Ewes who are found mainly in the Volta Region and along the Volta Lake, the Guans (including the Lolobi, Likpe, Akpafu, Buem, Santrokofi, Nkonya, Nchumuru, Krachi) and Akans who occupy mainly the middle belt and along communities along the Volta Lake. Other major ethnic groups in the Oti region include, the Basares, the Ntrubos, the Adeles, Atwodes and the Challas, the Kokombas, Kotokolis and the Akans. The most widely spoken languages in the regions are Ewe and Twi. The main occupations include farming, livestock rearing, trading and fishing while others are employed in state-owned and private institutions. Many of the people are engaged in producing staple food crops including yam, cassava, maize, rice and other cereals. Christianity is the dominant religion in the Volta and Oti regions followed by Traditional religion, Islam and other religions. Traditional markets are the oldest and most stable food retail hubs in the regions. There are many hawkers, street food stalls, container shops, “chop bars” and other food services selling a variety of local dishes, sugar-sweetened beverages, alcoholic beverages, and grocery in the towns and villages. There are also street food hawkers, food retailers in the vicinity of schools, bus terminals and lorry stations.

3.3.2 Topography, climate, vegetation and agriculture

Together the Volta and Oti regions are divided into three natural geographical belts namely the southern, middle and the northern belts with varied ecological zones.

Topography and vegetation: The Volta and Oti Regions have a large variation in vegetation types. The southern belt is mainly low plains with wetlands and sandy portions, stretching across the coastline. The vegetation in the southern belt is characterized by mangrove swamps and adjoining arid coastal savannah plains. The middle belt falls within the forest-savannah Transitional Ecological Zone of Ghana. The area is generally covered with moist semi-deciduous forest, characterized by timba resources. The topography is predominantly mountainous in the middle and northern belts which form part of the Akwapim-Togo Ranges (a narrow belt of mountains, ridges and hills in western Africa). Mount Afadja (Afadjato) (the highest elevation in Ghana) and Mountain Gemi (Amedzofe) (the highest human habitation in Ghana), are located here in the middle belt. The northern belt lies within the transitional zone between the savannah zone to the north and the forest zone to the south. The area is covered with savannah grassland and savannah woodland, with short, scattered drought-resistant trees, baobab trees, sheanut trees and *dawadawa* trees. There are also occasional pockets and remnants of semi-deciduous forests and fringe forests along the western borders extending to the Volta Lake, and along streams and the Oti River. More than half of the land area of the Volta and Oti Regions fall within the Volta River Basin, with the Volta Lake and its tributaries (rivers Oti, Asukawkaw, Menu, Dayi) draining a substantial portion of the regions.

Climate: The climate in the Volta and Oti Regions is tropical. The climate is generally warm with variable temperatures (21-32° Celsius) masked by seasons and elevations. The highest and lowest temperatures occur in March and August, respectively. Seasonality is mainly influenced by the West Africa monsoon winds. The area experiences a bimodal rainfall regime that peaks

between July and September. The main rainy season, occurring between May and August and the minor rainy season between September and October. Between the rainy seasons is a prolonged dry season, culminating in the dry Harmattan between November and February. The average annual rainfall ranges between 1,168mm and 2,103mm. The northern belt has a much arid climate as compared to the southern areas of due to its proximity to the north. The average annual rainfall varies from 750 to 1050 mm. The highest temperatures are reached at the end of the dry season, the lowest in December and January. The ambient temperatures vary between 14 °C at night and 40 °C during the day. However, the hot Harmattan wind from the Sahara blows frequently between December and the beginning of February.

3.3.5 Health facilities, infrastructure and healthcare services in the Volta and Oti regions

Together, the Volta and Oti regions have a total of 326 health institutions, including 242 Ghana Health Services (GHS) administered facilities, 18 mission-owned facilities, one quasi-government (military) hospital and 65 privately owned clinics and hospitals. With the exception of Krachi East, Nkwanta North and Adaklu Anyigbe, every district now has a government or mission-owned hospital.

3.4 Study population

The study population included all male and female adolescents aged 10-19 years who were resident in the Volta and Oti regions at the time of this study.

3.4.1 Inclusion criteria

Inclusion criteria required that all adolescent participants were aged between 10 and 19 years, were resident in the Volta and Oti regions, indicated willingness to voluntarily participate in the study by providing assent and, received parental consent to participate in the study.

3.4.2 Exclusion criteria

Adolescents who met the inclusion criteria but were unwilling or unable to provide informed consent/assent, adolescents who were critically ill or had cognitive or physical disabilities impacting their ability to participate, institutionalisation (e.g. prison, hospitalisation), and adolescents who had insufficient linguistic fluency to complete study procedures/questionnaires were excluded.

3.5 Sample size determination

The minimum sample size for the quantitative aspect of the study was calculated using Yamane's formula for population proportion (Yamane, 1967).

$$n = \frac{z^2 p(1-p)N}{z^2 p(1-p) + Ne^2} \quad \text{-----} \quad 1$$

Where: n= the minimum sample size

z = the standard normal variate for population distribution. In this study, the confidence level is set at 95% (standard value of 1.96). Therefore, 5% types 1 error was allowed and the level of significant placed at p

p = is the proportion of some relevant characteristic, in this case the prevalence of adolescent obesity which stands 14.7% =0.147 (Aryeetey et al., 2017).

e = the margin of error to be tolerated which has been set at 5% or 0.05.

N = the adolescent population size projected to be 589,513 in 2020.

The regional population is projected to be 2,667,478 in 2020 and the adolescent population is estimated to be 22.1% of the total population.

Since both the numerator and denominator for equation (1) contain $z^2 p (1 - p)$, equation (1) can be simplified to: $n = N / (1 + Ne^2)$

$$\text{Therefore, } n = \frac{N}{(1 + Ne^2)}$$

$$n = \frac{589513}{1 + 589513 * 0.05^2}$$

$$= 399.7 \approx 400$$

By considering a design effect of 1.5,

$$n = 400 * 1.5 = 606 \text{ and a 10\% non-response rate, } n = 606 * 0.1 = 667$$

Total sample size 667.

In anticipation of losses to follow up, delays in receiving parental consents and parental unavailability or refusal to participate in the study, the total number of adolescents selected was increased by 10%. Therefore, the final sample size would be 667.

3.6. Sampling procedure

3.6.1 Sampling procedure for quantitative study

The sampling frame for the quantitative phase of the study was derived from the Ghana Living Standards Survey (GLSS 7), which was conducted by the Ghana Statistical Service (GSS) in collaboration with the World Bank in 2017. The sampling frame included detailed information on enumeration area (EA) locations, the type of residence (urban or rural), and estimates of the number of residential households within each area. At the first stage, 46 EAs (17 in urban areas and 29 in rural areas) were randomly selected from the GLSS 7 master sampling frame for the Volta and Oti regions to form the primary sampling units (PSUs). The EAs were allocated into the two regions using probability proportional to population size (PPS) (32 in the Volta region

and 14 in the Oti region). In the second stage, 15 households were randomly selected from each of the chosen enumeration areas (EAs). This resulted in a total representative sample of 690 households, comprising 480 from the Volta region and 210 from the Oti region. The sample was stratified by locality, with 255 households in urban areas and 435 in rural areas, all drawn from pre-existing household lists within the EAs of the two regions to establish the secondary sampling units (SSUs). Finally, maps created for each EA cluster, along with the lists of households, were utilized to locate and sample the selected households.

3.6.2 Sampling procedure for qualitative study

Purposive sampling was adopted for the qualitative phase. Unlike quantitative studies, the number of participants for the qualitative phase was not calculated. Instead, sampling continued until data saturation was reached. Data saturation is the point in data collection where no new data, information, themes and dimensions are emerging in the interviews, and data begin to repeat without adding further depth of understanding of the issues (Saunders et al., 2018).

3.7 Data collection

Both quantitative and qualitative methods were applied to collect empirical data and all relevant information based on the objectives of the study including demographic characteristics, dietary and physical activity behaviour, food security, dietary diversity, anthropometric measurements and related determinants. Data collection was conducted using KoboToolbox. A team of fifteen experienced nutrition and public health graduates was recruited and trained as data collectors. Three nutrition professionals served as field supervisors.

3.8 Data Collection Instruments

Data collection was conducted using structured pre-tested questionnaires and interview guides administered in-person. The questionnaires were pre-tested on 15 adolescents who shared

similar characteristics with the study population in a community outside the study area. This pre-testing was essential to ensure the validity and reliability of the questionnaires prior to their use in the actual data collection. Additionally, the interview guides were pre-tested with three adolescents. The finalised instruments were then administered to respondents in the selected communities, utilizing face-to-face methods for data collection. The questionnaires included items on sociodemographic characteristics and food security to provide context for the findings on food insecurity.

Assessment of Nutrition Knowledge: Adolescents' nutrition knowledge was assessed using a questionnaire adapted from the General Nutrition Knowledge Questionnaire (GNKQ) (GNKQ) (Kliemann et al., 2016). The GNKQ is structured into four sections, each encompassing different categories of questions pertaining to nutrition and dietary choices.

Adolescent-Reported Parenting Styles: Using earlier research (den Exter Blokland et al., 2001; S. Kremers et al., 2013; S. P. J. Kremers et al., 2003; Lamborn et al., 1991; Robinson et al., 1995; Steinberg et al., 1989) a 29-item instrument was developed to assess the dimensions of parenting style, specifically warmth/involvement (subfactor 1) and strictness/demandingness/control (subfactor 2) (den Exter Blokland et al., 2001).

Perceived Parental Modelling of Healthy Eating: Adolescents' perceptions of their parents' role modelling of healthy eating were assessed using eight items. Participants reported their parents' consumption of fruits, vegetables, and low-fat snacks, as well as whether these foods were eaten during lunch, dinner, or when dining out. They also indicated if their parents drank 100% juice and used low-fat dressing and mayonnaise in their presence. Responses were measured on a 4-point Likert scale, where 1 indicated 'Never,' 2 'Hardly ever,' 3 'Sometimes,' and 4 'Usually/Always,' with higher scores reflecting greater agreement. The median score was

used to classify dietary behaviours into low and high categories. Composites for each factor were created, with parents scoring below the median classified as having unhealthy dietary behaviours and those above as having healthy behaviours.

Food security status: Food insecurity status (FIS) was assessed using the Household Food Insecurity Access Scale (HFIAS) tool developed by the USAID-funded Food and Nutrition Technical Assistance (FANTA) Project in 2006 (Coates Jennifer et al., 2007). The HFIAS instrument has been previously validated in Burkina Faso (Frongillo & Nanama, 2006) and Tanzania (Knueppel et al., 2010). The tool has nine core questions regarding food intake and the experience of food insecurity within the previous four weeks.

Dietary Diversity Score (DDS): Adolescent dietary intake was evaluated using a 24-hour recall method (FAO, 2010a; Heidari-Beni et al., 2022). Detailed information about all food and beverages consumed by adolescents in the previous 24 hours were gathered (during the day and night) whether at home or outside the home. The survey instrument consisted of 13 food groups representing commonly consumed food items in Ghana, including main meals, snacks, and beverages.

Food Frequency Questionnaire and Principal Component Analysis: A Food Frequency Questionnaire (FFQ) with 120 commonly consumed foods was used to assess dietary intake by asking adolescents to report their consumption over the past month, categorized as monthly, weekly, daily, or never. The food items were selected based on previously published FFQs tailored for Ghanaian populations (Abizari & Ali, 2019; Ogum Alangea et al., 2018). Principal Component Analysis (PCA) was employed to analyse the FFQ data and derive dietary patterns by grouping foods (14 categories) based on shared nutritional values.

Reactions to Adverts for HFSS Foods: The method for this study on children's and adolescents' reactions to advertisements for ultra-processed (HFSS) foods was adapted from Critchlow et al. (2020) (Critchlow et al., 2020). Each participant viewed marketing videos promoting high-fat, high-sugar, and high-salt (HFSS) foods. Each participant viewed marketing videos promoting HFSS foods. After each video, participants were asked if they had watched the entire advertisement (Yes/No). Those who answered “No” were given a second chance to view the video. Only participants who confirmed they had watched the advertisement proceeded to the next step, where they rated the extent to which the advert influenced their perceptions using a Likert scale.

Anthropometric measurement: Weight and height of each adolescent was collected to enable calculation of nutritional status including, stunting and weight status. The height of each participant was measured using a freestanding stadiometer (model: HM200P Charder height measurement, Charder Electronic Company Limited, USA) to the nearest 0.5cm. An Omron HBF 400 body fat monitor with a digital scale (Omron Co., Ltd, Japan) was used to measure weight of the participants to the nearest 0.1kg. Adolescent nutritional status was calculated using the WHO AnthroPlus software (AnthroPlus 2007) specifically designed for assessing the growth and nutritional status of children and adolescents aged 5-19 years. The nutritional status of the adolescents was based on the Body Mass Index (BMI) for age (BAZ) and height for age (HAZ).

Readiness to Adopt an Environmentally Sustainable Diet (RASD): Adolescent readiness to adopt a sustainable diet (RASD) was assessed using a method adapted from Culliford & Bradbury (2020) (Culliford & Bradbury, 2020). A set of nine questions addressed behaviours such as avoiding excess packaging, buying locally grown produce, consuming seasonal fruits and vegetables, limiting red and processed meat, prioritizing plant proteins (e.g., beans, nuts,

lentils), reducing air-freighted foods, choosing sustainable fish, minimizing food waste, and selecting organic produce. Each question offered six response options aligned with the stages of change from the Trans-Theoretical Model of behaviour change (Booth et al., 1993) which effectively measures an individual's readiness to adopt specific behaviours. The response options represented different stages: pre-contemplation, contemplation, planning, action, maintenance, and relapse. A composite score was calculated by assigning numeric values to the responses and summing the scores across the nine items. This score categorized participants into three levels: "Ready," "Consideration stage," and "Not ready."

Interview guides: Interview guides were used to facilitate discussions on topics pertinent to the research questions and objectives, allowing for an exploration of the various factors that influence adolescent dietary behaviour.

Data Quality Control: To minimize bias, standardized tools were employed to measure food insecurity and other variables, and trained interviewers collected the data. Random sampling helped reduce selection bias, while questionnaire validation addressed reporting bias. Data collectors and supervisors underwent three days of training, and a pretest was conducted with eligible adolescents in similar settings not involved in the study. Throughout the data collection period, supervisors provided ongoing oversight, and completed questionnaires were checked daily for completeness before collection from the data collectors.

3.9 Ethical consideration

Ethical approval for this study was granted by the Noguchi Memorial Institute for Medical Research Institutional Review Board (NMIMR-IRB), University of Ghana (NMIMR-IRB CPN 051/20-21). All participants were fully informed about the study's purpose, potential risks and benefits, and the data collection process. They were assured of confidentiality, anonymity,

and the measures in place to protect their information, as well as how the research findings would be shared. Participation was entirely voluntary. For minors under 18, both assent (via a signed form) and parental consent (via a signed consent form) were obtained. Participants aged 18 and older provided their consent by signing a consent form, indicating their understanding and willingness to participate. They could withdraw their consent at any time without providing a reason. All participant information was treated with strict confidentiality throughout the study. Identifiable data were separated from survey responses and stored in secure, password-protected files accessible only to the research team. No names or personal identifiers were used in any reports, presentations, or publications arising from the research. Data were coded using unique participant IDs to ensure anonymity. Physical documents, where applicable, were kept in locked cabinets, while digital data were encrypted and backed up on secure computers. In accordance with institutional and ethical review protocols, all data will be retained for the required retention period after completion of the PhD and subsequently destroyed through secure deletion and shredding procedures. Participants were informed that their data would be used solely for academic purposes and would not be shared with any third parties beyond what is required for scientific reporting.

Participation and withdrawal

Participation in this research was entirely voluntary, and no one was coerced or pressured to take part. Respondents had the freedom to choose whether or not to participate in the study. Those who felt uncomfortable answering specific questions could opt not to respond. Additionally, participants could withdraw from the study at any time without facing any penalties if they no longer wished to continue.

Benefits/ Risks

There were no direct risks associated with participating in this study, nor were there any direct benefits. However, the information obtained from the study would be useful in developing

interventions to promote adolescent health, improve the health delivery system, and inform policymakers. Free nutritional counselling on healthful diets was offered to every respondent after their participation in the study. Snacks were provided to compensate for the time spent participating, and periodic breaks were also given.

Conflict of Interest: The Principal Investigator had no conflicts of interest related to the study. No sponsorship was secured for this research.

Dissemination of results

The findings of this study will be disseminated through publications in reputable journals. The findings will also be made known to stakeholders in the Volta and Oti regions through seminar presentations to health workers and schools. The work will also be displayed in the University of Ghana and the University of Health and Allied Sciences libraries and the regional health directorates.

3.10 Conclusion

Detailed methods are presented in each of the results chapters.



4.0 ADOLESCENT FOOD INSECURITY AND ASSOCIATED FACTORS IN THE VOLTA AND OTI REGIONS OF GHANA: A CROSS-SECTIONAL STUDY

Abstract

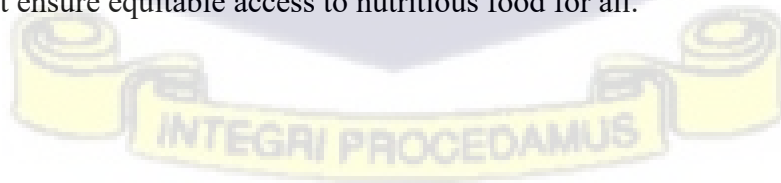
Background: Food insecurity poses a threat to adolescent nutrition and health status, especially in low- and middle-income countries (LMICs), and can have lifelong consequences. Current research overwhelmingly focuses on young children and adults, with limited focus on the experiences of adolescents.

Objectives: The present study assessed the prevalence of adolescent food insecurity in the Volta and Oti regions of Ghana, with a view to identifying the key drivers.

Methods: A community-based cross-sectional study was conducted among 667 adolescents aged 10-19 years old, in the Volta and Oti regions of Ghana. A multi-stage sampling approach was used to recruit participants, and a pretested structured questionnaire was used to collect socio-demographic characteristics data. The Household Food Insecurity Access Scale (HFIAS) was used to collect data on food insecurity status (FIS) through structured face-to-face interviews. Bivariate and Multivariable logistic regression models were used to analyse the data. The significance level was set at $p \leq 0.05$. Adolescents were classified according to the severity of their food security status: food secure, moderately food insecure, mildly food insecure, or severely food insecure.

Results: Nearly half (47.5%) of the adolescents surveyed reported experiencing months of inadequate food intake in the year leading up to the survey. The peak periods of living with limited food occurred within January-March (32.2%) and April-June (28.8%). Overall, 61% experienced food insecurity, including 23.5% who were severely food insecure. Additionally, 47.7% worried about not having enough food, and 54% could not access preferred foods due to limited resources. In addition, 50.1% ate a monotonous diet and 44.1% consumed foods that they found socially unacceptable. Regional location (aOR = 1.61; CI=1.09-2.39), rural-dwelling (aOR = 0.67; CI=0.46-0.97), maternal education (aOR=0.41; CI=0.22-0.78), and wealth (aOR=0.02; CI=0.0-0.09) predicted food insecurity.

Conclusion: The findings indicate a high prevalence of food insecurity among adolescents in the Volta and Oti regions of Ghana. This highlights the urgent need for action to ensure that all adolescents have sufficient access to nutritious food. The findings also showed seasonal variations in food insecurity, with peaks occurring in the first half of the year. Furthermore, the study identified several important predictors of food insecurity, including regional disparities, urban-rural differences, maternal education, and wealth. Efforts to reduce food insecurity among adolescents should prioritise addressing these factors and implementing comprehensive strategies that ensure equitable access to nutritious food for all.



4.1 Introduction

According to the Food and Agriculture Organisation (FAO), food security exists when all individuals, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and preferences for an active and healthy life. (FAO, 1996; Shebanina, 2023). This definition highlights a complex and multidimensional phenomenon that encompasses four main dimensions: availability; access, utilisation; and stability (FAO et al., 2021). It is influenced by factors such as the quality and safety of food products, environmental sustainability of food production, and economic availability of food (Shebanina, 2023). Food insecurity is characterised by inadequate food consumption, limited access to food, and vulnerability to shocks that affect the production and availability of food, particularly among socio-economically disadvantaged populations such as adolescents (Agbadi et al., 2017; Osarfo et al., 2016; The World Bank, 2022). Achieving food security requires addressing food availability, access, utilisation, and stability of supply, as well as livelihood security (de Pee & Pérez-Escamilla, 2023).

The economic dimension of food security is crucial, as it involves ensuring the affordability of food products and the ability of citizens to purchase necessary nutrients (Timmer, 2000). Affordability pertains to the capacity of individuals to purchase food, which is influenced by their income levels and food prices (Shebanina, 2023). Policies designed to increase real incomes and enhance agricultural technologies can improve food affordability (Shebanina, 2023). Elevated poverty levels can intensify food insecurity by restricting access to nutritious food, thereby perpetuating a cycle of malnutrition and economic instability (Kola Samuel Gomina et al., 2024; Novitasari & ., 2024). The relationship between food security and poverty is reciprocal; food insecurity can lead to increased poverty, while poverty limits access to food (Kola Samuel Gomina et al., 2024). Effective government policies are vital for balancing food production, demand, and demographic changes to ensure food security (Guliyev et al., 2024).

Economic development has a direct impact on food security, with demographic shifts influencing economic transformations that affect food availability (Guliyev et al., 2024). While economic factors are critical, environmental sustainability and food quality also play significant roles in achieving comprehensive food security, indicating that a multifaceted approach is necessary for long-term solutions.

Additionally, increasing agricultural productivity is essential for achieving food security, especially considering the challenges posed by the growing global population (Kerr, 2023). To strengthen food security, it is necessary to develop and implement effective measures, coordinate the development potential of the agrarian sector with economic and socio-ecological aspects, and prioritise principles such as self-sufficiency, social justice, and stability (Vassilopoulou, 2023). Globally, about 2.4 billion people (29.6% of the global population) were estimated to be moderately or severely food insecure in 2022, up by 391 million more than in 2019 (FAO et al., 2023). Food insecurity is most prevalent in sub-Saharan Africa. The Annual Household Income and Expenditure Survey (AHIES) in Ghana suggests that food insecurity affected nearly half (49.1%) (about 15 million people) in the first quarter of 2022 (Ghana Statistical Service, 2022). Furthermore, an estimated 12.3% were severely food insecure and 44.1% were multidimensionally poor in the first quarter of 2022. This is higher than the 11.7% food insecurity level (3.6 million people), reported in the 2020 Ghana Comprehensive Food Security and Vulnerability Analysis (CFSVA) (MoFA et al., 2020). The prevalence of food insecurity among adolescents in Ghana varies across regions and contexts. One study found that approximately 49% of adolescents in a rural district in Ghana were food insecure (Wiafe, Ayensu, et al., 2023). Another study conducted in the Mion District of Ghana's northern region reported that 70.3% of households with adolescent girls were food insecure (Azupogo et al., 2023). Additionally, a study in the Twifo-Atti-Morkwa district found that household food insecurity was significantly associated with depression among teenaged pregnant girls

(Doglikuu et al., 2023). However, its specific prevalence among adolescents in Ghana remains unknown.

Further research is needed to understand the burden of food insecurity across the adolescent population nationwide. However, existing data suggest that high levels of food insecurity are widespread, indicating a critical nutrition security issue requiring urgent programmatic and policy attention. This challenge is known to precipitate malnutrition and other adverse health outcomes (Wiafe, Apprey, et al., 2023b).

Various factors are linked with food insecurity, including household poverty, high food prices, limited agricultural productivity, insufficient access to land, inadequate infrastructure and limited access to markets (Herrera et al., 2021; Wudil et al., 2022; Yaro, 2013). Other factors include high levels of migration, low levels of education among household heads, and increased exposure to climate change-induced natural disasters such as floods and droughts, bush fire incidents, high food price inflation, and food price volatility (FAO et al., 2023; UNICEF et al., 2023). In Kenya, internal migrant households are more likely to experience inferior diets, low dietary diversity, and increased dietary deprivation compared to local households (Onyango, Crush, et al., 2023).

Furthermore, the COVID-19 pandemic and Ukraine-Russia crisis exacerbated food and nutrition insecurity in almost every country, especially in sub-Saharan Africa, by disrupting livelihoods, reducing incomes, and disrupting agricultural production and food supply chains, leading to food shortages and lower dietary diversity (Crush & Si, 2020; Nkwonta et al., 2023b; Onyango, Owusu, et al., 2023a; Onyeaka et al., 2022; Suryana et al., 2023). Such events have worsened food insecurity, food shortages, dietary diversity and malnutrition (Agamile, 2022; Diao et al., 2022; Ibukun & Adebayo, 2021; Kansime et al., 2021; Nechifor et al., 2021;

Onyango, Owusu, et al., 2023b), further amplifying existing vulnerabilities (Diao et al., 2022).

Governments and the global development community have recognised the need for urgent actions to address food insecurity as outlined in the UN Sustainable Development Goals (SDGs) 1, 2 and 3. Goal 2 (SDG2) sets targets to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture by 2030.

Food insecurity is a well-known cause of inadequate diet and malnutrition. It has detrimental effects on the quality, diversity, and adequacy of diets (Koyratty et al., 2022; Onyango, Crush, et al., 2023; Vuong et al., 2023). Research in Uganda found that households affected by major landslides had higher food insecurity scores and lower dietary diversity than control households during both food-plenty and food-poor seasons (Nahalomo et al., 2023). Similarly, in the Vietnamese Mekong Delta region, lower household diet diversity is linked to household food insecurity (Vuong et al., 2023).

In low- and middle-income countries, adolescent food insecurity has been shown to lead to chronic undernutrition, poor dietary quality, and hindered linear growth, with girls often being more affected by societal and household dynamics (Hadush et al., 2021). Food insecure adolescents are at increased risk for stunting which can have long-term health implications including mental health issues such as anxiety or depression (Masitoh et al., 2023; Moore, 2022; Sihite, 2022). This association is particularly significant in rural areas (Z. Khan & Ali, 2023; Masitoh et al., 2023). Stunting not only affects children's height but also threatens their intelligence, disease resistance, and future productivity (Hakeem et al., 2023). Furthermore, food insecurity among adolescents in LMICs has been associated with increased risk of anxiety and depression (Jebena et al., 2016). Adolescents face multiple challenges that affect their food security including poverty, lack of education, early marriage and pregnancy, gender discrimination, violence, migration, and social exclusion (Nagata et al., 2023; Nurbaya &

Najdah, 2023; Song & Kim, 2022). Adults are more likely to shield younger children from the effects of food insecurity than older children and adolescents (Coleman-Jensen, William McFall, et al., 2013).

The issues of food insecurity and health outcomes are the focus areas of the 2030 Sustainable Development Goals. Nonetheless, research at the macro level is insufficient to provide empirical evidence for this connection. The long-term health consequences of food insecurity and nutritional deprivation are often overlooked. Given these impacts, especially within rural areas, efforts to achieve household and adolescent food security must be prioritised.

However, evidence about adolescent food insecurity specifically from Ghana is limited. Previous studies have focused on children, women, and adult or adult food insecurity situations. This study aimed to determine the prevalence and predictors of adolescent food insecurity in the Volta and Oti regions of Ghana.

4.2 Methods

4.2.1 Study Design

This community-based cross-sectional study was conducted in the Volta and Oti regions of Ghana. The data were collected as part of a larger study on the factors shaping adolescents' diet diversity, food security, reaction to advertising, nutritional status, and readiness to adopt sustainable healthy diets.

4.2.2 Study Settings and Period

This study was conducted in forty-seven communities located in twenty-six districts and municipalities in the Volta and Oti regions of Ghana from August 2021 to March 2022. The Volta and Oti regions are two of the sixteen administrative regions in Ghana; they cover a total

land mass of 20,572 Km², representing 8.7 percent of the total land area of Ghana. The area stretches from the Gulf of Guinea to the south, running through all vegetation zones found in the country. It shares boundaries to the west with the Volta Lake, to the east with the Republic of Togo and to the north with the Northern region. The major economic activities in the regions are agriculture, fishing, wholesale, and retail trade.

4.2.3 Participants

The study participants were adolescents aged 10-19 years. A representative sample of 667 adolescents was sampled from both urban and rural areas within the Volta and Oti regions using a multi-stage random sampling method.

4.2.4 Sample Size Determination

The minimum sample size was calculated using Yamane's formula for population proportion, $n = N / (1 + Ne^2)$ (Yamane, 1967), where n represents the minimum sample size, e is the margin of error set at 5%, and N is the projected adolescent population in the two regions, which was estimated to be 589,513 in 2020. The calculated sample was multiplied by a design effect of 1.5, as a multi-stage sampling technique was used, and a 10% non-response rate was added. Accordingly, the total estimated sample size was 667.

4.2.5 Sampling Technique and Procedures

These enumeration areas (EAs) were drawn from the 2017 Ghana Living Standards Survey round 7 (GLSS 7) master sampling frame. The sampling employed a two-stage stratified sampling design. Forty-six (46) enumeration areas (EAs) from a total of ninety-six enumeration areas were selected to form the Primary Sampling Units (PSUs). The PSUs were allocated into the two administrative regions using probability proportional to population size (PPS). The EAs were further divided into urban and rural localities of residence. A complete listing of

households in the selected PSUs was used as to the Secondary Sampling Units (SSUs). At the second stage, fifteen households from each PSU were systematically selected. The total sample size came to 675 adolescents in the two regions.

4.2.6 Inclusion and Exclusion Criteria

4.2.6.1 Inclusion Criteria

Adolescents aged between 10 and 19 years, resident in the Volta or Oti regions, who indicated willingness to voluntarily participate in the study, were eligible for this study.

4.2.6.2 Exclusion Criteria

Adolescents who met the inclusion criteria but were unwilling or unable to provide informed consent/assent, adolescents who were critically ill or had cognitive or physical disabilities impacting their ability to participate, institutionalisation (e.g. prison, hospitalisation), and adolescents who had insufficient linguistic fluency to complete study procedures/questionnaires were excluded.

4.2.7 Data Collection Tool and Procedures

Data for the study were collected using structured, pretested questionnaires administered in-person. The questionnaires included items on sociodemographic characteristics and food security to provide context for the findings on food insecurity. Data collection was conducted using KoboToolbox. A team of fifteen experienced nutrition and public health graduates was recruited as data collectors, with three nutrition professionals serving as supervisors. Interviews with adolescents were carried out in their homes to safeguard their privacy while also ensuring confidentiality.

4.2.8 Variables and Measures

Food security status: Food insecurity status (FIS) was assessed using the Household Food Insecurity Access Scale (HFIAS) tool developed by the USAID-funded Food and Nutrition Technical Assistance (FANTA) Project in 2006 (Coates Jennifer et al., 2007). The HFIAS instrument has been previously validated in Burkina Faso (Frongillo & Nanama, 2006) and Tanzania (Knueppel et al., 2010). The tool has nine core questions regarding food intake and the experience of food insecurity within the previous four weeks. The questions were asked in local Ghanaian languages or in English. This method is based on the idea that the experience of food insecurity (access) causes predictable reactions and responses that can be captured and quantified through a survey and summarised on a scale. The HFIAS measures the access component of food insecurity, and the degree of uncertainty or anxiety involved in its acquisition. These questions can be used to distinguish food secure from food insecure (Coates et al., 2007), capturing information on food shortage (insufficient food intake), quality of diet (insufficient quality, variety, preferences, and social acceptability), and the physical consequences to determine the status of a given household's access to food (Swindale and Bilinsky, 2006; Carletto et al., 2013). Core questions were used to capture the range of food insecurity from food shortage (insufficient food intake), the anxiety of running out of food, compromise on quality or variety of diet (insufficient quality, variety, preferences, and social acceptability), and physical consequences (cutting down the portion size, disrupted eating patterns, and sleeping hungry) (Swindale and Bilinsky, 2006; Carletto et al., 2013). Each question was used to assess whether the condition or behaviour occurred at any time during the previous four weeks (30 days). The severity or frequency of the experience of each of the nine items was assessed on a 3-point Likert scale (1 = Rarely, 2 = Sometimes, 3 = Often). Food insecurity was measured using a continuous scale. Sociodemographic factors were categorical variables. Dietary behaviours were measured using Likert scales.

4.2.9 Data Quality Control

To minimise bias, standardised tools were used to measure food insecurity and other variables. Trained interviewers collected data. Selection bias was minimised through random sampling. Reporting bias was reduced through questionnaire validation. The data collectors and supervisors underwent a three-day training session. A pretest was conducted on eligible adolescents in comparable settings that were not involved in the research. Throughout the data collection period, supervisors and researchers provided thorough supervision. Completed questionnaires were checked daily before collection from the data collectors. The administered questionnaires were checked for completeness before being collected from the data collectors on a daily basis. **Missing data were primarily handled using pairwise deletion for descriptive statistics and Full Information Maximum Likelihood (FIML) estimation for regression models, assuming the data were Missing At Random (MAR).**

4.2.10 Data Processing and Analysis

Data were entered into EpiData and exported to STATA version 17 software for analysis. Sociodemographic characteristics were considered as independent variables. The food insecurity access scale (FIAS) score was determined for each adolescent. To calculate the FIAS score, responses were coded based on frequency of occurrence, with a maximum score of 27 indicating severe food insecurity and a minimum score of 0 indicating food security. The FIAS score was then derived by summing the coded responses for each question. For example, if an adolescent answered “often” to several questions, they received higher scores, reflecting greater food insecurity. Frequencies, means, and percentages were used to summarise the results. Logistic regression was used to identify predictors of food insecurity. Bivariate and Multivariate logistic regression models were used to analyse the data. The significance level was set at $P \leq 0.05$. All analyses were conducted using the Stata software (StataCorp., 2021). Adolescents were classified according to the severity of their food security status into food

secure, moderately food insecure, mildly food insecure, or severely food insecure. Individuals were classified as food secure if the individuals responded ‘no’ to all the items and insecure if the individuals responded ‘yes’ to at least one of the nine items included on the HFIAS tool. Voluntary fasting or dieting to lose weight was thereby excluded from the measure. All individual scores were summed into composite scores. Adolescents were categorised into four groups based on their composite scores: “food secure,” “mildly food insecure,” “moderately food insecure,” and “severely food insecure” (Coates Jennifer et al., 2007; Nurbaya & Najdah, 2023). Adolescents who scored 0 and 1 were grouped as “food secure”, those who scored from 2 to 8 were categorized as “mild Food insecure” mild food insecure, 9 to 16 were termed as moderately food insecure, and seventeen above were classified as being severely food insecure. A reliability coefficient (alpha) of 0.72 was obtained.

4.3 Results

4.3.1 Prevalence and categories of food insecurity among adolescents

Table 4.1 presents the results of the food security assessment among adolescents in the Volta and Oti regions of Ghana. In total, 667 eligible adolescents participated in this study, and 317 (47.5%) reported experiencing months within the past year when they did not have enough food to meet their family's needs. The distribution of these months was as follows: January-March (32.2%), April-June (28.8%), July-September (23.3%), and October-December (15.6%). Whereas 32.8% of the adolescents reported having enough of their preferred foods, 28.7% reported having enough food, but not always the kinds or varieties of food preferred. Additionally, 13.8% reported sometimes not having enough food to eat, and 24.7% often experienced insufficient food.

Further, almost half of the adolescents (47.7%) reported being worried or concerned that they would not have enough food to eat or sufficient food to meet their needs, and more than half

(54%) of adolescents reported being unable to consume or afford the kinds of foods they preferred due to resource constraints. Adolescents resorted to using a variety of strategies to cope with food insecurity. In addition, about half (50.1%) of the adolescents reported eating a limited variety of foods (monotonous diet) and 44.1% reported eating certain foods that they did not want to eat or eating foods that they found socially unacceptable because they lacked the resources to acquire other types of food. Due to limited financial means or food unavailability, about two-thirds of adolescents (66.6%) reported reducing the size of meals and 34.8% reported eating fewer meals (skipping meals) each day because there was not enough food. About 33% of adolescents reported having no food of any kind (running out of food) available in their households due to resource constraints, leaving them without any food while 22.5% experienced going without eating for an entire day and night due to insufficient food or financial resources. Regarding food security status, 39% of the sampled adolescents were classified as food secure, indicating consistent access to enough food to meet their needs. However, 61% of adolescents experienced food insecurity and these were either mildly food insecure (22.0%), moderately (15.4%) or severely (23.5%) food insecure.

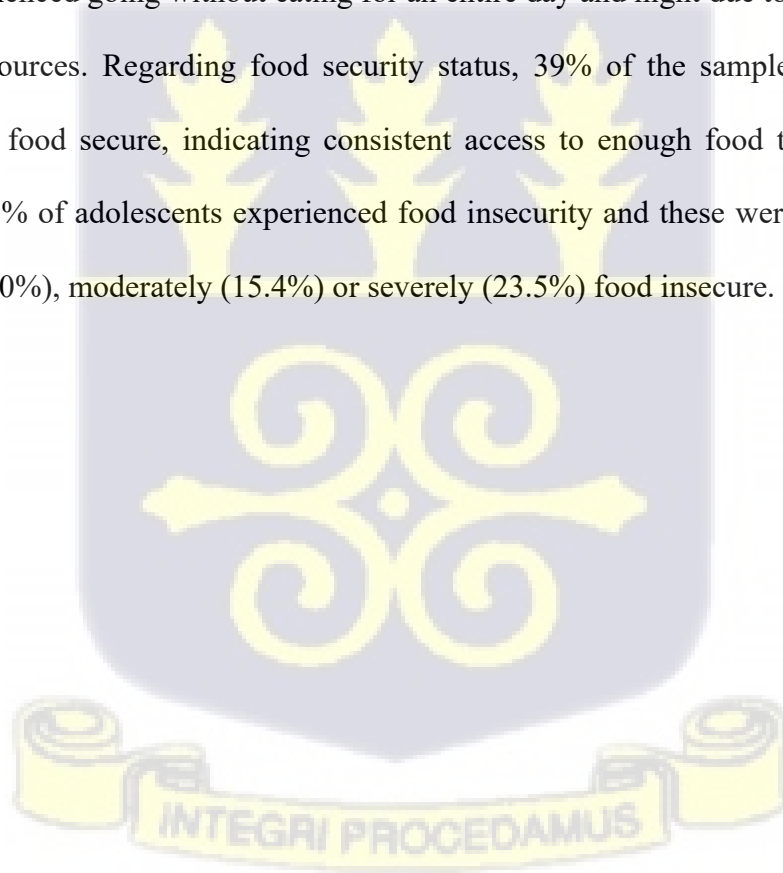


Table 4.1: Prevalence of Adolescent Food Insecurity

Variable	Food security status	
	Frequency	Percentage
Over the last 12 months there were months when there was not enough food to meet your family needs	317	47.5
Months (in the past 12 months) in which you did not have enough food to meet your family's needs.		
<i>January-March</i>	102	32.2
<i>April-June</i>	91	28.8
<i>July-September</i>	74	23.3
<i>October-December</i>	50	15.6
Description of the food eaten in your household in the last 12 month.		
<i>Enough of the kinds of food we want to eat</i>	219	32.8
<i>Enough but not always the kinds of food we want</i>	191	28.7
<i>Sometimes not enough to eat</i>	92	13.8
<i>Often not enough to eat</i>	165	24.7
WORRIED: In the last four weeks you were worried you would not have enough food to eat	318	47.7
HEALTHY: In the last four weeks you were unable to eat the kinds of food you preferred due to a lack of resources.	360	54.0
LIMITED VARIETY: You ate a limited variety of foods (monotonous diet) due to a lack of resources	334	50.1
UNDESIRABLE FOOD: You ate some foods that you really did not want to eat (socially unacceptable food) because of a lack of resources to obtain other types of food	294	44.1
You cut the size of meals/ ate smaller meals/ skipped meals in either the morning, afternoon or evening because there was not enough money or food	444	66.6
You ate fewer meals in a day because there was not enough food.	232	34.8
You had no food to eat of any kind (run out of food) because of lack of resources to get food.	221	33.2
You went without eating a whole day and night because there was not enough food or enough money for food.	150	22.5
You went to sleep at night without eating	213	31.9
Food security status		
<i>Food secure</i>	260	39.0
<i>Food insecure</i>	407	61.0
<i>Mildly food insecure</i>	147	22.0
<i>Moderately food insecure</i>	103	15.4
<i>Severely food insecure</i>	157	23.5

4.3.2 Factors associated with adolescent food insecurity

The findings presented in Table 4.2 suggest that regional disparities are associated with food insecurity. Adolescents in the Volta region had a higher likelihood of being food insecure compared to the Oti region (aOR = 1.61; CI=1.09-2.39). Additionally, urban residence was associated with reduced odds of food insecurity, with urban dwellers being 67% less likely to experience food insecurity compared to rural areas (aOR = 0.67; CI=0.46-0.97). Higher maternal education level was associated with lower odds of food insecurity, with mothers who had completed Junior High School (aOR=0.41; CI=0.22-0.78) and Senior High School (aOR=0.38; CI=0.19-0.75) exhibiting significantly lower odds of food insecurity than those with no formal education. Additionally, higher wealth quintiles were significantly associated with lower odds of food insecurity, with the second (aOR=0.15; CI=0.03-0.67), third (aOR=0.05; CI=0.01-0.21), and fourth (aOR=0.02; CI=0.0-0.09) wealth quintiles showing lower odds of food insecurity. These findings highlight the importance of parental education and economic status in determining food security.

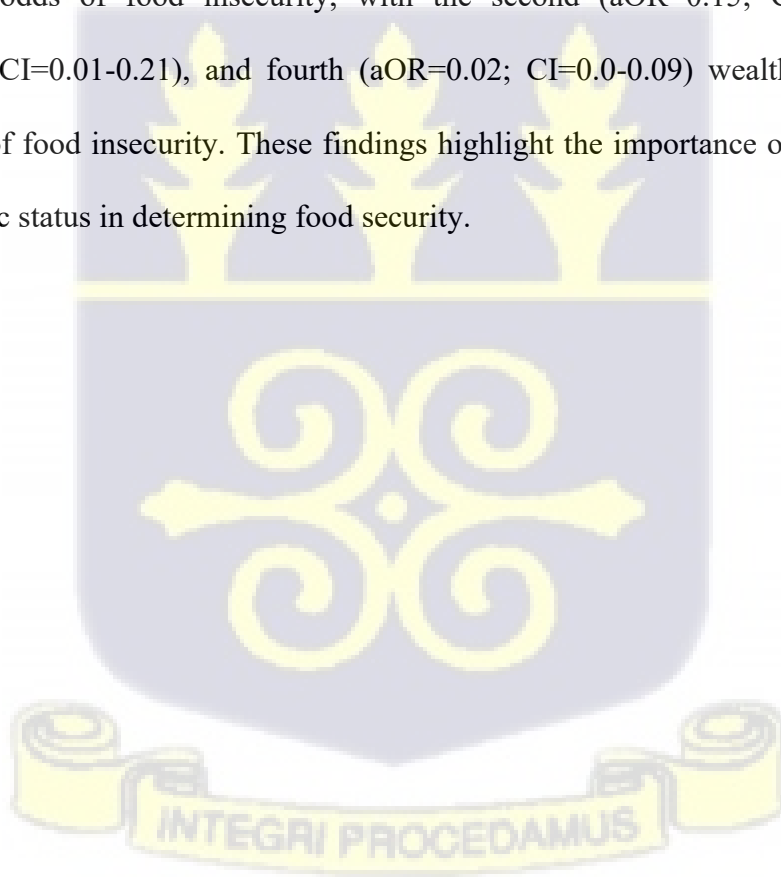


Table 4.2: Food security and its associated factors

Variable	Food security		X ² (p-value)/Fisher's exact	cOR (95% CI), p-value	aOR (95% CI), p-value
	Insecure 407(61%)	Secure 260(39%)			
Region			12.566(<0.001) **		
Oti	101(50.8)	98(49.2)		Ref	Ref
Volta	306(65.4)	162(34.6)		1.83(1.31-2.56), <0.001 **	1.61(1.09-2.39), 0.017 **
Gender			0.015(0.903)		
Female	243(61.2)	154(38.8)		Ref	
Male	164(60.7)	106(39.3)		0.98(0.71-1.35), 0.903	
Age			0.570(0.752)		
10-14	154(62.9)	91(37.1)		Ref	
15-17	172(59.7)	116(40.3)		0.88(0.62-1.24), 0.459	
18-19	81(60.5)	53(39.5)		0.90(0.59-1.39), 0.644	
Religion			3.597(0.166)		
Christianity	345(60.2)	228(39.8)		Ref	
Islam	36(60.0)	24(40.0)		0.99(0.58-1.71), 0.975	
Traditionalist	26(76.5)	8(23.5)		2.15(0.96-4.83), 0.064	
Residence			16.277(<0.001) **		
Rural	282(66.8)	140(33.2)		Ref	Ref
Urban	125(51.0)	120(49.0)		0.52(0.37-0.71), <0.001 **	0.67(0.46-0.97), 0.036 **
Parental status			6.045(0.049) **		
None	20(74.1)	7(25.9)		Ref	
Single parent	93(67.9)	44(32.1)		0.74(0.29-1.88), 0.526	
Dual parent	294(58.5)	209(41.5)		0.49(0.20-1.19), 0.114	
Educational level			18.722(0.001) **		
None	28(82.4)	6(17.7)		Ref	Ref
Primary	72(69.9)	31(30.1)		0.49(0.19-1.32), 0.162	1.28(0.37-4.40), 0.698
JHS/JSS	174(63.0)	102(37.0)		0.37(0.15-0.91), 0.031 **	1.39(0.42-4.53), 0.590
SHS/SSS	123(51.9)	114(48.1)		0.23(0.09-0.58), 0.002 **	1.13(0.35-3.68), 0.841
Tertiary	10(58.9)	7(41.1)		0.31(0.08-1.13), 0.076	1.24(0.26-6.01), 0.785
Marital status			2.008(0.156)		
Never married	381(60.4)	250(39.6)		Ref	

Married/living together	26(72.2)	10(27.8)	1.71(0.81-3.59), 0.161	
Mother's occupation			32.152(<0.001) **	
Artisan	23(76.7)	7(23.3)	Ref	Ref
Professional	124(77.0)	37(23.0)	1.01(0.41-2.57), 0.966	1.59(0.52-4.87), 0.411
Office worker	36(59.0)	25(41.0)	0.44(0.16-1.18), 0.102	1.13(0.34-3.68), 0.844
Trader	183(56.1)	143(43.9)	0.39(0.16-0.93), 0.034 **	0.96(0.33-2.78), 0.944
Farmer	41(46.1)	48(53.9)	0.26(0.10-0.67), 0.005 **	1.12(0.25-5.10), 0.881
Mother's educational level			38.140(<0.001) **	
No formal educational	102(79.7)	26(20.3)	Ref	Ref
Basic	117(66.1)	60(33.9)	0.49(0.29-0.85), 0.010 **	0.41(0.22-0.78), 0.007 **
JHS	94(58.0)	68(42.0)	0.35(0.21-0.59), <0.001 **	0.48(0.26-0.89), 0.022 **
SHS	56(48.7)	59(51.3)	0.24(0.14-0.43), <0.001 **	0.38(0.19-0.75), 0.005 **
Tertiary	38(44.7)	47(51.3)	0.21(0.11-0.38), <0.001 **	0.35(0.09-1.20), 0.095
Father's occupation			30.817(<0.001) **	
Artisan	36(66.7)	18(33.3)	Ref	Ref
Professional	168(72.7)	63(27.3)	1.33(0.71-2.52), 0.375	1.40(0.64-3.09), 0.403
Office worker	46(66.2)	24(33.8)	0.58(0.28-1.17), 0.125	1.22(0.51-2.89), 0.658
Trader	47(66.2)	24(33.8)	0.98(0.46-2.07), 0.956	2.11(0.86-5.19), 0.104
Farmer	110(48.9)	115(51.1)	0.48(0.26-0.89), 0.020 **	1.77(0.81-3.87), 0.153
Household size			1.939(0.585)	
<4	55(64.7)	30(35.3)	Ref	
4-5	142(63.4)	82(36.6)	0.94(0.56-1.59), 0.830	
6-7	104(59.4)	71(40.6)	0.79(0.47-1.37), 0.413	
8+	106(57.9)	77(42.1)	0.75(0.44-1.28), 0.292	
Wealth quintiles			114.94(<0.001) **	
First	78(97.5)	2(2.5)	Ref	Ref
Second	94(83.2)	19(16.8)	0.13(0.03-0.56), 0.007 **	0.15(0.03-0.67), 0.013 **
Third	152(58.9)	106(41.1)	0.04(0.01-0.15), <0.001 **	0.05(0.01-0.21), <0.001 **
Fourth	83(38.4)	133(61.6)	0.02(0.0-0.07), <0.001 **	0.02(0.0-0.09), <0.001 **

4.4 Discussion of findings

4.4.1 Prevalence of household food insecurity

The findings of this study show that food insecurity is a prevalent issue among adolescents in the Volta and Oti regions of Ghana, with nearly half of the respondents reporting periods of insufficient food in the past year. The findings showed that in the 12 months preceding the study, a high proportion of adolescents faced challenges related to food unavailability and meeting their desired food preferences. The study found that food insecurity experiences may vary throughout the year, with higher levels during January-March and April-June. The study also assessed food adequacy, which refers to having sufficient food to meet nutritional needs. A substantial proportion of adolescents experience challenges in accessing food that meets their nutritional needs and preferences. This resulted in adolescents resorting to various coping strategies, such as compromising dietary variety and cutting meal sizes. Extreme situations, including running out of food entirely, were reported by a substantial number of participants. Concerns about inadequate or insecure access to food have become increasingly prevalent in recent years, due to challenges such as climate change, economic inequality, economic slowdowns and the global COVID-19 pandemic which have exacerbated existing issues related to food security and nutrition (Alaimo et al., 2020; FAO et al., 2023; Kakaei et al., 2022). Nutritional inadequacy during critical growth periods can have long-lasting effects, impair cognitive, brain development, and affect developmental trajectories (Pai & Bahadur, 2020).

These issues are particularly significant in developing countries, where malnutrition and micronutrient deficiencies are prevalent (Dewi Pangestuti et al., 2023; Zaheer et al., 2023). The findings showed that food insecurity is a public health problem among adolescents in Ghana. These findings align with previous research that reported elevated levels of food insecurity among school-going adolescents in Ghana, with rates of 57.8% (Seidu et al., 2020). A report by Masa and Chowa also showed that more than 60% of adolescents in Ghana were from food-

insecure households (Masa & Chowa, 2021). Other studies conducted in both high-income (Bruening et al., 2016; L. M. Morris et al., 2016) and low-income countries (McRell et al., 2022; Swahn et al., 2012) have reported elevated levels of food insecurity among school-going adolescents. These findings highlight that food insecurity among adolescents is a global concern that requires attention. However, despite their evident vulnerability to food insecurity, adolescents remain understudied in food security research compared to younger children and adults. While parents typically shield children from the impact of food insecurity (Coleman-Jensen et al., 2019), research indicates that younger children tend to receive more protection from adults than older children or adolescents in the context of food insecurity (Coleman-Jensen, McFall, et al., 2013). These high food prices are a result of slow adjustment on the supply side, as the agri-food system in sub-Saharan Africa is characterised by significant seasonal price variations (Abokyi et al., 2020).

The results of this study also confirm that seasonality imposes significant fluctuations in adolescent food security. The findings from this study also show that seasonality affects adolescents' food security in the two regions. Adolescents were found to experience deterioration in food security during the lean season. This is similar to another report on the effects of seasonality on food security and dietary diversity in northern Ghana (Abizari et al., 2017). The lean period in Ghana indeed coincides with the dry season, which typically falls between January and May. During this time, food availability and accessibility are reduced, leading to increased food insecurity. In Ghana, the lean season, from January to June, significantly exacerbates food insecurity, particularly in vulnerable populations. The lean season, from to June, is associated with heightened food insecurity and increased risk of severe acute malnutrition (SAM) in children (Nonterah et al., 2022). This period, often referred to as the hunger season, is associated with increased rates of severe acute malnutrition (SAM) in children, especially in regions like the Guinean Sahelian ecological zone, where SAM

prevalence peaks during this time (Venkat et al., 2023). The availability of nutritious food diminishes, creating a gap between dietary needs and food supply (Kubuga & Siensio, 2024a). The lean period during the dry season is a critical time for vulnerable populations, particularly in rural areas, where access to nutritious food is already limited. Seasonal migration emerges as a common coping strategy among impoverished households facing food shortages (Dzudzor et al., 2024). Research indicates that this period is marked by low agricultural productivity due to climate variability, which significantly impacts crop yields and food supply chains resulting (Osman, 2023; Philip Osei et al., 2022). Consequently, limited food availability arises as the agricultural sector struggles to meet demand, leading to higher food prices as market supply diminishes (Afele et al., 2022; Osman, 2023).

The combination of these factors culminates in increased food insecurity, particularly among vulnerable populations who lack access to adequate resources and coping mechanisms (Osman, 2023; Philip Osei et al., 2022). Furthermore, the reliance on rain-fed agriculture in many regions makes food production particularly susceptible to the adverse effects of climate change, further compounding the challenges faced during the dry season (Philip Osei et al., 2022). Thus, the lean period in Ghana is indeed characterised by low agricultural productivity, limited food availability. During the lean season, which often coincides with the beginning of the rainy season in many low-income countries, food stocks from the previous harvest are depleted, markets become inaccessible, food prices reach their peaks, wages plummet, and income-generating avenues become limited, worsening the food insecurity situation (Bonuedi et al., 2022; Stephanie Brunelin & Jonathan Lain, 2022; World Food Program USA, 2021). De Jager et al. highlighted the importance of considering seasonality in nutrition-sensitive farming in rural Northern Ghana to ensure enhanced availability of vegetables and fruits throughout the year and year-round nutritious diet (de Jager et al., 2023). To mitigate these challenges, sustainable agricultural practices and community-based interventions are essential to enhance

food access and nutrition during the lean season (Aferiba Tandoh et al., 2024a; Kubuga & Sienso, 2024a). Addressing these issues is crucial for improving food security and health outcomes in Ghana.



CHAPTER FIVE

5.0 ADOLESCENT DIETARY DIVERSITY AND THE INFLUENCE OF PARENTING STYLES, PARENTAL ROLE MODELLING IN TWO REGIONS OF GHANA

Abstract

Background: Dietary diversity is a qualitative indicator of diet quality. Optimal dietary diversity is linked with nutritional wellbeing and health outcomes. However, there is a lack of evidence regarding the eating habits and dietary diversity of adolescents in the Volta and Oti regions of Ghana. This study seeks to determine adolescent dietary diversity and its predictors in the Volta and Oti regions of Ghana, examining the influence of parenting styles and parental role modeling on dietary diversity. The findings will inform evidence-based strategies to promote healthy eating habits and optimal nutrition among young people.

Methods: A cross-sectional study design involving 667 adolescents in the Volta and Oti regions of Ghana was used. A two-stage sampling technique was used to select respondents for face-to-face interviews. Individual dietary diversity score (DDS) was estimated using 24-hour dietary recall data from previous day. Linear regression analysis was conducted to determine the factors associated with dietary diversity by modelling the DDS outcome.

Results: The mean age of participants was 15.1 (± 2.5) years, and the mean dietary diversity score was 5.3 ± 2.5 on a scale of 0 to 12. Most adolescents (63.3%) had inadequate dietary diversity (< 5 food groups), and 16% had low DDS scores (fewer than 4 food groups). The dietary patterns were dominated by starchy staples; $>90\%$ of adolescents consumed cereals and grains, and 84% consumed roots and tuber foods in the 24 hours preceding the survey. Consumption of animal-source foods was low; 16.2% consumed fish or shellfish products; 12.7% consumed meat, or chicken; 7.5% consumed dairy products; and 6.8% consumed eggs. Plant-source proteins, including beans, peas, lentils, and nuts, were consumed by 68.2%. However, only 53% consumed vegetables, and 43.2% consumed fruits. Several socioeconomic and behavioural factors were associated with DDS. Adolescents from permissive households (OR=0.32, 95% CI: 0.16-0.63), those with busy lifestyles (OR = 11.9, 95% CI = 1.99-70.91), and those lacking cooking skills (OR =0.35, 95% CI: 0.13-0.95) were more likely to have inadequate diets. In contrast, adolescents living in urban settings (OR=2.08, 95% CI: 1.29-3.35) and those with high nutrition knowledge (OR=3.77, 95% CI: 2.09-6.81) had higher odds of achieving adequate dietary diversity.

Conclusion: The findings indicate that enhancing dietary diversity among adolescents in low- and middle-income countries, such as Ghana, necessitates a multifaceted approach addressing both individual, household, and socioeconomic barriers and environmental factors. This includes focusing on parenting styles, adolescent nutrition knowledge and food costs, which hinder access to diverse food sources. Parental training, adolescent training in nutrition, economic support and higher income levels can help to improve dietary diversity.

5.1 Introduction

Adolescence is a critical yet often overlooked period of life characterised by rapid physical, physiological, mental, emotional, and social development, and the onset of secondary sexual characteristics. These changes can put adolescents at risk of malnutrition and deficiencies in essential micronutrients (Jusni et al., 2022; Moore Heslin & McNulty, 2023b). Adolescence is the second window of opportunities for growth. It is also a period of psychosocial development and the establishment of lifelong dietary and lifestyle habits. adolescent nutritional requirements are higher than any other life stage. Adolescents are a particularly nutritionally vulnerable population due to their higher physiological demands mainly related to the growth spurt (Zemene et al., 2019). Adolescent dietary habits and behaviours are therefore crucial for overall health and well-being (Das et al., 2018a; Moore Heslin & McNulty, 2023c). However, the quality of the diet consumed by adolescents often deteriorates significantly (Abizari & Ali, 2019b; R. Annan et al., 2022b; Hormenu, 2022b; Jusni et al., 2022). Unhealthy diets remain a leading risk factor for adolescent morbidity and mortality (Black et al., 2013a; Christian & Smith, 2018b).

Diverse diets that incorporate a wide variety of nutrient-dense foods between and within food groups have been shown to increase the likelihood of meeting micronutrient requirements and reduce the risk of noncommunicable diseases (Hanley-Cook et al., 2024a). Regular consumption of a variety of foods from different food groups is required to adequately meet nutrient requirements. Dietary diversity refers to the variety of foods or food groups consumed over a reference period. Eating a variety of foods is a key recommendation of food-based dietary guidelines. Studies have shown that higher dietary diversity is associated with improved dietary quality (Heidari-Beni et al., 2022; Kennedy et al., 2007; Mirmiran et al., 2004). Inadequate dietary diversity is a leading cause of malnutrition among adolescents (Wiafe, Apprey, et al., 2023c). The Ghana Food-Based Dietary Guidelines recommend that every day, individuals

consume a variety of foods from the six food groups to ensure optimal nutrition (Ministry of Food and Agriculture & University of Ghana School of Public Health, 2023). Eating a diverse diet, which includes a variety of foods from different food groups, ensures that the body receives all essential nutrients (Hu et al., 2022). Adequate diets allow adolescents to experience catch-up growth after stunting in their early childhood. In contrast, inadequate nutrition, including limited dietary diversity, during this stage can have short- and long-term consequences and increase the risk of nutritional deficiencies (Destaw et al., 2021; Mak et al., 2019). Failure to achieve optimal nutrition during this critical stage can result in stunted linear growth and increased susceptibility to obesity and nutrition-related chronic disorders, both present and later in life (Das et al., 2017a; Lassi et al., 2017b). Social and economic disadvantages as well as environmental factors may further exacerbate this vulnerability (Zemene et al., 2019).

Parenting styles and parental role modelling of healthy eating significantly influences dietary diversity among adolescents. Research indicates that authoritative parenting fosters healthier eating habits and greater dietary diversity among adolescents, while authoritarian styles may enforce adherence to dietary guidelines for specific food groups (Hübner & Bartelmeß, 2024). This dynamic is essential in shaping adolescents' dietary behaviors and overall health. While authoritative parenting may encourage open communication and autonomy, leading to healthier food choices and greater dietary diversity among adolescents, authoritarian parenting may result in compliance with dietary rules but can also lead to unhealthy eating patterns, particularly a preference for sugar-rich foods (Ardakani et al., 2024a; Hübner & Bartelmeß, 2024). Evidence further suggests that effective parental role modelling and supportive food-related practices can foster better dietary choices, thereby improving adolescents' nutritional status and reducing the risk of non-communicable diseases (Dello Russo et al., 2023; Gondi et al., 2022). Thus, understanding the dynamics of parenting styles and their impact on dietary

diversity is vital for developing targeted interventions to promote healthier eating habits among adolescents. Current evidence suggests that adolescents in Ghana do not meet the recommended dietary requirements, including insufficient fruit and vegetable consumption and intake of animal source foods (Abizari & Ali, 2019a; Liguori et al., 2022a; Ogum Alangea et al., 2018; Wiafe, Apprey, et al., 2023b). Consumption of unhealthy foods has been reported among adolescents in Ghana (Abizari & Ali, 2019; Annan et al., 2022; Hormenu, 2022). This study explores the relationships between parenting styles, parental role modelling, and dietary diversity among adolescents, with a focus on understanding how these factors influence adolescents' eating habits and promote healthy dietary patterns.

5.2 Methods

5.2.1 Study Setting

This study was conducted in the Volta and Oti regions of Ghana in 2021. The Volta and Oti regions are two of the sixteen administrative regions of Ghana located along the eastern border of Ghana. The regions are located west of the Republic of Togo, east of Lake Volta, bordered by the Gulf of Guinea to the south, the Northern Region to the north, the Bono East Region to the west, and to the northwest by the Savannah Region (Figure 5.1). The two regions were created out of the erstwhile Volta region in February 2019. In total, the two regions cover a land area of 20,570 km², representing 8.6% of Ghana, and lie between latitudes 5° 45'N and 8° 45'N. The Volta Region has seventeen administrative units; Ho is its administrative capital. This region is mainly occupied by the Ewe ethnic group. The Oti Region has eight administrative municipal and district assemblies, with Dambai as its capital. The Oti Region is multi-ethnic and multilingual and includes the Akan and Guan people; the Lolobi, Likpe, Akpafu, Buem, and Nkonya people; and the Krachis, Adeles, Kotokolis, and Kokombas. The main occupations include farming, livestock rearing, trading, and fishing, whereas others are employed in state-owned and private institutions. The area experiences bimodal rainfall regime

that peaks between July and September. The main rainy season occurs between May and August and the minor rainy season occurs between September and October. Between the rainy seasons, there is a prolonged dry season, culminating in dry Harmattan between November and February. The average annual rainfall ranges from 1,168 to 2,103 mm. The northern belt has a much more arid climate than the southern areas. More than half of the land area of the Volta and Oti Regions fall within the Volta River Basin, with the Volta Lake and its tributaries (rivers Oti, Asokwakaw, Mema, Dayi) draining a substantial portion of the regions.

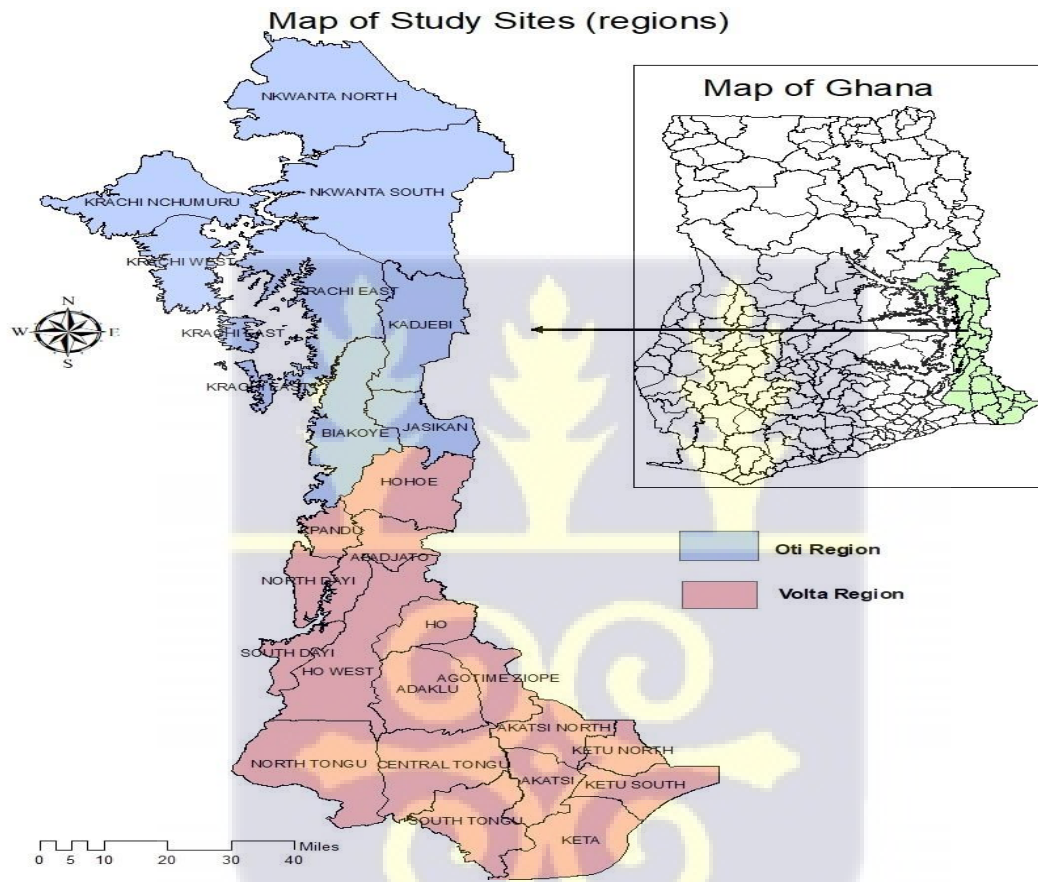


Figure 5.1: Map of Ghana showing the Volta and Oti regions, administrative districts, and municipalities.

5.2.2 Study Design

This was a community-based cross-sectional study that involved the collection of quantitative data. The study was reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cross-sectional studies. This study was part

of a larger study called “Drivers of adolescent diets, food security, nutritional status and their readiness to adopt sustainable healthy diets.”

5.2.3 Study Participants

Adolescents aged 10-19 years, living in the Volta and Oti regions of Ghana. A total of 667 adolescents aged 10-19 years were recruited for this study.

5.2.4 Inclusion Criteria

The study included all adolescents aged between 10 and 19 years residing in the Volta and Oti regions, who expressed a willingness to participate in the study by providing voluntary assent with parental consent. For those below 18 years of age, it was necessary to have both parental consent and adolescents’ own approval. Adolescents older than 18 years of age were required to provide voluntary consent.

5.2.5 Exclusion Criteria

Adolescents with physical disabilities that could affect anthropometric measurements or BMI calculations were excluded from participation, as well as individuals who refused to consent or consent without proper permission from their parents.

5.2.6 Sample Size Determination

The sample size was estimated using Yamane’s formula, $n = N \div (1 + Ne^2)$, for population proportion (Yamane, 1967). The sample size calculation considered the projected adolescent population of 589,513 in the Volta and Oti regions in 2020. It also factored-in at a confidence level of 95% with a standard value of 1.96 and the population proportion representing the prevalence of adolescent overweight and obesity was 14.7% (Aryeetey et al., 2017a). The margin of error set at 5% was considered, a design effect coefficient of 1.5 to cater to any

potential biases caused by clustering within the sampling process and a 10% non-response rate were chosen resulting in a final sample size of 667.

5.2.7 Sampling Procedure

The sampling process was based on the 2017 Ghana Living Standards Survey round 7 (GLSS 7) master sampling frame and utilized a two-stage stratified sampling design. In the first stage, 46 enumeration areas (EAs) out of a total of 96 were selected as the Primary Sampling Units (PSUs). These PSUs were allocated to the two administrative regions using probability proportional to population size (PPS). The selected EAs were then stratified by urban and rural localities. In the second stage, a complete listing of households within each PSU was compiled, and 15 households were systematically selected as the Secondary Sampling Units (SSUs). This approach resulted in a total sample size of 675 adolescents across the two regions.

5.2.8 Data Collection Procedure

Data were collected using a structured, pre-tested, and interviewer-administered questionnaire. Data were collected using the Kobo Toolbox software. The questionnaire was divided into five sections: sociodemographic characteristics, nutritional knowledge, parenting styles, parental role modelling of healthy eating, 24-hour dietary recall, and perceived barriers to dietary adequacy. Before data collection, the instrument was pretested among 15 adolescents with similar characteristics to ensure validity and reliability. Six trained nutrition graduates under the supervision of the Principal Investigator conducted the interviews in English, Ewe, Twi, or other languages, as required. Health education sessions were organized for adolescents after data collection in each community. The data were collected between August 2021 and March 2022.

5.2.9 Data collection tools

Assessment of Nutrition Knowledge: Adolescents' nutrition knowledge was assessed using a questionnaire adapted from the General Nutrition Knowledge Questionnaire (GNKQ) (GNKQ) (Kliemann et al., 2016). The GNKQ is structured into four sections, each encompassing different categories of questions pertaining to nutrition and dietary choices. The questions included a section focused on recommendations from experts and adherence to dietary guidelines. In this section, participants were required to respond to questions related to general recommendations advocated by experts and adhering to dietary guidelines for diverse food groups.

For instance, participants were asked whether experts recommend increasing or decreasing consumption of fruits and vegetables? The second section delved into a more detailed understanding of specific foods and their nutrient content. Participants were required to identify which nutrients have the most calories for the same weight of food. In the third section (identifying healthier food options) participants were presented with various meal choices, desserts, or different ways of preparing food, all aimed at gauging their ability to identify healthier dietary options. Lastly, in the fourth section focused on physical activity, respondents were assessed on their comprehension of recommended levels of moderate-to-vigorous intensity physical activity - reflecting an intricate exploration into participants' understanding across different dimensions relating to nutrition and physical wellness.

Each question in the questionnaire was designed to have only one correct answer, and participants were awarded one point for each correct response. Composite scores for nutrition knowledge were computed then divided into tertiles (as low, moderate, or high nutrition knowledge levels) for regression analyses. In all, 27 questions were used to assess nutritional

knowledge. Composite scores were generated and Cronbach's alpha reliability generated. Cronbach's α reliability coefficient was 0.82.

5.2.9.1 Adolescent-Reported Parenting Styles

Using earlier research (den Exter Blokland et al., 2001; S. Kremers et al., 2013; S. P. J. Kremers et al., 2003; Lamborn et al., 1991; Robinson et al., 1995; Steinberg et al., 1989) a 29-item instrument was developed to assess the dimensions of parenting style, specifically warmth/involvement (subfactor 1) and strictness/demandingness/control (subfactor 2) (den Exter Blokland et al., 2001). The participants were asked to rate each item on a scale of 1 to 5, with 1 indicating "completely disagree," 2 indicating "disagree," 3 indicating "neither agree nor disagree," 4 indicating "agree," and 5 indicating "completely agree." The median value was used to categorise each factor as low or high.

Nineteen items were used to evaluate subfactor 1, which encompasses the dimensions of warmth, responsiveness, love, and involvement of parenting style. For example, "I can count on my parents to help me out if I have some kind of problem." The median score was 52 and Cronbach's α reliability coefficient was 0.88. Parental strictness was assessed by asking adolescents about parental monitoring and supervision. Ten items were used to assess subfactor 2 (the parenting style dimension of strictness/demandingness and control). For example, "How much do your parents try to know where you go out at night"). The median score was 32 and Cronbach's α reliability coefficient was 0.82.

Parents were classified as low or high based on their ratings, with those below the median being categorised as low and those above the median as high. To determine the parenting styles, composites were created for both subfactors 1 and 2, and parents were assigned to one of four categories: authoritative, authoritarian, permissive, or neglectful. These categories are based on

the Baumrind parenting model, which originally classified parenting styles into three categories (Baumrind, 1971) and were expanded to four by Maccoby and Martin (Maccoby & Martin, 1983). A parent who scored high in both subfactor 1 (warmth and involvement) and subfactor 2 (strictness, demandingness, and control) was categorised as authoritative, while a parent who scored low in both subfactors was classified as neglectful. A parent who scored high in subfactor 1 and low in subfactor 2 was categorised as permissive, while a parent who scored low in subfactor 1 and high in subfactor 2 was classified as authoritarian.

5.2.9.2 Perceived Parental Modelling of Healthy Eating

Adolescents' perception of their parents' role-modelling of healthy eating was assessed using eight items. Participants were asked about their parents' consumption of fruits, vegetables, and low-fat foods as snacks and whether their parents ate these foods during lunch, dinner, or while eating out. Additionally, the adolescents were asked if their parents drank 100% juice and used low-fat dressing and mayonnaise in their presence. The responses were measured using a 4-point Likert scale, where 1 represented 'Never', 2 represented 'Hardly ever', 3 represented 'Sometimes', and 4 represented 'Usually/Always'. A higher score indicated greater agreement with the item. The median was used to classify each factor into low and high scores. Composites were created for each factor, and parents who scored below the median were classified as having unhealthy dietary behaviours, while those who scored above the median were classified as having healthy dietary behaviours. The Cronbach's α reliability coefficient was 0.92.

4.2.9.3 Dietary Diversity Score (DDS)

Adolescent dietary intake was evaluated using a 24-hour recall method (FAO, 2010; Heidari-Beni et al., 2022; Kennedy et al., 2007; Mirmiran et al., 2004; Ruel, 2003). Detailed information about all food and beverages consumed by adolescents in the previous 24 hours were gathered (during the day and night) whether at home or outside the home. The survey instrument

consisted of 13 food groups representing commonly consumed food items in Ghana, including main meals, snacks, and beverages. The list included a range of food groups, including cereals and grains, tubers, fruits, vegetables, legumes, animal source foods including fish, meat, eggs and dairy products and condiments. Each consumed item within the selected period received a score of 1, while non-consumed foods scored zero.

Participants were also asked to list all ingredients included in composite dishes. The data from the 24-hour recall was then utilised to assess DDS based on the FAO's 2010 guidelines for measuring household and individual dietary diversity (FAO, 2010). In all 13 different food groups were collected. For analysis purposes, condiments and spices were excluded from consideration. According to the FAO guidelines on food diversity, these two food categories can be used for further analysis and consideration of micronutrient bioavailability but are not included in the individual dietary diversity score. The total number of food groups consumed by individuals within the 24-hour period before the survey was added up to determine their dietary diversity. Additionally, the percentage of individuals consuming different food groups, such as vitamin A-rich fruits and vegetables and iron-rich foods, was calculated. Dietary diversity scores (DDS) (low, medium, high, and mean) and dietary adequacy (inadequate versus adequate) were computed. Adolescents who consumed fewer than four food groups (≤ 4 food groups) were considered to have low dietary diversity, 4 to 5 food groups is medium dietary diversity, and 6 or more food groups is high dietary diversity (FAO, 2010). Higher DDS is linked to better nutritional outcomes (Hanley-Cook et al., 2024b). Inadequate dietary diversity is defined as consuming food items from less than five out of ten food groups (Gonete et al., 2020b; Kera et al., 2024; Rai et al., 2022). A DDS of 6 and above is often considered indicative of a lower risk of micronutrient inadequacy. A score below this threshold suggests a higher likelihood of nutritional deficiencies, particularly in populations with limited access to diverse foods (Abizari & Ali, 2019a; Wiafe, Apprey, et al., 2023b; Zhao et al., 2017).

5.2.9.4 Food Insecurity

Food insecurity status was evaluated using the Household Food Insecurity Access Scale (HFIAS) tool, which was developed by the USAID-funded Food and Nutrition Technical Assistance (FANTA) Project in 2006 (Coates Jennifer et al., 2007).

5.2.9.5 Food Frequency Questionnaire and Principal Component Analysis

A Food Frequency Questionnaire (FFQ) consisting of 120 commonly consumed foods was used to record usual consumption dietary intake by asking adolescents to report which foods, from a list of about 120 food items or prepared dishes, they have eaten during the past month based on the following categories: monthly, weekly, daily and never. The food items were determined based on previously published FFQs designed specifically for Ghanaian (Abizari & Ali, 2019a; Ogum Alangea et al., 2018). The food items were analysed using Principal Component Analysis (PCA) to derive dietary patterns. Foods grouped (14) from FFQ data based on shared nutritional value were used to identify dietary patterns using principal component analysis (PCA).

5.2.9.6 Perceived Barriers to Healthy Eating

Children's and adolescents' perceived barriers to healthy eating and healthy diets were assessed using a list of predetermined barriers. Questionnaire items relating to barriers to healthy eating and diets were adapted from previously published studies (de Mestral et al., 2020; Kearney & McElhone, 1999; Pinho et al., 2018; Sun et al., 2019), which used validated self-reported questionnaires. The statements were slightly modified and adapted to the target group of this study (children and adolescents). Perceived barriers were rated on a 5-point Likert scale ranging from 1 (never a problem) to 5 (Always a problem) for each item. The barriers were divided into personal, social, cultural, community and environmental barriers and included time constraint, limited options in at home, limited options in food markets, price, lack of social support, social opposition, taste, daily habits, and willpower.

5.2.9.7 Data Analysis

Data were analysed using the statistical software package into STATA 17. Data on the online Kobo Toolbox platform was exported as excel files. The excel files containing the data were imported into STATA 17 for analysis. Descriptive analysis was done to determine means, frequencies, and percentage distribution for variables. Bivariate and multivariate analyses were performed to evaluate associations between dependent (dietary adequacy) and independent variables. Dietary diversity was dichotomized as a category into adequate and inadequate diets. Statistical significance was set at $P < 0.05$. Odds ratios with 95 % confidence intervals were derived where appropriate. Fisher's exact test was used when sample sizes were too small. Independent variables were included in the logistic regression analysis if they had a significant association ($P < 0.05$) with a dependent variable in the bivariate analysis.

Study Variables: The study variables were categorised into dependent and independent variables.

Data Quality Control: Before data collection, the questionnaire instrument was pretested on 15 adolescents in a district, which was not a part of the actual data collection area. Based on feedback from the pretest, adjustments were made to the questionnaire. two days of training was provided to data collectors and supervisors on the data collection tools, data collection techniques, interview approaches, and ensuring respondent privacy and confidentiality. Each day, after data collection, supervisors and the principal investigator reviewed the questionnaires for completeness and provided feedback to the data collectors.

5.2.9.8 Ethical Considerations

All participants were guaranteed privacy and anonymity. Interviews were conducted in a private setting such that the answers the respondents gave were only heard by the interviewer. This was to ensure that respondents were comfortable enough to provide responses for various questions.

Information obtained was handled anonymously and confidentially. Data were stored in password-secured computers and only accessible to the principal investigator and research assistants. Names of participants were not required in any way to run analysis. Respondents were assured that under no circumstance will their names or any contact details be linked to the data they had provided during data analysis and dissemination of the findings of the study.

5.3 Results

5.3.1 Background Characteristics of the Population

A total of 667 adolescents aged 10-19 years were surveyed. Table 5.1 presents the background characteristics of the study population. Females accounted for 59.5% of the sample. majority of adolescents were residents of the Volta region (70.2%), and 63.3% lived in rural areas. The mean age of the adolescents was 15.1 ± 2.5 years, with 36.7% aged 10–14 years old, 43.2% aged 15-17. A high proportion of the adolescents identified as Christians (85.9%). majority (65.1%) were Ewe ethnic group. Most (75.4%) lived with both parents. Forty-three per cent had five or more siblings. More than two-fifth (41.4%) had Junior High School (JHS) education, 35.5% had Senior High School (SHS) education. majority (82.7%) attended public schools, 94.6% had never been married and 94.4% lived with their biological mother. Also, 86.7% lived with their biological father, 26.5% of mothers of the adolescents had primary education, and 24.3% had JHS education. Nearly half (48.9%) of the adolescents said their mothers were traders (48.9%), 34.6% said their parents were professionals (doctors, nurses, teachers, midwives, headteachers), 33.7% were farmers and 12.9% were office workers. The average household size was 6.3 ± 2.8 . Analysis of wealth distribution showed that 38.7% were in the fourth quintile (38.7%) and 32.4%, the fifth quintile (32.4%), indicating relatively higher wealth.

Table 5.1: Background characteristics of adolescents (n=667)

Variable	Frequency	Percentage (%)
Region		
Oti	199	29.8
Volta	468	70.2
Sex		
Female	397	59.5
Male	270	40.5
Age, yr		
10-14	245	36.7
15-17	288	43.2
18-19	134	20.1
Religion		
Christianity	573	85.9
Islam	60	9.0
Traditionalist	34	5.1
Residence		
Rural	422	63.3
Urban	245	36.7
Parental status		
None	27	4.1
Single parent	137	20.5
Dual parent	503	75.4
Sibling status		
None	54	8.1
One	94	14.1
Two	16	2.4
Three	129	19.4
Four	87	13.0
Five and above	287	43.0
Educational level		
None	34	5.1
Primary	103	15.4
Junior High School	276	41.4
Senior High School	237	35.5
Tertiary	17	2.6
Type of school	n=632	
Private	109	17.3
Public	523	82.7
Marital status		
Never married	631	94.6
Married/living together	36	5.4
Living with Natural mother		
No	37	5.6
Yes	630	94.4
Living with Natural father		
No	89	13.3
Yes	578	86.7
Mother's occupation		
Artisan	30	4.5
Professional (doctors, nurses, teachers)	161	24.1
Office worker	61	9.2
Trader	326	48.9
Farmer	89	13.3
Mother's educational level		
No formal educational	128	19.2
Basic	177	26.5
Junior High School (JHS)	162	24.3
Senior High School (SHS)	115	17.2
Tertiary	85	12.8
Ethnicity		
Ewes	434	65.1

Buem	53	7.9
Kotokoli	31	4.7
Kokomba	27	4.1
Lolobi	16	2.4
Nkonya	20	3.0
Santrokofi	22	3.2
Others	64	9.6
Father's occupation		
Artisan	54	8.2
Professional	231	34.6
Office worker	86	12.9
Trader	71	10.6
Farmer	225	33.7
Age		
<4	85	12.7
4-5	224	33.6
6-7	175	26.3
8+	183	27.4
Wealth quintiles		
First	27	4.1
Second	53	7.9
Third	113	16.9
Fourth	258	38.7
Fifth	216	32.4

5.3.2 Nutrition Knowledge of Adolescent

Figure 5.2 shows the nutritional knowledge levels of the adolescents. The results show that 41.7% of the adolescent had high level of nutrition knowledge.

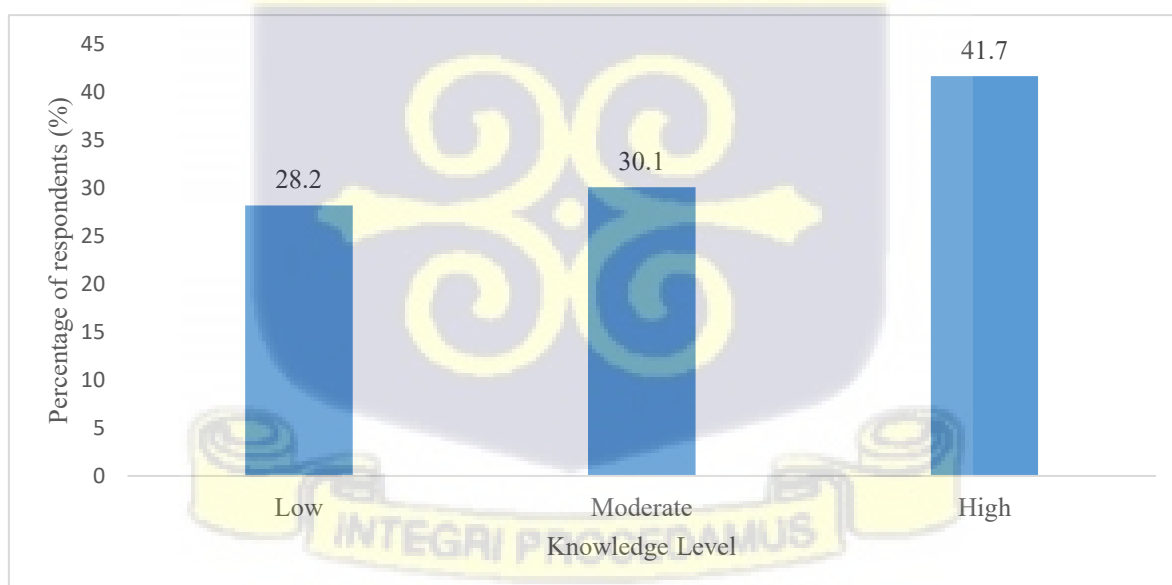


Figure 5.2. nutrition knowledge of adolescent respondents

Nutritional Knowledge: 0-30% =low; 31-60% = moderate; 61-100% = high

5.3.3 Types of Food Groups Consumed among Adolescents in the Volta and Oti regions and their Dietary Diversity Scores

Table 4.2 shows frequency of the consumption of various foods from the food groups over the 24 hours preceding the survey. The results indicate that a high percentage of adolescents consume energy-dense staple foods. Analysis showed that 90.4% of the adolescents consumed staple foods derived from cereals and grains, such as millet, sorghum, maize, rice, wheat, bread, noodles, and biscuits. Similarly, 83.5% of the adolescents reported consuming foods made from roots and tubers, including potatoes, yams, manioc, and cassava. Additionally, there was a high intake of energy-dense, nutrient-poor foods that were high in fat and sugar. Seventy-nine percent of the adolescents reported consuming foods prepared with oil, fat, or butter, while 75.3% reported consuming sugar-sweetened foods or honey. The consumption of foods made from beans, peas, lentils, or nuts was reported by 68.2% of adolescents and 52.8% of adolescents reported consuming vegetables including carrots, potato leaves and green pepper. Only 43.2% of adolescents sampled consumed fruits, including bananas, pawpaw, oranges, and other fruits. There was a very low consumption of animal-source foods. Only 16.2% of adolescents reported consuming fresh or dried fish or shellfish products and only 12.7% of adolescents consumed flesh meat including beef, pork, lamb, goat, rabbit, wild game, chicken, duck, other birds, liver, kidney, and heart. Additionally, only 7.5% of adolescents reported consuming dairy products including cheese, yoghurt, milk, or other milk products and 6.8% reported eating eggs.

5.3.4 Dietary Diversity Scores of Adolescents in the Volta and Oti Regions

The results of dietary analysis showed that 46.2% of adolescents had medium dietary diversity indicating that they consumed food from 5-7 food groups. Nearly 38% had high dietary diversity scores or consumed food from 7 or more food groups in the 24 hours preceding the survey, and 16% had low dietary diversity and had low dietary diversity, indicating that they

consumed food from only 1-4 food groups in the 24 hours preceding the survey. The mean dietary diversity score was high amongst females (5.5 ± 2.4) compared to male adolescents (5.0 ± 2.5)., mean dietary diversity score was 5.3 ± 2.5 for all adolescents surveyed. Overall, 63.3% of adolescents had inadequate diets and 36.7 had adequate diets (Table 5.2).

Table 5.2: Frequency of consumption of foods by adolescents

Variable	Frequency	Percentage
Dietary diversity		
Low dietary diversity	107	16.0
Medium dietary diversity	308	46.2
High dietary diversity	252	37.8
Mean dietary diversity score		
Mean dietary diversity score $\pm$ SD	5.3 ± 2.5	
Mean female dietary diversity $\pm$ SD	5.5 ± 2.4	
Mean male dietary diversity $\pm$ SD	5.0 ± 2.5	
Dietary adequacy		
Inadequate	422	63.3
Adequate	245	36.7

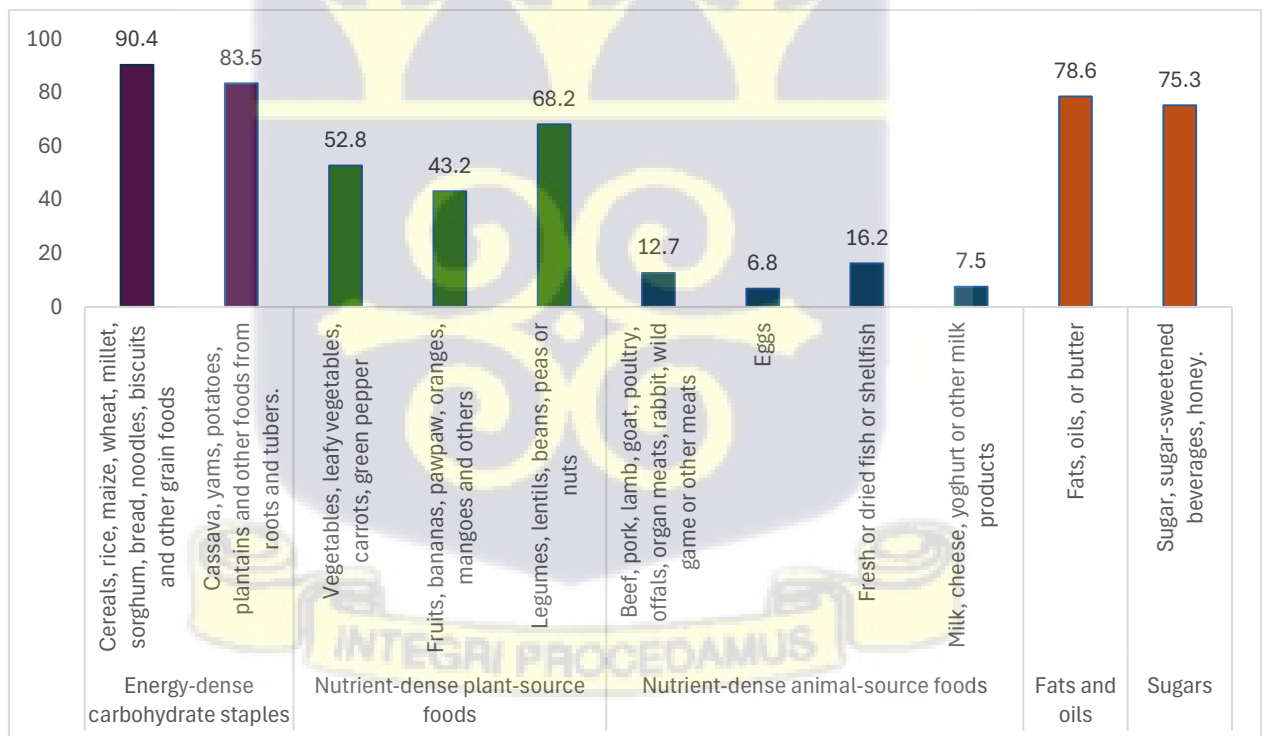


Figure 5.3: Food groups consumed by adolescents

5.3.5 Emerging dietary patterns of adolescents

The emerging dietary patterns of adolescents were analysed using principal component analysis (PCA), which revealed three distinct components that explain the variability in food consumption that explain the variability in adolescents' diets (Figures 5.3 and 5.4). The first component, which explains the largest proportion of the variance (34.5%), is characterised by high factor loadings for Cereals, grains, bread, biscuits, pastries, and roots and tubers, and is thus associated with high consumption of starchy, carbohydrate-rich foods. Component two, which accounts for 24.1% of the variance, has high loadings for sugar-sweetened beverages, alcoholic beverages, and other foods, spreads, and toppings, and thus reflects a pattern of high consumption of sweet and indulgent foods and beverages. The third component, which explains 20.5% of the variance, has high loadings for animal source foods, proteins, fruits, vegetables, snack foods and desserts, and thus reflects a pattern of high consumption of nutrient-dense foods, including fruits and vegetables, as well as some indulgence in snack foods and desserts. These three components identified in this analysis thus represent distinct dietary patterns. The first component reflects a traditional or staple food pattern, with carbohydrates as the primary energy source. The second component suggests a "treat" or an "indulgent" pattern, potentially linked to pleasure or emotional eating. The third component indicates a more balanced or varied dietary pattern, with a focus on nutrient-dense foods and some allowance for indulgence. The variance in dietary intakes is represented by factor loadings shown in Table 5.3.



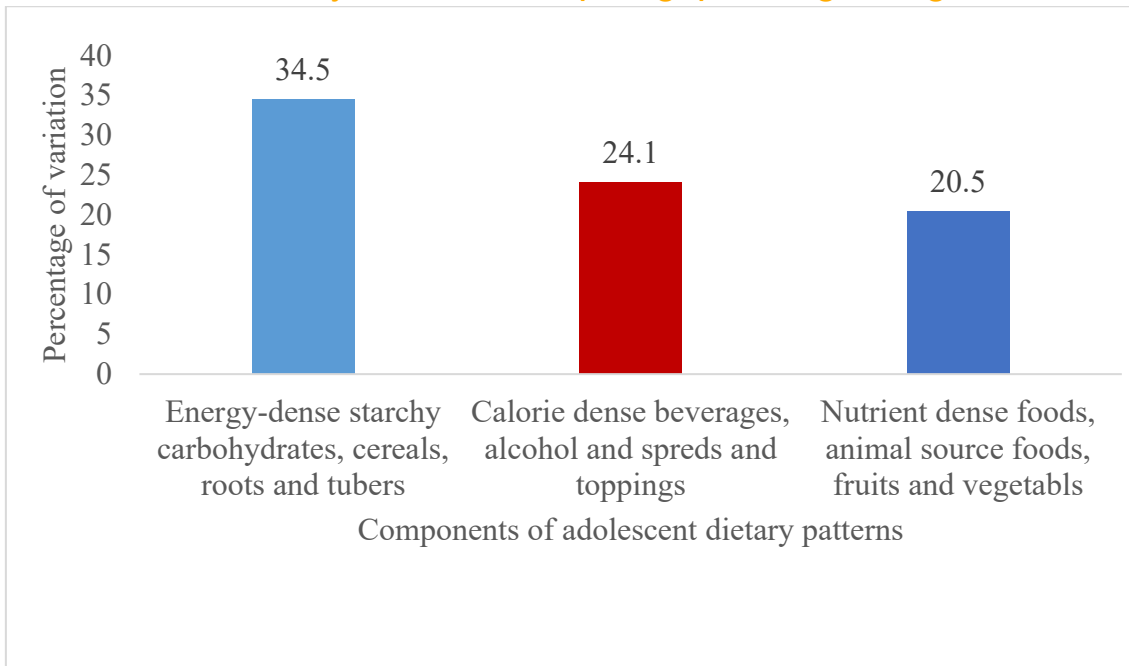


Figure 5.4: Dietary patterns of adolescents determined using principal component analysis

Table 5.3: Factor loadings of adolescent food intakes

Food group	Component 1	Component 2	Component 3
Cereals and grains	0.785	0.185	0.202
Bread, biscuits, pastries	0.763	0.195	0.380
Roots and tubers	0.699	0.286	0.295
Animal-source foods/proteins	0.202	0.165	0.707
Fruits	0.334	0.233	0.644
Vegetables	0.404	0.111	0.604
Snack foods/desserts	0.137	0.344	0.727
Sugar-sweetened beverages	0.471	0.697	0.062
Alcoholic beverages	0.283	0.749	0.288
Other foods, spreads, and toppings	0.066	0.775	0.352

5.3.6 Dietary Diversity and its Associated Factors

There was a significant association between region ($p < 0.001$), age ($p < 0.001$), residence ($p < 0.001$), sibling status ($p < 0.001$), educational level ($p = 0.018$), mother's occupation ($p < 0.001$), mother's educational level ($p = 0.002$), father's occupation ($p < 0.001$), household size ($p < 0.001$), wealth quintiles ($p = 0.011$), dietary behaviour ($p < 0.001$), nutritional knowledge ($p < 0.001$), food preference ($p < 0.001$) and dietary adequacy. Among the barriers to dietary adequacy, a statistically significant association was found between dietary adequacy and price of healthy foods too expensive ($p < 0.001$), taste preferences for unhealthy food ($p = 0.009$) and lack of cooking skills ($p = 0.025$). Additionally, a statistically significant association was found

between dietary adequacy and it takes too much planning to prepare and eat a healthier diet ($p=0.026$), there are no healthy food option at my school ($p<0.001$), and the perception that healthier foods are too expensive ($p=0.002$). Moreover, a statistically significant association was found between dietary adequacy and the perception that fruits vegetables are too expensive ($p=0.011$), fruits and vegetables do not taste as nice as high fat foods ($p<0.001$), I do not know how to cook vegetables ($p=0.013$) and a perceived lack of knowledge ($p=0.003$) (Table 5.4).



Table 5.4: Factors associated with adequate dietary diversity among adolescents

Variable	Dietary Diversity		X ² (p-value)/Fisher's exact
	Adequate 245(36.7)	Inadequate 422(63.3)	
Region			18.755(<0.001)
Oti	89(44.7)	110(55.3)	
Volta	156(33.3)	312(66.7)	
Gender			3.137(0.077)
Female	135(34.0)	262(66.0)	
Male	110(40.7)	160(59.3)	
Age, yr			24.509(<0.001)
10-14	116(47.4)	129(52.6)	
15-17	77(26.7)	211(73.3)	
18-19	52(38.8)	82(61.2)	
Residence			18.755(<0.001)
Rural	181(42.9)	241(57.1)	
Urban	64(26.1)	181(73.9)	
Parental status			1.321(0.517)
None	12(44.4)	15(55.6)	
Single parent	46(33.6)	91(66.4)	
Dual parent	187(37.2)	316(62.8)	
Sibling status			50.160(<0.001)
None	24(44.4)	30(55.6)	
One	62(66.0)	32(34.0)	
Two	5(31.3)	11(68.7)	
Three	28(21.7)	101(78.3)	
Four and above	126(33.7)	248(66.3)	
Educational level			0.018
None	7(20.6)	27(79.4)	
Primary	33(32.0)	70(68.0)	
Junior High School	118(42.8)	158(57.2)	
Senior High School	84(35.4)	153(64.6)	
Tertiary	3(17.7)	14(82.3)	
Marital status			0.189(0.664)
Never married	233(36.9)	398(63.1)	
Married/living together	12(33.3)	24(66.7)	
Living with Natural mother			1.431(0.232)
Yes	228(36.2)	402(63.8)	
Living with Natural father			3.30(0.069)
Yes	220(38.1)	358(61.9)	
Mother's occupation			20.766(<0.001)
Artisan	10(33.3)	20(66.7)	
Professional	53(32.9)	108(67.1)	
Office worker	14(22.9)	47(77.1)	
Trader	146(44.8)	180(55.2)	
Farmer	22(24.7)	67(75.3)	
Mother's educational level			16.558(0.002)
No formal educational	37(28.9)	91(71.1)	
Basic	61(34.5)	116(65.5)	
Junior High School	63(38.9)	99(61.1)	
Senior High School	59(51.3)	56(48.7)	
Tertiary	25(29.4)	60(70.6)	
Father's occupation			21.325(<0.001)
Artisan	19(35.2)	35(64.8)	
Professional	72(31.2)	159(68.8)	
Office worker	21(24.4)	65(75.6)	
Trader	39(54.9)	32(45.1)	
Farmer	94(41.8)	131(58.2)	
Household size			90.676(<0.001)
<4	39(45.9)	46(54.1)	
4-5	132(58.9)	92(41.1)	

6-7	39(22.3)	136(77.7)	
8+	35(19.1)	148(80.9)	
Wealth quintiles			13.116(0.011)
First	13(48.2)	14(51.8)	
Second	21(39.6)	32(60.4)	
Third	56(49.6)	57(50.4)	
Fourth	86(33.3)	172(66.7)	
Fifth	69(31.9)	147(68.1)	
Dietary behaviour			17.68(<0.001)
Poor	82(27.9)	212(72.1)	
Good	163(43.7)	210(56.3)	
Nutritional knowledge			67.776(<0.001)
Low	102(54.3)	86(45.7)	
Moderate	90(44.8)	111(55.2)	
High	53(19.1)	225(80.9)	
Parental role modelling of healthy eating			0.852(0.356)
1. Not a good model	114(35.0)	212(65.0)	
2. A good model	131(38.4)	210(61.6)	
Parenting style			20.56(<0.0001)
1. Authoritative	75(28.3)	190(71.7)	
2. Permissive	46(54.8)	38(45.2)	
3. Neglectful	87(38.8)	137(61.2)	
4. Authoritarian	37(39.4)	57(60.6)	
Food security			2.35(0.503)
1. Food Secure	87(33.5)	173(66.5)	
2. Mildly food insecure	59(40.1)	88(59.9)	
3. Moderately food insecure	41(39.8)	62(60.2)	
4. Severely food secure	58(36.9)	99(63.1)	
Healthy foods too expensive (cost)			6.09(0.014)
No	6(17.1)	29(82.9)	
Yes	239(37.8)	393(62.2)	
Taste preferences for unhealthy food			8.01(0.005)
No	5(14.3)	30(85.7)	
Yes	240(38.0)	392(62.0)	
Lack of cooking Skills			6.77(0.009)
No	11(20.4)	43(79.6)	
Yes	234(38.2)	379(61.8)	
Lack of knowledge about healthy eating			1.34(0.248)
No	9(27.3)	24(72.7)	
Yes	236(37.2)	398(62.8)	
It takes too much planning to prepare and eat a healthier diet			1.51(0.219)
No	15(28.9)	37(71.2)	
Yes	230(37.4)	385(62.6)	
There is no healthy food option at my school			4.52(0.034)
No	9(21.4)	33(78.6)	
Yes	236(37.8)	389(62.2)	
Fruits vegetables are too expensive			1.59(0.208)
No	10(27.0)	27(72.97)	
Yes	235(37.3)	395(62.7)	
Fruits and vegetables do not taste as nice as high fat foods			0.12(0.727)
No	18(39.1)	28(60.9)	
Yes	227(36.6)	394(63.4)	
Fruits and vegetables take too long to prepare			0.54(0.461)
No	25(32.9)	51(67.1)	
Yes	220(37.2)	371(62.8)	

I do not know how to cook vegetables			4.14(0.042)
Yes	233(37.8)	383(62.2)	
I do not know how to cook healthier meals			3.23(0.072)
Yes	230(37.8)	379(62.2)	
Lack of access to healthy foods			0.16(0.693)
Yes	235(36.9)	402(63.1)	

5.4 Predictors of Adolescent Dietary Adequacy

Binary logistic regression analysis showed that middle adolescence (aged 15-17 years) had 2.08 times higher odds (95% CI: 1.19-3.65, $p=0.011$) of having adequate dietary diversity compared to those aged 10-14 years (early adolescents). Additionally, residence was an important predictor, with adolescents living in urban settings having 2.08 times higher odds (95% CI: 1.29-3.35, $p=0.002$) of having adequate dietary diversity compared to their rural counterparts. Furthermore, educational level was a significant predictor of dietary adequacy. Adolescents with junior high school (JHS) and senior high school (SHS) education had lower odds of adequate dietary diversity compared to those with no formal education, with odds ratios of 0.19 (95% CI: 0.07-0.63, $p=0.006$) and 0.16 (95% CI: 0.05-0.57, $p=0.004$), respectively. Household size emerged as a significant predictor of dietary adequacy among adolescents, with adolescents from larger households (6-7 members and 8+ members) having higher odds of adequate dietary diversity compared to adolescents from households with fewer than 4 members. Nutritional knowledge was a strong predictor, with individuals having high nutritional knowledge having 3.77 times higher odds (95% CI: 2.09-6.81, $p<0.001$) of adequate dietary diversity compared to those with low nutritional knowledge. Adolescents from permissive households had lower odds (OR=0.32, 95% CI: 0.16-0.63, $p=0.001$) of attaining adequate dietary diversity compared to those from authoritative households. Adolescents with a preference for unhealthy food had lower odds of adequate dietary diversity (aOR = 0.21, 95% CI: 0.06-0.77, $p = 0.019$), as did those lacking cooking skills (aOR = 0.35, 95% CI: 0.13-0.95, $p=0.040$) and those who did not know how to cook vegetables (aOR = 0.36, 95% CI: 0.13-0.98, $p=0.046$) (Table 5.5).

Table 5.5: Binary logistic regression analysis of the predictors of adequate dietary diversity

Covariates	aOR* (95%CI)	p-value
Region (Oti)		
Volta	1.25(0.72-2.17)	0.418
Age yr (10-14)		
15-17	2.08(1.19-3.65)	0.011
18-19	0.89(0.32-1.49)	0.346
Residence (Rural)		
Urban	2.08(1.29-3.35)	0.002
Sibling status (None)		
One	0.73(0.28-1.92)	0.539
Two	2.05(0.44-9.61)	0.363
Three	2.04(0.76-5.49)	0.157
4+	1.16(0.47-2.85)	0.754
Educational level (None)		
Primary	0.39(0.12-1.32)	0.131
JHS/JSS	0.19(0.07-0.63)	0.006
SHS/SSS	0.16(0.05-0.57)	0.004
Tertiary	0.46(0.07-2.91)	0.409
Mother's occupation (Artisan)		
Professional	0.55(0.18-1.69)	0.300
Office worker	0.75(0.21-2.71)	0.657
Trader	0.58(0.19-1.72)	0.323
Farmer	3.82(0.46-31.70)	0.214
Mother's educational level (None)		
Basic	0.73(0.38-1.42)	0.353
Junior High School	0.65(0.32-1.30)	0.223
Senior High School	0.55(0.25-1.19)	0.133
Tertiary	0.17(0.03-1.17)	0.073
Father's occupation (Artisan)		
Professional	0.95(0.39-2.25)	0.902
Office worker	1.02(0.36-2.89)	0.965
Trader	0.36(0.13-1.01)	0.051
Farmer	0.49(0.19-1.25)	0.135
Household size (<4)		
4-5	0.68(0.30-1.52)	0.346
6-7	2.67(1.11-6.43)	0.028
8+	3.94(1.66-9.36)	0.002
Wealth quintiles (First)		
Second	1.11(0.34-3.71)	0.859
Third	0.98(0.33-2.92)	0.967
Fourth	2.22(0.73-6.72)	0.159
Fifth	3.03(0.94-9.79)	0.063
Dietary behaviour (Poor)		
Good	0.92(0.57-1.46)	0.702
Nutritional knowledge (Low)		
Moderate	1.28(0.73-2.26)	0.388
High	3.77(2.09-6.81)	<0.001
Parenting style (Authoritative)		
Permissive	0.32(0.16-0.63)	0.001
Neglectful	0.62(0.38-1.01)	0.055
Authoritarian	0.64(0.32-1.30)	0.221
Healthy foods too expensive (cost)		
(No)		
Yes	1.09(0.30-3.88)	0.896
Taste preferences for unhealthy food		
(No)		
Yes	0.21(0.06-0.77)	0.019
Lack of cooking Skills (No)		
Yes	0.35(0.13-0.95)	0.040

There is no healthy food option at my school (No)		
Yes	0.74(0.23-2.41)	0.620
Fruits and vegetables do not taste as nice as high fat foods (No)		
Yes	0.96(0.42-2.19)	0.925
I do not know how to cook vegetables (No)		
Yes	0.36(0.13-0.98)	0.046
*All variables significant (p<0.05) at the chi-square test were adjusted in the final model options in brackets are the reference groups		

5.5 Discussion

This study sheds light on the factors influencing dietary adequacy among adolescents in the Volta and Oti regions of Ghana. The study objective was to investigate the factors that influence adequate dietary diversity among adolescent in the Volta and Oti regions of Ghana. Dietary diversity provides information about the number of different food groups consumed over a reference period (Moursi et al., 2008). The different food categories provide a variety of macro and micronutrients needed for physiological and biological processes. Adolescents who consume food from several food groups are more likely to meet their nutritional needs and thus promoting their growth and development diet (FAO, 2012a; Otekunrin et al., 2023). The dietary diversity of adolescents is critical for their nutritional and general wellbeing.

Findings from this study showed a high prevalence (63.3%) of inadequate dietary diversity among adolescents. Mean dietary diversity score of 5.0 ± 2.5 and 63.3% of adolescents had inadequate dietary diversity 24 hours preceding the survey. Much higher proportions of inadequate dietary diversity have been reported among adolescents in similar studies in other parts of Ghana, including 84.7% among adolescents in rural Ghana (Wiafe, Apprey, et al., 2023b). However, this is higher than the 56% inadequate dietary diversity observed among pregnant adolescent girls in Ghana (Gyimah et al., 2021a). For the adolescent, limited dietary diversity can lead to inadequate intake of essential micronutrients, which are crucial for proper growth and development (Mak et al., 2019).

Inadequate dietary diversity can have both immediate and long-term health consequences for adolescents. Poor nutrition during adolescence can result in several immediate and long-term health consequences, including micronutrient deficiencies, weakened immune systems, poor cognitive function, increased risk of overweight/obesity, and increased presentation of cardiometabolic risk factors (Moore Heslin & McNulty, 2023d). In addition, low dietary diversity has been associated with anaemia, a condition where someone does not have enough healthy red blood cells to carry adequate oxygen to their body's tissues (Delil et al., 1970; Jugha et al., 2021). In particular, the results show inadequate consumption of vegetables, fruits, and animal source foods (ASF). Several studies have shown a positive association between the consumption of various animal-source foods (ASF) and haematological indices (Jackson et al., 2016; Visser et al., 2021). Individuals who consume mostly cereal-based diets are at greater risk of developing iron deficiency anaemia (Hurrell & Egli, 2010). In contrast, increasing the consumption of ASF, along with fruits and vegetables rich in vitamin C and carotenoids may improve the bioavailability and absorption of iron from diets largely composed of cereals (Chouraqui, 2023; García-Casal, 2006). Additionally, dietary diversity has been linked to improved immunity and a reduced risk of infections and complications (Abrha et al., 2019).

The findings also show that the diets of most adolescents lack variety, consisting of energy dense starchy staples (cereals, roots, and tubers), high refined grain consumption and high intake of dietary fat. In contrast, adolescent consumption of animal-source foods (ASF), fruits and vegetables, eggs, fish, and poultry were limited. The dominance of starchy staples in adolescent diets suggests a lack of essential micronutrients like vitamins, minerals, and protein. The findings are similar to findings by Wiafe et. al., on adolescent dietary diversity in rural Ghana (Wiafe, Apprey, et al., 2023c) and findings by Gyimah et al., on dietary diversity among pregnant adolescents in Ghana (Gyimah et al., 2021a). Other studies have highlighted the over-dependence on starchy staple including cereals and roots and tubers in Ghana (Abizari et al.,

2017; Abizari & Ali, 2019a; Omari, 2017; Omari et al., 2013) and in Nigeria (Ayogu, 2019; Otekunrin et al., 2023). The over-reliance on staple starches and the insufficient intake of fruits, vegetables and animal source foods can lead to inadequate intake of essential micronutrients, which are crucial for proper growth and development (Mak et al., 2019). The moderate consumption of fruits and vegetables is a positive aspect of the Ghanaian adolescent diet. The levels of fruits and vegetable consumption reported in this study are slightly higher than that reported in other studies (Hormenu, 2022b; Seidu et al., 2020). Fruits and vegetables are rich in essential vitamins, minerals, and fibre, and increasing their intake can contribute to better overall health and well-being and reducing the risk of chronic diseases. However, the intake of fruits and vegetables in Ghana is still below recommended levels, indicating a need for increased consumption. Adolescents who do not consume a balanced and varied diet may experience compromised growth and development, decreased productivity, and impaired cognitive development (Visser et al., 2021). In addition, low dietary diversity can lead to poor academic performance, low school enrolment, and reduced educational achievement (Visser et al., 2021).

The consumption of foods from plant protein sources, including beans, peas, lentils, or nuts was high. The high consumption of plant protein might be making up for the low consumption of animal-source foods. Plant-based proteins can be used as partial substitute for animal-source foods, but certain factors should be considered. Plant-based proteins, such as soy and beans protein, have lower anabolic properties compared to animal-source proteins due to differences in digestion, amino acid absorption rates and amino acid composition (Pinckaers et al., 2021). However, consuming a greater amount of plant-based protein or using specific blends of plant-based proteins can compensate for the lower quality (Päivärinta et al., 2020). Substituting animal proteins with plant proteins may result in improved dietary fat quality, increased fibre intake and better blood lipoprotein profiles (Ferrari et al., 2022). Plant protein sources are

associated with better health outcomes overall, particularly on the cardiovascular system, and have a lower environmental impact compared to animal sources (Ferrari et al., 2022; Haghighatdoost et al., 2023). People eating plant-based foods also tend to have lower body weight, lower cholesterol levels, and lower risk of diabetes, stroke, cancer, and death from heart disease than people who eat meat (Sriram, 2023). Other additional advantages of plant-based foods are that they are more easily and efficiently produced, stored, transported, and consumed compared to animal-source foods (Sriram, 2023). However, when replacing animal proteins with plant proteins, attention should be paid towards ensuring adequate intake and status of certain micronutrients like vitamin B-12 and iodine (Pellinen et al., 2022). Increased consumption of plant-based foods and decreased consumption of animal-based foods is recommended for healthy diets and sustainable food production (Langyan et al., 2022; Päivärinta et al., 2020).

5.5.1 Perceptions influencing adolescent dietary adequacy

A wide range of individual, family, environmental, and cultural influences and perceptions may support or hinder adolescents from achieving dietary adequacy. These included parenting style. Evidence shows parents who have a permissive parenting style may allow their adolescents to make their own food choices, which can lead to unhealthy eating habits. The parenting style dimension of warmth and/or caring has been associated with female adolescent healthy dietary intake (Berge et al., 2010). Along with meal frequency, limited cooking skills, the place where meals are eaten, the reluctance to give up preferred foods and busy lifestyle may either enable or serve as barriers to dietary adequacy (Abdelhafez et al., 2020). Additionally, the price of healthy foods, taste preferences, reluctance to change their eating habits also hindered or facilitated dietary adequacy. Several studies show that diet costs are associated with dietary quality (Drewnowski & Monsivais, 2020; FAO et al., 2022; van der Velde et al., 2019). Furthermore, holidays and special occasions, the lack of healthy food options at school,

the perception that high fat foods were part of traditional cuisines and the perception that healthier foods were too expensive affected adolescent dietary adequacy (Seguin et al., 2014).

5.5.2 Predictors of adolescent dietary adequacy

Living in urban settings, engaging in healthy eating habits, having less busy lifestyles, or not finding the preparation of healthy food inconvenient were all linked to better dietary adequacy among adolescents. In contrast, perceiving that “fruits and vegetables were not as tasty as high-fat foods and lacking cooking skills had a negative effect on dietary adequacy. Surprisingly, larger households with eight or more members were associated with improved dietary adequacy. positively predicted dietary adequacy. Factors such as educational level, nutritional knowledge, occupation, region of residence, wealth quintiles, food preferences and security did not directly predict dietary adequacy despite being significantly linked to it in this study.

The findings of this study align with those described by other researchers (Ogum Alangea et al., 2018; Wiafe et al., 2023c). The research findings support previous studies that have shown that adolescents in developing countries, particularly in rural areas, tend to consume plant-based diets that are based on cereals, roots, and tubers, with limited intake of animal-source foods (Aurino et al., 2017; Ijarotimi, 2013; Ochola & Masibo, 2014). The results of this study show that dietary patterns of adolescents in Ghana reflect the overall food environment in the country, which is characterized by a high availability of inexpensive starchy staples, energy-dense nutrient-poor sugar-sweetened beverages and processed foods, along with limited access to fruits, vegetables, and animal-source foods (Abizari & Ali, 2019b; Wiafe, Apprey, et al., 2023d). While these staples provide essential carbohydrates and energy, the limited intake of animal-source foods raises concerns about potential micronutrient deficiencies. These foods provide a significant source of calories but are often low in micronutrients. This can lead to micronutrient deficiencies, which can have a range of negative health consequences, including

impaired growth and development, weakened immune systems, and increased risk of chronic diseases. The consumption of local grains and tubers like millet, sorghum, maize, rice, yams, and cassava are likely deeply embedded in the cultural and culinary traditions of Ghana (Laryea et al., 2016; Noort et al., 2022). Such dietary preferences often have historical roots and contribute to the cultural identity of the population (Gyimah et al., 2021b; Laryea et al., 2016). The high consumption of energy-dense staples, such as grains, cereals, roots, and tubers, is a common feature of diets in developing countries, including Ghana. The high consumption of energy-dense nutrient-poor foods, particularly those rich in fats and sugar-sweetened beverages, is a growing concern in Ghana, as is the case in many parts of the world. These foods are often high in calories, sugar, and unhealthy fats but low in essential nutrients. This raises concerns about the nutritional quality of the diet. These foods can lead to weight gain, obesity and are often associated with adverse health outcomes, including an increased risk of chronic diseases such as heart disease, type 2 diabetes, and certain types of cancer.

5.5.3 Predictors of Adequate Dietary Diversity among Adolescents in Ghana

The research findings suggest that being a middle adolescent (aged 15-17 years) was a significant predictor for adequate dietary diversity. This may be due to improved access to a wider variety of food options. However, this advantage was not observed in late adolescents aged 18-19. Residence of the adolescent was a significant predictor for adequate dietary diversity, with urban adolescents showing higher odds of having adequate dietary diversity compared to their rural counterparts (Greatwood et al., 2023b). Urban-rural disparity in dietary diversity could be attributed to factors such as the greater availability and accessibility of diverse food options in urban areas, along with potential socioeconomic differences (Livingstone et al., 2023). The study underscores the importance of considering environmental factors, such as residence and socioeconomic status, in understanding and addressing dietary disparities among adolescents. This contrasts with findings from a study in Costa Rica which

also showed that age influenced dietary diversity (Monge-Rojas et al., 2022). However, in the Costa Rica study, rural adolescents had higher odds of achieving a diverse diet compared to urban adolescents (Monge-Rojas et al., 2022). Educational level of the adolescent was a significant predictor for adequate dietary diversity. Adolescents who had junior high school and senior high school level of education were significantly less likely to have adequate dietary diversity compared to their counterparts who had not received any formal education. This counterintuitive finding may be due to several confounding factors or the need for improved nutrition education at these educational levels. One possible explanation could be that the education system itself is not effectively addressing nutrition education. This could lead to a lack of practical knowledge about healthy eating habits and food preparation among students who have received formal education. It is also possible that the increased independence and financial autonomy of adolescents might lead them to make choices that prioritize convenience and affordability over nutritional value.

Household size emerged as a significant predictor, with adolescents in larger households (6-7 members and 8+ members) having higher odds of good dietary diversity compared to households with fewer than 4 members. This could be related to economies of scale or the ability to access a wider variety of foods in larger households. Nutritional knowledge was a significant predictor of dietary adequacy, with adolescents possessing higher levels of nutritional knowledge exhibiting adequate dietary diversity compared to those with lower levels of knowledge. Nutritional knowledge has been associated with better dietary practices and more diverse diets (Katenga-Kaunda et al., 2021; Manandhar & Kakchapati, 2023; Muthike et al., 2015). This finding underscores the importance of nutrition education in fostering healthy eating habits. It is noteworthy that possessing moderate or high levels of nutritional knowledge significantly increased the odds of good dietary diversity compared to having low levels of

knowledge. This suggests that knowledge empowers adolescents to make healthier food choices.

Additionally, the findings show that parenting style has a significant relationship with dietary diversity. Adolescents from permissive households were found to be less likely to consume adequate diverse diets compared to those from authoritative households. This result underscores the potential impact of parenting practices on dietary choices. Authoritative parenting, characterised by warmth and clear boundaries, was associated with a higher likelihood of good dietary diversity compared to permissive parenting. This suggests that a supportive and nurturing, yet structured environment may have a positive influence on food choices. Previous research has shown that both authoritative and authoritarian parenting styles were linked to improved child dietary quality, while permissive parenting was associated with lower overall dietary quality (Burke et al., 2019a). However, whereas authoritative parenting style promotes eating self-regulation, authoritarian parenting style involves pressuring a child to eat and having restrictive parental food behaviours and therefore, may contribute to more dysfunctional eating practices (Arlinghaus et al., 2017; Collins et al., 2014). Taste preferences for unhealthy food, insufficient culinary skills, and lack of knowledge regarding vegetable preparation were identified as factors hindering dietary diversity. Individuals who reported these barriers displayed lower odds of achieving optimal dietary diversity. These findings emphasize the need for interventions that focus on addressing these issues, specifically by improving taste preferences, enhancing cooking skills, and providing practical knowledge for preparing healthy meals. This underscores the significance of practical skills development.

5.6 Conclusion

This study contributes to the knowledge about adolescent dietary diversity in Ghana. Adolescents living in rural settings are at risk of low variety in their diets, often consuming high

levels of fats and oils while not getting enough micronutrient-rich foods such as fruits, vegetables, and animal products. This type of diet is nutritionally inadequate and may contribute to the problem of the double burden of malnutrition among adolescents. Meal skipping was a predictor of inadequate dietary diversity. The research findings suggest that there is a need to promote dietary diversity among adolescents. Considering that Ghana has a National Food-Based Dietary Guidelines, which aims to address the problem of unhealthy dietary behaviours, the finding strengthens the point that the guidelines should be used to promote diverse diets among adolescents in the schools and communities. This can be achieved by encouraging adolescents to consume a variety of foods from different food groups. Parents, caregivers, and schools can play a role in promoting dietary diversity by providing healthy and diverse food options, encouraging adolescents to participate in meal planning, grocery shopping, and cooking, and creating a supportive environment that encourages healthy eating habits. Nutrition education programs can also be developed to educate adolescents on the importance of dietary diversity and how to achieve it. Dietary diversity is important because it ensures that individuals consume a variety of nutrients that are essential for good health. Overall, while certain food items like cereal staples, oil, and sugar are commonly consumed, there is a need to improve dietary diversity by including a wider variety of foods such as fruits, vegetables, lean protein sources, and other animal-source foods. Encouraging a diverse and balanced diet among children and adolescents can contribute to better nutrient adequacy and overall health. Interventions should focus on the family environments of these adolescents.

5.7 Limitation of the study

The 24-hour dietary recall method has been found to be susceptible to recall bias, which may result in either an overestimation or underestimation of the foods consumed during the preceding day.

Declarations

Ethical Approval

Ethical approval for this study was obtained from the Institutional Review Board of the Noguchi Memorial Institute for Medical Research (NMIMR-IRB), University of Ghana (NMIMR-IRB CPN 051/20-21, Appendix).

Consent Issues

An informed consent statement was read to a parent or adult with primary care responsibility for the adolescent who may accept or decline to allow the adolescent to participate. Only eligible adolescents whose parents or guardians consented to participate were interviewed. Adolescents below 18 years of age signed an assent form, and those above 19 years of age signed consent forms.

Competing Interest

The authors declare that they have no competing interests.

Contributors

Conflict of Interests

The author has no conflicts of interest to disclose.

Funding

No external funding was received for this research.

Consent for publication

We hereby provide consent for publication of the manuscript detailed above, including any accompanying images or data contained within the manuscript.

Availability of data and materials

The data for this work will be made available upon request.

CHAPTER SIX

6.0 INFLUENCE OF ADVERTISING ON CONSUMER BEHAVIOUR: A STUDY OF ADOLESCENT PERCEPTION AND EXPERIENCE OF FAST-FOOD AND SUGAR-SWEETENED BEVERAGE MARKETING IN GHANA

Abstract

Background: The influence of advertising on adolescent dietary behaviours, particularly regarding fast food and sugary beverages, is significant. Research indicates that exposure to marketing strategies for high-fat, salt, and sugar (HFSS) products shapes preferences and consumption patterns among youth.

Objective: To identify the factors influencing adolescent perception and experiences related to advertisements for fast-food and sugar-sweetened beverage brands that are high in fat, salt, and sugar (HFSS).

Method: a community-based descriptive cross-sectional study design involving the collection of quantitative data. Data was collected from 667 adolescents aged 10 -19 years using a structured questionnaire. Each participant was shown marketing videos promoting sugar-sweetened beverage and a high-fat fast food product (HFSS). For each advert, participants reported on their experience and perception on eight measures on a Likert scale. The items were binary coded based on whether a positive reaction was reported or not.

Results: The Adolescents exhibited a range of positive perceptions after viewing the fast-food advertisements, with 65.7% finding the product fun, 60.7% enjoying the advertisement itself, and over half feeling the product appeared appealing (55.6%) and popular (57.0%), while 50.1% perceived it as a healthy choice. Adolescents believed that the advert made the product appear popular, appealing, and a healthy choice. Positive perception were associated with residence, age, sex, nutritional knowledge, wealth quintile and BMI. For example, adolescents residing in urban areas were more likely to perceive the fast-food advertisement, as popular (AOR 1.54, 95% CI 1.04-2.29), enjoyable (AOR 1.56, 95% CI 1.02-2.37) or tempting to try (AOR 2.32, 95% CI 1.59-3.39). They were also more likely to report that the advertisement tempted them to try the SSB product (AOR = 1.49, 95% CI: 1.03–2.14). Adolescents responded positively to sugar-sweetened beverage advertisements, with 66.5% liking the advert, 61.3% finding the product fun, and over half perceiving it as appealing (56.7%) and popular (56.2%), while 50.1% viewed it as a healthy choice. Female adolescents showed a higher likelihood of perceiving SSB advertisement as fun and appealing (AOR = 1.95, 95% CI: 1.32–2.88, and AOR = 1.53, 95% CI: 1.05–2.22, respectively).

Conclusion: The results highlight the potential influence of marketing and advertising on adolescents' food preferences and consumption behaviours, particularly in urban areas. adolescents in the Volta and Oti regions of Ghana exhibit a positive reaction to the two HFSS food adverts. Unhealthy food marketing, including fast-food and sugary drink ads, poses a significant threat to adolescents' dietary habits, particularly in urban areas. The findings support the need for policymakers and health professionals to develop effective strategies to mitigate the impact of unhealthy food marketing on adolescents' dietary habits, such as restricting advertising of unhealthy foods and promoting nutrition education. By doing so, we can help adolescents make informed choices and develop healthy eating habits that will benefit them throughout their lives.

6.1 Introduction

The advertising of fast foods significantly impacts adolescent dietary behaviours (Bagnato et al., 2023; Potvin Kent et al., 2023). These foods typically contain excessive calories, saturated fats, refined sugars, and sodium, leading to nutrient-poor diets (Ashdown-Franks et al., 2019; Costa et al., 2024; Das et al., 2017b). Research highlights several concerns. For example, fast-food meals frequently exceed recommended daily caloric intake, with children and adolescents deriving a significant portion of their daily calories from these foods (Amith et al., 2021; Palos Lucio et al., 2020). Eating fast-food has also been associated with lower intakes of fruits, vegetables, fibre and milk among adolescents (Bauer et al., 2009). Exposure to marketing strategies for high-fat, salt, and sugar (HFSS) products shapes preferences and consumption patterns among children and adolescents (Adjei et al., 2022; Bagnato et al., 2023; Taillie et al., 2019; Tsochantaridou et al., 2023b). Increased awareness of food advertisements negatively affects children's and adolescents' food acquisition and consumption (Amevinya et al., 2022b; Boyland et al., 2016) and correlates with higher consumption of unhealthy products (Gascoyne et al., 2024). Advertising of energy-dense, nutrient-poor foods and beverages is a significant public health concern (Amevinya et al., 2022b; Boyland et al., 2016). The consumption of fast food is closely linked to poor dietary quality and weight gain, particularly among adolescents (Costa et al., 2024). High fast-food intake is also, a significant predictor of obesity among adolescents, with studies showing a robust association between frequent consumption and increased body weight (Mumena et al., 2022; Potvin Kent et al., 2022; Sandeep Kumar & Dr Ashish Raina, 2024). Moreover, sugary drink marketing influences brand recall and preference among children and adolescents, emphasising the need for regulatory measures (Remedios et al., 2023).

Substantial evidence indicates that advertising negatively impacts adolescent dietary choices. While some contend that personal agency and parental guidance can help counteract these

effects, the pervasive nature of advertising often undermines these efforts, making it challenging for families to promote healthier dietary choices (Delgado et al., 2022). Ghana faces a significant public health concern due to the pervasive marketing of HFSS and ultra-processed foods, fuelled by rising modern retail outlets and widespread advertisements across television, internet, social media, and billboards and posters near schools (Amevinya et al., 2022a; Andam et al., 2018). The WHO emphasises the need for stronger policies to protect children from harmful food marketing, as excessive sugar intake leads to various health issues (WHO, 2023b). Given the established link between food advertising and dietary choices, notably among children and adolescents (Vassallo et al., 2018), it is important to understand these dynamics in context of adolescents in Ghana. Understanding how adolescents' perception and experience of HFSS advertisements could provide valuable insights for public health interventions and policies aimed at reducing obesity among adolescents. The objective of this study is to investigate the factors influencing adolescent perception and experiences related to advertisements for fast-food and sugar-sweetened beverage brands that are high in fat, salt, and sugar (HFSS). We define fast food as food that is prepared and served quickly, characterised by its convenience and affordability. It is designed to be ready-to-eat or take-away-to-eat and typically includes items that are mass-produced or processed, made with standardized ingredients. Fast food is usually made from pre-cooked or frozen ingredients that are prepared in bulk to ensure rapid service. This type of food is generally high in calories, fat, sugar, and sodium, while being low in essential nutrients, including fruits and vegetables (Kumari & Singh, 2023). This standardisation allows for uniform quality across various outlets, making it a popular choice for consumers seeking quick meal options.

To identify the factors influencing adolescent perception and experiences related to advertisements for fast-food and sugar-sweetened beverage brands that are high in fat, salt, and sugar (HFSS).

6.2 Materials and Methods

6.2.1 Study Site

The study was carried out in the Volta and Oti regions of Ghana in 2021. The two regions were selected for their diverse sociocultural backgrounds and varying levels of urbanisation, which may influence dietary behaviours differently. The two regions together cover a land area of 20,570 km², representing 8.6% of Ghana's total land area. The Volta Region has 17 districts and municipalities and its capital is Ho, while the Oti Region has 8 districts with Dambai as the capital. They are located at the eastern border of Ghana, west of Republic of Togo and east of Lake Volta, bordered by the Gulf of Guinea to the south, with adjacent boundaries shared with Northern Region to the north and Bono East Region to the west. The main occupations are farming, livestock rearing, trading, fishing, and employment in public/private sectors. The regions experience a bimodal rainfall regime with a prolonged dry season. Rainfall patterns range from 1,168mm to 2,103mm per year, with the northern areas being more arid. A significant portion of the regions falls within the Volta River Basin and its tributaries.

6.2.2 Study Design and Participants

This was a community-based descriptive cross-sectional study design involving the collection of quantitative. Data was collected from 667 adolescents aged 10 -19 years.

6.2.3 Study Participants

Study participants were adolescents aged 10-19 years from the Volta and Oti regions of Ghana. In all, 667 adolescents, 10-19 years old, participated in this study.

6.2.4 Inclusion and Exclusion Criteria

The study included adolescents aged 10-19 from the Volta and Oti regions who voluntarily agreed to participate, with parental approval for minors (<18 years). Adolescents with

disabilities affecting anthropometric measurements, non-assenting or non-consenting individuals and adolescents without permission from parents were excluded.

6.2.5 Sample Size Determination

The sample size was calculated using Yamane's formula, $n = N \div (1 + Ne^2)$, with a projected adolescent population of 589,513 in the Volta and Oti regions in 2020. A confidence level of 95%, a standard value of 1.96, and a population proportion representing the prevalence of adolescent overweight and obesity at 14.7% were considered. The margin of error set at 5% was factored in, along with a design effect coefficient of 1.5 to cater to any potential biases caused by clustering within the sampling process and a chosen non-response rate resulting in a final sample size of 667.

6.2.6 Sampling Procedure

This study employed a two-stage stratified sampling design, utilizing the 2017 Ghana Living Standards Survey round 7 (GLSS 7) master sampling frame. At the first stage 46 enumeration areas (EAs) were selected from a total of 96 EAs to form the Primary Sampling Units (PSUs). The PSUs were allocated to the two administrative regions (Volta and Oti) using probability proportional to population size (PPS). The EAs were further stratified into urban and rural localities of residence. At the second stage, a comprehensive listing of households in the selected PSUs was used to systematically select 15 households from each PSU to form the Secondary Sampling Units (SSUs). Maps were used to locate the houses for sampling. The total sample size consisted of 675 adolescents from the two regions.

6.2.7 Data Collection Procedure

Data were collected using a structured questionnaire administered by trained nutrition graduates in English, Ewe, Twi or other languages as required. The instrument was pre-tested for validity

and reliability on 15 adolescents with similar characteristics. Data collected included participants' demographic information and individual characteristics, reactions to HFSS advertisements. Data were recorded using the Kobo Toolbox. Health education sessions were conducted for the participants after data collection. Data were collected from August 2021 to March 2022.

6.2.8 Data Collection Tools

6.2.8.1 Advertising Creatives for HFSS Foods

Two representative HFSS food adverts, instant noodles advert (advert 1), and carbonated soft drinks advert (advert 2) were used to assess participants' reactions to the marketing strategies employed in promoting food products. According to the NOVA classification, the two products are classified as ultra-processed foods. The first advert showcased a popular fast-food instant noodle brand, while the second advert featured a sugar-sweetened carbonated beverage brand. These specific adverts were selected to represent well-known brands whose products typically fall under the category of energy-dense, nutrient-poor foods. To ensure that participants' experience and perceptions were not influenced by external factors, such as price offers, promotions, or competitions, these elements were deliberately excluded from the adverts. Video adverts were chosen as the medium of exposure because they closely resembled the type of content typically seen on television during advertising/commercial breaks and online platforms, such as social media. Both adverts had received approval from the Ghana Food and Drugs Authority (FDA) and had been aired on TV channels and available online (specifically on YouTube) between the years 2021 and 2022, which coincided with the data collection period of this study.

6.2.8.2 Reactions to Adverts for HFSS Foods

The method used for this study on children's and adolescents' reactions to adverts for the ultra-processed (HFSS) foods was based on the study conducted by Critchlow et al. (Critchlow et al., 2020). Each participant was shown marketing videos promoting high-fat, -sugar, and -salt (HFSS) foods. After each video, the participant was asked to confirm if they had been able to watch the entire content of the video (advert) (Yes/No). If they answered "No", they were given a second chance to watch the video. Only participants who confirmed watching the advertisement proceeded to the next step. For those who confirmed watching the advert, they were then asked to rate the extent to which the advert influenced their perceptions using the following Likert scale items:

1. Does not tempt me to try [product] / Tempts me to try the [product].
2. Makes [product] seem unappealing / Makes [product] seem appealing.
3. Advert is boring / Advert is fun.
4. Made [product] seem unhealthy choice / Made [product] seem healthy choice.
5. Made [product] seem unpopular choice / Made [product] seem popular choice.
6. Made me think that having [product] is boring / Made me think that having [product] is fun.
7. Would be unappealing to people my age / Would be appealing to people my age.
8. I dislike this advert / I like this advert.

6.2.9 Assessment of Nutrition Knowledge

Adolescents' nutritional knowledge was assessed using a questionnaire adapted from the General Nutrition Knowledge Questionnaire (GNKQ) (GNKQ) (Kliemann et al., 2016). The GNKQ is structured into four sections, each encompassing different categories of questions pertaining to nutrition and dietary choices: 1. recommendations from experts and adherence to dietary guidelines; 2. understanding of specific foods and their nutrient contents; 3. identifying

healthier food options, 4. physical activity. Each question in the questionnaire was designed to have only one correct answer, and participants were awarded one point for each correct response. Composite scores for nutrition knowledge were computed then divided into tertiles (as low, moderate, or high nutrition knowledge levels) for regression analyses. In all, 27 questions were used to assess nutritional knowledge. Composite scores were generated and Cronbach's alpha reliability generated. Cronbach's α reliability coefficient was 0.82.

6.2.10 Food Security Status

The Household Food Insecurity Access Scale (HFIAS) tool, developed by USAID's Food and Nutrition Technical Assistance (FANTA) Project in 2006, was used to assess Food Insecurity Status (FIS) (Coates Jennifer et al., 2007). The HFIAS instrument has been previously validated in Burkina Faso (Frongillo & Nanama, 2006) and Tanzania (Knueppel et al., 2010).

6.2.11 Data Analysis

The data were analysed using STATA version 17. The data collected covered multiple dimensions of experience and perceptions of advertisements, including temptation, appeal, fun, health perception, popularity perception, personal relevance, age appeal, and overall liking, and used to assess the impact of fast-food advertising on adolescents' attitudes and perceptions towards HFSS foods. Each of these measures was scored on a five-point Likert scale, with responses ranging from 1 (e.g., "Made [product] seem unpopular choice") to 5 (e.g., "Made [product] seem popular choice"). The scale responses were coded into two categories: positive experience and perceptions (codes 4 and 5) and neutral/negative experience and perceptions (codes 1-3). This approach allowed for the assessment of participants' immediate reactions to the adverts and provided insights into the influence of advertising on their perceptions and attitudes towards the two HFSS foods. Binary logistic regression analyses were performed to examine the associations between demographic and individual factors, BMI and food security

on the one hand and adolescents' experience and perceptions to HFSS food advertisements. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were calculated, and p-values were determined to assess the statistical significance of the associations.

6.2.11.1 Data Quality Control

Before data collection, the questionnaire instrument was pretested on 15 adolescents in a district, which was not a part of the actual data collection area. Based on feedback from the pretest, adjustments were made to the questionnaire. The principal investigator provided two days of training to data collectors and supervisors on the data collection tools, data collection techniques, interview approaches, and ensuring respondent privacy and confidentiality. Each day, after data collection, supervisors and the principal investigator reviewed the questionnaires for completeness and provided feedback to the data collectors.

6.2.12 Ethical Considerations

Ethical approval for this study was obtained from the Noguchi Memorial Institute for Medical Research Institutional Review Board (NMIMR-IRB), University of Ghana (NMIMR-IRB CPN 051/20-21). Before participating in the research, all participants were fully informed about the study's purpose, potential risks and benefits, and the data collection process. They were also assured of confidentiality, anonymity, the measures in place to protect their information and how the research findings would be shared. Participation was entirely voluntary. For minors under 18, both their assent (via a signed assent form) and their parents' or guardians' consent were obtained (via a signed consent form). Participants 18 years and older provided their consent directly by signing a consent form, acknowledging their understanding and willingness to participate in the study. Participants were free to withdraw their consent at any time, and without providing any reason.

6.3 Results

The target sample size for this study was 667, but this goal was exceeded by collecting data from 675 participants. Following a thorough review for completeness and data cleaning, the final analysis included 667 participants, meeting the initial sample size requirement.

6.3.1 Experiences and perceptions of an Advertisement for a Fast-Food Brand that is High in Fat and Salt

Adolescents exhibited a range of positive perceptions after viewing fast-food advertisements, with 65.7% finding the product fun, 60.7% enjoying the advertisement itself, and over half feeling the product appeared appealing (55.6%) and popular (57.0%), while 50.1% perceived it as a healthy choice (Table 6.1).

Table 6.1: Positive experiences and perceptions to an advertisement for a fast-food brand that is high in fat and salt (Advert 1)

Perception of the Fast-Food Advert	Total Positive Reactions	Perception by Age Group		
		10-14	15-17	18-19
	n (%)	n (%)	n (%)	n (%)
Tempted them to try product	306(45.9)	135(55.1)	135(46.9)	64(47.8)
Made product look appealing	371(55.6)	147(60.0)	160(55.6)	64(47.8)
Advert was fun	405(60.7)	148(60.4)	182(63.2)	75(56.0)
Made product seem a healthy choice	334(50.1)	124(50.6)	144(50.0)	56(41.8)
Made product seem popular choice	380(57.0)	147(60.0)	165(57.3)	68(50.8)
Appealing to age group	388(58.2)	147(60.0)	170(59.0)	71(53.0)
Made product seem fun	438(65.7)	155(63.3)	200(69.4)	83(61.9)
Liked the advert	324 (48.6)	126(51.4)	142(49.3)	58(43.3)

After adjusting for potential covariates, the binary logistic regressions revealed that adolescents residing in urban areas were more likely to perceive the product as popular (AOR 1.54, 95% CI 1.04-2.29, $p = 0.032$) compared to their rural counterparts (Table 6.2). Furthermore, adolescents in urban areas had higher odds of finding the advertisement enjoyable (AOR 1.56, 95% CI 1.02-2.37, $p = 0.038$) compared to their rural counterparts, indicating that the urban environment makes the advertisement more appealing to them. Moreover, adolescents from urban areas were

more likely to experience the temptation to try the product (AOR 2.32, 95% CI 1.59-3.39, $p < 0.001$) compared to those from rural areas.

In terms of gender, the findings revealed that male adolescents had higher odds of finding the fast-food noodle brand product fun (AOR 1.46, 95% CI 1.01-2.12, $p = 0.045$) compared to females. Additionally, males had 1.67 times higher odds of finding the advertisement fun (AOR 1.67, 95% CI 1.13-2.48, $p = 0.010$) compared to females. Furthermore, males had 1.53 times higher odds of perceiving the product as appealing (AOR 1.53, 95% CI 1.05-2.22, $p = 0.027$) compared to females.

Adolescents in the 15-17 age group were less likely to perceive the fast food noodle product as popular (AOR 0.37, 95% CI: 0.22-0.60, $p < 0.001$), find it age appealing (AOR 0.43, 95% CI: 0.27-0.68, $p < 0.001$), perceive it as product fun (AOR 0.58, 95% CI: 0.36-0.92, $p = 0.021$), and experience the temptation to try the product (AOR 0.38, 95% CI: 0.23-0.61, $p < 0.001$) compared to those in the 10-14 age group. Adolescents in the 18-19 age group were even less likely to perceive the fast food noodle product as popular (AOR 0.25, 95% CI: 0.13-0.48, $p < 0.001$), find it age appealing (AOR 0.28, 95% CI: 0.15-0.52, $p < 0.001$), perceive it as product fun (AOR 0.33, 95% CI: 0.18-0.63, $p = 0.001$), find it product appealing (AOR 0.22, 95% CI: 0.11-0.42, $p < 0.001$), and experience the temptation to try the product (AOR 0.38, 95% CI: 0.21-0.72, $p = 0.003$) compared to those in the 10-14 age group.

Adolescents in the third wealth quintile were more likely to experience the temptation to try the fast-food noodles due to the advert while those in the fourth wealth quintile were more likely to perceive the fast-food noodle advert as healthy and experience the temptation to try the product (AOR=4.12, 95% CI: 1.10-15.37, $p=0.035$) and (AOR=5.47, 95% CI: 1.31-22.84, $p=0.020$), (AOR=4.11, 95% CI: .12-15.08, $p=0.033$) respectively. Adolescents in the fifth

wealth quintile reported that the advertisement made them more likely to find the product healthy and also tempted to try fast food (AOR= 4.49, 95% CI: 1.05-19.26) $p=0.043$), and (AOR=4.53, 95% CI: 1.20-17.06, $p=0.026$).

Adolescents who experienced severe food insecurity had significantly lower odds of perceiving the noodle product as healthy compared to food-secure adolescents (AOR=0.49, 95% CI: 0.29-0.85, $p=0.010$). Additionally, severely food-insecure adolescents reported that the advertisement made them less likely to be tempted to try fast food (AOR=0.50, 95% CI: 0.29-0.85, $p=0.010$). Adolescents who were overweight had significantly lower odds of perceiving the fast-food noodle advertisement as appealing to their age and fun (AOR=0.58, 95% CI: 0.35-0.97, $p=0.037$) and (AOR=0.54, 95% CI: 0.31-0.92, $p=0.023$). Adolescents with moderate and high nutritional knowledge were more likely than those with low nutritional knowledge to have positive reactions for all eight measures for the fast-food noodle advert. The results show a clear positive relationship between nutritional knowledge and reactions to fast-food advertisements.

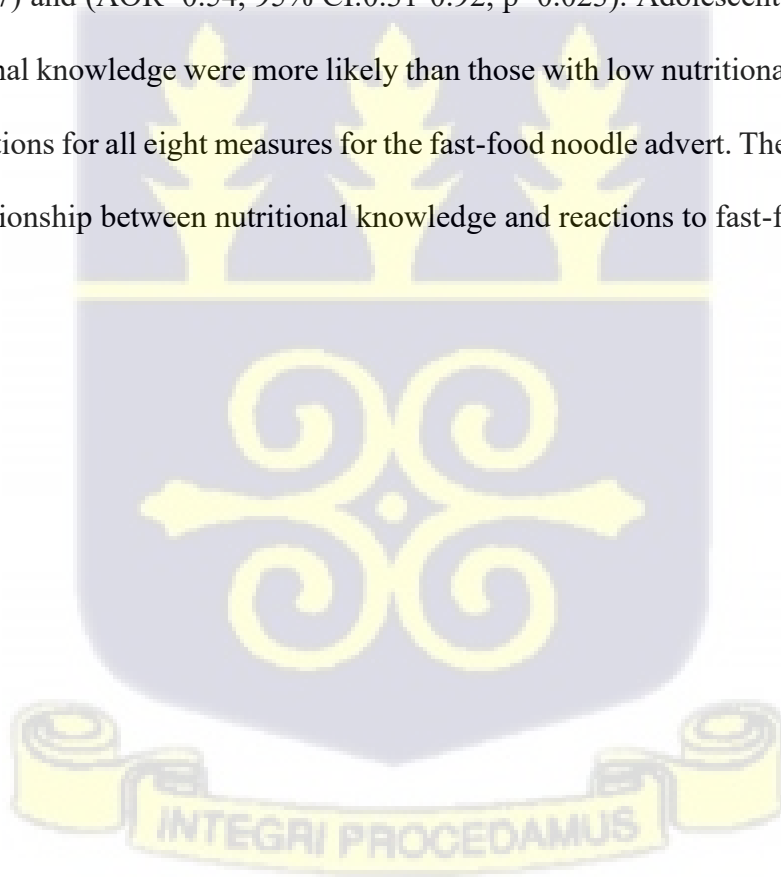


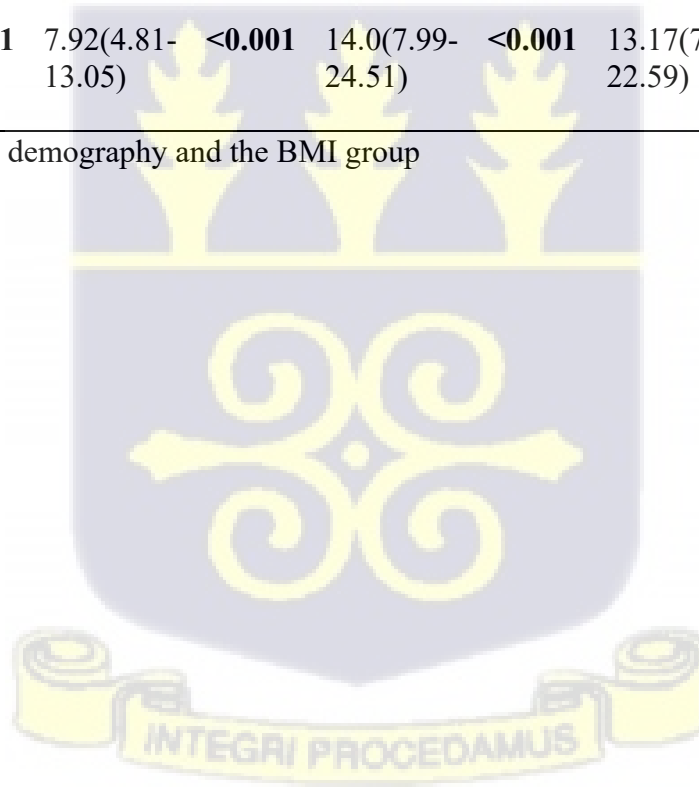
Table 6.2: Bivariate logistic regression analysis of adolescent perception of an advertisement for a fast-food brand that is high in fat and salt

Covariates	Seemed Popular		Age Appeal		Product Fun		Advert Fun		Product Appealing		Product Healthy		Temptation to Try	
	AOR	p	AOR	p	AOR	P	AOR	p	AOR	p	AOR	p	AOR	P
Residence														
Rural	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Urban	1.54(1.04-2.29)	0.032	1.36(0.93-1.99)	0.114	1.03(0.69-1.52)	0.887	1.56(1.02-2.37)	0.038	1.26(0.85-1.85)	0.247	2.32(1.59-3.39)	<0.001	1.32(0.91-1.93), 0.143	
Gender														
Female	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Male	1.28(0.88-1.87)	0.199	0.89(0.62-1.28)	0.536	1.46(1.01-2.12)	0.045	1.67(1.13-2.48)	0.010	1.53(1.05-2.22)	0.027	0.86(0.59-1.25)	0.428	1.21(0.84-1.74),0.302	
Age														
10-14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
15-17	0.37(0.22-0.60)	<0.001	0.43(0.27-0.68)	<0.001	0.58(0.36-0.92)	0.021	0.87(0.54-1.41)	0.576	0.36(0.22-0.59)	<0.001	0.59(0.37-0.96)	0.034	0.38(0.23-0.61), <0.001	
18-19	0.25(0.13-0.48)	<0.001	0.28(0.15-0.52)	<0.001	0.33(0.18-0.63)	0.001	0.58(0.31-1.11)	0.098	0.22(0.11-0.42)	<0.001	0.41(0.22-0.77)	0.006	0.38(0.21-0.72), 0.003	
Educational level														
None	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Primary	0.70(0.23-2.09)	0.525	0.79(0.29-2.21)	0.659	1.42(0.49-4.03)	0.512	1.02(0.36-2.91)	0.966	0.50(0.17-1.46)	0.207	3.12(0.91-10.73)	0.071	1.50(0.49-4.64), 0.480	
JHS/JSS	1.34(0.49-3.71)	0.570	1.79(0.69-4.63)	0.231	2.10(0.79-5.59)	0.137	1.11(0.42-2.96)	0.834	0.74(0.28-1.99)	0.553	3.04(0.94-9.76)	0.062	2.07(0.72-5.97), 0.179	
SHS/SSS	1.33(0.46-3.84)	0.592	1.82(0.68-4.91)	0.234	2.69(0.97-7.42)	0.056	0.74(0.26-2.08)	0.567	0.82(0.29-2.28)	0.699	2.39(0.7-7.89)	0.150	1.58(0.3-4.67), 0.412	

Tertiary	0.92(0.21-4.06)	0.907	2.46(0.56-10.77)	0.233	2.86(0.65-12.69)	0.166	0.72(0.15-3.43)	0.685	0.61(0.14-2.62)	0.505	4.29(0.88-20.92)	0.071	2.33(0.51-10.65), 0.277	
Wealth quintiles														
First	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Second	1.23(0.36-4.16)	0.741	2.14(0.64-7.08)	0.215	0.67(0.22-2.05)	0.483	0.54(0.18-1.58)	0.258	2.13(0.59-7.62)	0.245	2.95(0.62-14.14)	0.176	3.9(0.87-14.81), 0.076	
Third	1.26(0.66-2.46)	0.685	2.45(0.81-7.39)	0.113	1.21(0.44-3.28)	0.709	0.54(0.20-1.44)	0.217	2.75(0.84-9.01)	0.094	3.72(0.87-15.81)	0.076	4.12(1.10-15.37), 0.035	
Fourth	1.52(0.50-4.55)	0.459	2.12(0.71-6.31)	0.178	1.19(0.44-3.24)	0.726	0.73(0.27-1.93)	0.525	4.19(1.29-13.51)	0.016	5.47(1.31-22.84)	0.020	4.11(1.12-15.08), 0.033	
Fifth	1.47(0.47-4.58)	0.509	2.21(0.71-6.81)	0.169	1.42(0.51-4.01)	0.510	0.91(0.33-2.52)	0.850	3.19(0.96-10.65)	0.058	4.49(1.05-19.26)	0.043	4.53(1.20-17.06), 0.026	
Food security														
Food secure	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mildly food insecure	0.78(0.47-1.29)	0.339	0.95(0.58-1.54)	0.829	0.73(0.47-1.19)	0.209	0.99(0.58-1.68)	0.965	0.89(0.54-1.46)	0.639	1.18(0.72-1.91)	0.511	0.80(0.49-1.29),.369	
Moderately food insecure	1.28(0.66-2.46)	0.468	1.48(0.79-2.80)	0.222	1.03(0.55-1.93)	0.934	1.06(0.55-2.04)	0.871	1.65(0.86-3.17)	0.133	1.73(0.91-3.29)	0.096	1.43(0.76-2.69), 0.263	
Severely food insecure	0.49(0.29-0.84)	0.009	0.59(0.36-1.0)	0.052	0.61(0.36-1.03)	0.065	0.64(0.37-1.11)	0.112	0.68(0.39-1.15)	0.150	0.49(0.29-0.85)	0.010	0.50(0.29-0.85), 0.010	
BMI														
Normal	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Moderate thinness	0.78(0.30-2.01)	0.604	0.93(0.37-2.35)	0.884	0.82(0.32-2.07)	0.671	0.80(0.31-2.09)	0.649	1.44(0.56-3.72)	0.453	0.67(0.25-1.77)	0.420	0.53(0.20-1.38), 0.192	

Severe thinness	0.55(0.19-1.54)	0.254	0.56(0.21-1.53)	0.262	0.39(0.15-1.05)	0.062	1.04(0.36-2.98)	0.939	0.83(0.29-2.39)	0.734	0.45(0.16-1.26)	0.129	0.89(0.33-2.43), 0.822
Overweight	0.63(0.37-1.07)	0.087	0.58(0.35-0.97)	0.037	0.90(0.53-1.52)	0.700	0.54(0.31-0.92)	0.023	0.76(0.45-1.27)	0.296	0.83(0.49-1.40)	0.494	0.77(0.47-1.28), 0.320
Obesity	0.89(0.52-1.51)	0.659	1.02(0.61-1.71)	0.927	9.86(0.52-1.44)	0.576	0.63(0.37-1.07)	0.087	1.18(0.69-2.01)	0.538	0.94(0.55-1.61)	0.812	1.08(0.64-1.82), 0.777
Nutritional knowledge													
Low	1	1	1	1	1	1	1	1	1	1	1	1	1
Moderate	4.04(2.43-6.72)	<0.001	3.32(2.04-5.40)	<0.001	2.81(1.74-4.52)	<0.001	2.45(1.52-3.96)	<0.001	4.10(2.47-6.82)	<0.001	4.57(2.65-7.76)	<0.001	3.44(2.06-5.74), <0.001
High	14.79(8.58-25.48)	<0.001	9.84(5.88-16.45)	<0.001	7.92(4.81-13.05)	<0.001	14.0(7.99-24.51)	<0.001	13.17(7.68-22.59)	<0.001	9.28(5.40-15.95)	<0.001	11.11(6.52-18.92), <0.001

Perception of fast-food advert and associations with demography and the BMI group



6.3.1.1 Association Between Adolescents' Perception of Adverts for Fast-Food Brand that is High in Fat, Salt Dietary Adequacy

Adolescents' reactions to fast-food advertising were associated with their dietary adequacy. Adolescents who found fast-food advertising made product seem popular choice, appealing to their age group, made product seem fun, fun, made product look appealing, tempting and who believed that fast food was a healthy choice were more likely to have inadequate dietary adequacy ($p < 0.001$) (Table 6.3).



Table 6.3: Association between adolescents' perception of adverts for fast-food brand that is High in Fat, Salt dietary adequacy

Variable	Dietary Diversity		X ² (p-value)/Fisher's exact
	Inadequate 422(63.3)	Adequate 245(36.7)	
Made product seem popular choice			37.37(<0.001)
Negative	74(44.3)	93(55.6)	
Neutral	96(49.5)	98(50.5)	
Positive	75(24.5)	231(75.5)	
Appealing to age group			26.26(<0.001)
Negative	35(36.8)	60(63.2)	
Neutral	102(50.8)	99(49.2)	
Positive	108(29.1)	263(70.9)	
Made product seem fun			34.80(<0.001)
Negative	21(41.2)	30(58.8)	
Neutral	110(52.1)	101(47.9)	
Positive	114(28.2)	291(71.8)	
Advert was fun			27.55(<0.001)
Negative	43(33.6)	85(66.4)	
Neutral	105(51.2)	100(48.8)	
Positive	97(29.0)	237(71)	
Made product look appealing			36.55(<0.001)
Negative	29(40.3)	43(59.7)	
Neutral	112(52.1)	103(47.9)	
Positive	104(27.4)	276(72.6)	
Liked the advert			28.48 (<0.001)
Negative	18(17.3)	86(82.7)	
Neutral	112(47.3)	125(52.7)	
Positive	115(35.3)	211(64.7)	
Tempted them to try product			16.63 (<0.001)
Negative	25(41.0)	36(59.0)	
Neutral	102(46.8)	116(53.2)	
Positive	118(30.4)	270(69.6)	
Made product seem a healthy choice			41.94 (<0.001)
Negative	10(27.0)	27(73.0)	
Neutral	107(55.7)	85(44.3)	
Positive	128(29.2)	310(70.8)	

6.3.2 Perception of an Advertisement for a Sugar-Sweetened Beverage Brand (Advert 2)

Adolescents responded positively to sugar-sweetened beverage advertisements, with 66.5% liking the advert, 61.3% finding the product fun, and over half perceiving it as appealing (56.7%) and popular (56.2%), while 50.1% viewed it as a healthy choice (Table 6.4).

Table 6.4: Positive Perceptions of an advertisement for a sugar-sweetened beverage brand (Advert 2)

Type of Reactions to sugar-sweetened beverage Advert	Total Positive Reactions	Reaction by Age Groups		
		10-14	15-17	18-19
	n (%)	n (%)	n (%)	n (%)
Tempted them to try product	320(48.)	125(51.0)	136(47.2)	59(44.0)
Made product look appealing	378(56.7)	144(58.8)	166(57.6)	68(50.8)
Advert was fun	402(60.3)	140(57.1)	182(63.2)	80(59.7)
Made product seem a healthy choice	334(50.1)	135(55.1)	135(46.9)	64(47.8)
Made product seem popular choice	375(56.2)	147(60.0)	162(56.3)	66(49.3)
Appealing to age group	378(56.7)	142(58.0)	165(57.3)	71(53.0)
Made product seem fun	409(61.3)	155(63.3)	177(61.5)	77(57.5)
Liked the advert	444(66.5)	153(62.5)	201(69.8)	90(67.2)
Total	667	245	288	134

5.3.2.1 Bivariate Logistic Regression Analysis of Adolescent Perceptions of an

Advertisement for a Sugar-Sweetened Beverage Brand

Residence and Gender: The study found that adolescents residing in urban areas were nearly twice as likely to express a positive perception of the SSB advertisement, indicating a preference for the product (AOR = 1.97, 95% CI: 1.18-2.69, $p = 0.006$) (Table 6.5). They were also more likely to report that the advertisement tempted them to try SSBs (AOR = 1.49, 95% CI: 1.03–2.14, $p = 0.03$). Additionally, females showed a higher likelihood of finding the sugar-sweetened beverage advertisement fun and making the product appealing compared to males (AOR = 1.95, 95% CI: 1.32–2.88, $p = 0.001$, and AOR = 1.53, 95% CI: 1.05–2.22, $p = 0.027$, respectively). Age: Adolescents aged 15-17 had lower odds of reacting positively to the sugar-sweetened beverage advertisement in almost all aspects, including perceiving it as popular, having age appeal, being fun, making the product appealing, appearing healthy, and tempting them to try ($p < 0.001$, $p = 0.004$, $p = 0.027$, $p < 0.001$, $p < 0.001$, and $p = 0.006$, respectively). Conversely, adolescents aged 18-19 were more likely than their counterparts to have positive reactions in seven out of eight measures, with the exception of liking the advertisement ($p = 0.283$).

Wealth Quintiles: Adolescents in the 3rd, 4th, and 5th wealth quintiles were more likely to react positively to the sugar-sweetened beverage advertisement, particularly in terms of perceiving the product as healthy (AOR = 4.11, 95% CI: 1.12–15.37, $p = 0.035$, AOR = 4.11, 95% CI: 1.12–15.08, $p = 0.033$, AOR = 4.53, 95% CI: 1.12–17.06, $p = 0.026$, respectively). Adolescents in the 4th wealth quintile were also more likely to report that the advertisement made the product appealing (AOR = 4.19, 95% CI: 1.29–13.51, $p = 0.016$). Adolescents in the 5th wealth quintile reported that the advertisement made them more likely to be tempted to try SSBs (AOR = 3.23, 95% CI: 1.02–10.23, $p = 0.046$). Food Security: Adolescents who experienced severe food insecurity had significantly lower odds of perceiving the sugar-sweetened beverage product as popular compared to food-secure adolescents (AOR 0.57, 95% CI 0.34-0.97, $p = 0.040$). Additionally, severely food-insecure adolescents had significantly lower odds of finding the advertisement fun compared to their food-secure counterparts (AOR 0.39, 95% CI 0.24-0.67, $p = 0.001$). These individuals also had significantly lower odds of perceiving the product as appealing (AOR 0.52, 95% CI 0.31-0.87, $p = 0.013$) and feeling tempted to try the product (AOR 0.50, 95% CI 0.29-0.85, $p = 0.010$) compared to their food-secure peers. Nutritional Knowledge: Adolescents with moderate and high nutritional knowledge were more likely than those with low nutritional knowledge to have positive reactions for all eight measures of the sugar-sweetened beverage advertisement. The results show a clear positive relationship between nutritional knowledge and reactions to SSB advertisement.



Table 6.5: Bivariate logistic regression analysis of adolescent reaction to an advertisement for a sugar-sweetened beverage brand

Reactions to sugar-sweetened beverage advert																
Covariates	Seemed Popular		Age Appeal		Product Fun		Advert Fun		Product Appealing		Liked Adver		Product Healthy		Temptation to Try	
	AOR	p	AOR	p	AOR	p	AOR	p	AOR	p	AOR	p	AOR	p	AOR	P
Residence																
Rural	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Urban	1.16(0.79-1.72)	0.444	1.19(0.81-1.77)	0.370	0.96(0.65-1.40)	0.820	0.89(0.59-1.33)	0.559	1.26(0.85-1.86)	0.247	1.79(1.18-2.69)	0.006	1.32(0.91-1.93)	0.143	1.49(1.03-2.14)	0.032
Gender																
Male	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Female	1.23(0.85-1.79)	0.275	1.26(0.7-1.83)	0.219	1.02(0.71-1.47)	0.915	1.95(1.32-2.88)	0.001	1.53(1.05-2.22)	0.027	1.31(0.89-1.92)	0.165	1.21(0.84-1.74)	0.302	0.93(0.65-1.32)	0.681
Age																
10-14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
15-17	0.38(0.24-0.62)	<0.001	0.51(0.32-0.81)	0.004	0.43(0.27-0.69)	<0.001	0.68(0.42-1.09)	0.116	0.36(0.22-0.59)	<0.001	0.77(0.48-1.24)	0.283	0.38(0.23-0.61)	<0.001	0.53(0.34-0.84)	0.006
18-19	0.22(0.11-0.42)	<0.001	0.37(0.19-0.70)	0.002	0.29(0.16-0.56)	<0.001	0.39(0.20-0.76)	0.006	0.22(0.11-0.42)	<0.001	0.63(0.33-1.18)	0.148	0.38(0.21-0.72)	0.003	0.42(0.23-0.77)	0.005
Educational level																
None	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Primary	0.88(0.31-2.51)	0.816	1.51(0.55-4.17)	0.422	0.75(0.27-2.09)	0.577	0.72(0.25-2.08)	0.540	0.50(0.17-1.46)	0.207	0.73(0.27-1.95)	0.532	1.50(0.49-4.64)	0.480	1.09(0.39-3.07)	0.858
JHS/JSS	1.09(0.41-2.89)	0.860	1.72(0.67-4.41)	0.257	1.61(0.62-4.19)	0.332	0.66(0.24-1.77)	0.406	0.74(0.28-1.99)	0.553	1.31(0.53-3.28)	0.561	2.07(0.72-5.97)	0.179	1.17(0.44-3.06)	0.753
SHS/SSS	1.31(0.41-3.59)	0.600	1.89(0.71-5.05)	0.199	1.83(0.67-4.97)	0.236	1.25(0.45-3.52)	0.669	0.82(0.29-2.2)	0.699	1.48(0.57-3.87)	0.424	1.58(0.53-4.67)	0.412	1.07(0.39-2.91)	0.891
Tertiary	1.87(0.41-8.59)	0.422	1.96(0.44-8.82)	0.380	1.79(0.42-7.63)	0.433	1.58(0.31-7.89)	0.580	0.61(0.14-2.62)	0.505	1.58(0.35-7.23)	0.556	2.32(0.51-10.65)	0.277	2.63(0.61-11.49)	0.196
Wealth quintiles																
First	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Second	1.15(0.35-3.74)	0.817	1.39(0.46-4.23)	0.554	1.39(0.44-4.46)	0.576	0.39(0.12-1.23)	0.108	2.13(0.59-7.62)	0.245	0.69(0.24-2.01)	0.495	3.59(0.87-14.81)	0.076	1.55(0.44-5.41)	0.495
Third	1.48(0.50-4.36)	0.479	1.35(0.49-3.72)	0.556	1.67(0.58-4.86)	0.344	0.82(0.29-2.27)	0.701	2.75(0.84-9.01)	0.094	0.97(0.37-2.54)	0.944	4.12(1.10-15.37)	0.035	2.20(0.1-6.87)	0.173
Fourth	1.72(0.59-5.01)	0.321	1.25(0.46-3.39)	0.663	1.37(0.47-32)	0.557	0.59(0.21-1.63)	0.310	4.19(1.29-13.51)	0.016	0.55(0.21-1.46)	0.230	4.11(1.12-15.08)	0.033	2.24(0.73-6.87)	0.158
Fifth	1.19(0.39-3.60)	0.756	0.92(0.33-2.61)	0.870	1.61(0.54-4.79)	0.389	0.69(0.24-2.0)	0.499	3.19(0.96-10.65)s	0.058	0.95(0.34-2.62)	0.915	4.53(1.20-17.06)	0.026	3.23(1.02-10.23)	0.046

Food security																
Food secure	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mildly food insecure	0.72(0.44-1.17)	0.186	0.84(0.51-1.38)	0.483	0.83(0.51-1.35)	0.459	1.01(0.60-1.70)	0.957	0.89(0.54-1.46)	0.639	0.59(0.35-0.97)	0.041	0.80(0.49-1.29)	0.369	0.69(0.44-1.11)	0.131
Moderately food insecure	1.46(0.76-2.82)	0.259	1(0.57-2.05)	0.808	1.06(0.57-1.98)	0.847	1.15(0.59-2.21)	0.682	1.65(0.86-3.17)	0.133	0.81(0.43-1.54)	0.527	1.43(0.76-2.69)	0.263	1.89(1.03-3.49)	0.040
Severely food insecure	0.57(0.34-0.97)	0.040	0.39(0.24-0.67)	0.001	0.52(0.31-0.87)	0.013	0.65(0.389-1.11)	0.116	0.68(0.39-1.15)	0.150	0.53(0.31-0.92)	0.023	0.50(0.29-0.85)	0.010	0.71(0.43-1.17)	0.177
BMI																
Normal	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Moderate thinness	1.42(0.55-3.65)	0.470	1.95(0.73-5.17)	0.180	2.12(0.81-5.53)	0.124	1.94(0.60-1.70)	0.108	1.44(0.56-3.72)	0.453	1.37(0.52-3.67)	0.525	0.53(0.2-1.38)	0.192	1.59(0.65-3.96)	0.310
Severe thinness	0.64(0.23-1.79)	0.392	1.37(0.49-3.77)	0.545	0.95(0.35-2.62)	0.921	0.82(0.29-2.27)	0.701	0.83(0.29-2.39)	0.734	0.97(0.36-2.56)	0.940	0.89(0.33-2.43)	0.822	0.64(0.24-1.72)	0.379
Overweight	0.81(0.48-1.37)	0.436	0.73(0.44-1.23)	0.238	0.83(0.49-1.38)	0.463	0.59(0.21-1.63)	0.310	0.76(0.45-1.27)	0.296	0.68(0.39-1.15)	0.151	0.77(0.47-1.29)	0.320	0.64(0.39-1.05)	0.080
Obesity	1.61(0.94-2.74)	0.081	1.54(0.91-2.60)	0.106	1.15(0.69-1.92)	0.598	0.69(0.24-2.0)	0.499	1.18(0.69-2.01)	0.538	0.84(0.50-1.41)	0.512	1.08(0.64-1.82)	0.777	1.12(0.67-1.86)	0.669
Nutritional knowledge																
Low	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Moderate	4.15(2.49-6.92)	<0.001	3.29(2.02-5.36)	<0.001	3.74(2.28-6.12)	<0.001	6.52(3.88-10.97)	<0.001	4.10(2.47-6.82)	<0.001	3.22(1.98-5.22)	<0.001	3.47(2.06-5.74)	<0.001	3.78(2.28-6.28)	<0.001
High	16.09(9.28-27.93)	<0.001	11.37(6.71-19.25)	<0.001	11.46(6.82-19.25)	<0.001	15.92(9.25-27.41)	<0.001	13.17(7.68-22.59)	<0.001	7.89(4.73-13.15)	<0.001	11.11(6.52-18.92)	<0.001	7.15(4.28-11.92)	<0.001



6.3.2.2 Association Between Adolescents' Perceptions of Adverts for Sugar-Sweetened Beverage Brand and Dietary Adequacy

Adolescents with inadequate dietary diversity were more likely to have a "Positive" perception of the product's popularity choice (74.1%) compared to those with adequate dietary diversity (25.9%) ($p < 0.001$) (Table 6.6). A similar trend was observed in adolescents' perceptions of the advertisement's appeal to their age group. Those with inadequate dietary diversity had a "Positive" perception in 72.5% of cases, while it was 27.5% for those with adequate dietary diversity ($p < 0.001$). Adolescents with inadequate dietary diversity exhibited a higher likelihood of perceiving the product as fun (70.1%) compared to those with adequate dietary diversity (29.9%) ($p < 0.001$). Adolescents with inadequate dietary diversity were more likely to have a "Positive" perception (71%) compared to their counterparts with adequate dietary diversity (29%, $p < 0.001$). Adolescents with inadequate dietary diversity were more inclined to perceive the product as appealing (72.0%) compared to those with adequate dietary diversity (28.0%). This association was highly significant ($p < 0.001$). A significant association was found between dietary diversity and liking the advertisement. Adolescents with inadequate dietary diversity exhibited a more favorable perception (64.3%) compared to those with adequate dietary diversity (35.7%, $p < 0.001$). Dietary diversity was significantly related to adolescents feeling tempted to try the product. Those with inadequate dietary diversity had a "Positive" perception in 70.9% of cases, whereas it was 29.1% for those with adequate dietary diversity ($p < 0.001$). Adolescents with inadequate dietary diversity were more likely to have a "Positive" perception (68.5%) compared to those with adequate dietary diversity (31.5%, $p < 0.001$).

Table 6.6: Association between adolescents' reactions to adverts for sugar-sweetened beverage brand and dietary adequacy

Variable	Dietary Diversity		X ² (p-value)/Fisher's exact
	Inadequate 422(63.3)	Adequate 245(36.7)	
Made product seem popular choice			32.23 (<0.001)
Negative	62(43.1)	82(56.9)	
Neutral	100(49.3)	103(50.7)	
Positive	83(25.9)	237(74.1)	
Appealing to age group			33.93 (<0.001)
Negative	31(41.9)	43(58.1)	
Neutral	110(51.2)	105(48.8)	
Positive	104(27.5)	274(72.5)	
Made product seem fun			21.67 (<0.001)
Negative	29(42.0)	40(58.0)	
Neutral	96(49.0)	100(51.0)	
Positive	120(29.9)	282(70.1)	
Advert was fun			27.55 (<0.001)
Negative	43(33.6)	85(66.4)	
Neutral	105(51.2)	100(48.8)	
Positive	97(29.0)	237(71.)	
Made product look appealing			31.58 (<0.001)
Negative	23(37.7)	38(62.3)	
Neutral	117(50.7)	114(49.3)	
Positive	105(28.0)	270(72.0)	
Liked the advert			46.88 (<0.001)
Negative	14(12.4)	99(87.6)	
Neutral	115(50.2)	114(49.8)	
Positive	116(35.7)	209(64.3)	
Tempted them to try product			26.53 (<0.001)
Negative	31(48.4)	33(51.6)	
Neutral	95(49.0)	99(51.0)	
Positive	119(29.1)	290(70.9)	
Made product seem a healthy choice			25.93 (<0.001)
Negative	8(22.9)	27(77.1)	
Neutral	97(51.6)	91(48.4)	
Positive	140(31.5)	304(68.5)	

6.4 Discussion

The study highlights the importance of marketing in shaping and reinforcing attitudes towards unhealthy products/brands, particularly among young people. The research findings suggest

that adolescents in the Volta and Oti regions of Ghana had a generally positive reaction to the two HFSS food adverts. The majority of adolescents in the two regions had positive perceptions regarding the brands featured in the adverts, as well as the design of the advertisements themselves. They believed that these adverts could potentially influence their behaviour and consumption of HFSS foods. The majority of adolescents expressed positive reactions across six out of the eight measures for the noodle advertisement and across seven out of the eight measures for the advertisement for the sugar-sweetened beverage advertisement. This influence is especially concerning because young people are more vulnerable to the effects of marketing due to their limited cognitive and executive skills (A. S. Khan et al., 2023). Similar findings have been reported among 11-19-year-old adolescents in the UK (Critchlow et al., 2020). Other studies show that exposure of children and young people to HFSS adverts is likely to be a contributor to HFSS food consumption (Alfayad et al., 2022). The findings suggest that marketing has a significant influence on the attitudes and behaviours of adolescents in urban areas, potentially making them more susceptible to the persuasive intent of marketing messages than those in rural areas. Food marketing involves the use of numerous persuasive techniques to influence children's food attitudes, preferences and consumption (Amore et al., 2019) and has been shown to negatively impact children's food knowledge, preferences, consumption, diet quality, and health (R. Smith et al., 2019b).

Additional evidence shows that unhealthy food and beverage marketing through media popular with children strongly influences consumer behaviour and significantly impact on different diet-related outcomes (Amore et al., 2019; Mc Carthy et al., 2022; Mendes Lübeck et al., 2021). Unhealthy food marketing is a significant contributor to childhood obesity and chronic diseases (Amore et al., 2019). Research has implicated commercial marketing of energy-dense nutrient-poor foods and beverages in contributing to population levels of overweight and obesity and poor diet (Dixon et al., 2018). Moreover, the study emphasizes that marketing plays a

significant role in framing unhealthy foods with appealing imagery and branding, while downplaying their poor nutritional content (Ertz & Le Bouhart, 2022).

The primary aim of this study was to assess adolescent reaction to HFSS food advertisements. The findings of the study shed light on the complex interplay between socio-economic factors, nutritional knowledge, food insecurity, weight status, and adolescents' reactions to fast-food advertisements. These results offer valuable insights into the diverse ways in which different subgroups of adolescents respond to and interpret marketing messages related to fast food. The findings suggest that adolescents in urban areas may be more susceptible to the persuasive intent of marketing than those in rural areas. Adolescents residing in urban areas exhibited a higher likelihood of perceiving the advertised product as popular, finding the advertisement enjoyable, and experiencing the temptation to try the product. This urban-rural divide suggests that the urban environment may contribute to making fast-food advertisements more appealing to adolescents. This susceptibility may be due to factors such as higher exposure to marketing messages, greater availability of unhealthy products, and the influence of peer networks. According to a study by Tsochantaridou et al., adolescents who were exposed to advertising for unhealthy foods and beverages were more likely to show high desire and intention to consume those advertised foods (Tsochantaridou et al., 2023c). The findings suggest that there are significant gender differences in how adolescents perceive food advertisements. Whereas male adolescents were more likely to find the fast-food noodle brand advertisements fun, appealing, and enjoyable compared to female adolescents, female adolescents were more likely to find sugar-sweetened beverage advertisements fun and appealing compared to male adolescents. These findings suggest that gender plays a role in how adolescents perceive and respond to food advertisements. However, it is important to note that the study only examined one fast food noodle brand product and one sugar-sweetened beverage advertisement. Therefore, the results may not be generalisable to other food products or advertisements. Critchlow et al, in their study

among adolescents in the UK, found that both boys and girls were generally receptive to advertising for unhealthy foods, with girls showing a stronger positive reaction than boys (Critchlow et al., 2020). Further research is needed to explore the relationship between gender and food marketing in greater depth. Understanding these variations is crucial for tailoring interventions to specific gender preferences and attitudes.

The study's findings suggest that adolescents' perceptions of food advertisements vary significantly with age. Adolescents in the 15-17 and 18-19 age groups were less likely to perceive the fast-food noodles and sugar-sweetened beverage product advertisements as popular, find it age-appealing, perceive it as fun, find it product-appealing, and experience the temptation to try the product compared to those in the 10-14 age group. This age-related pattern suggests that younger adolescents may be more susceptible to the influence of fast-food advertisements. As age increases, there appears to be a decline in the perceived appeal and temptation associated with these advertisements. Older adolescents may, therefore, be less susceptible to these tactics and are more likely to be critical of food advertising. However, it is important to note that older adolescents are not immune to the effects of food advertising. The study found that adolescents aged 18-19 were more likely than younger adolescents to have positive reactions to advertisements for sugar-sweetened beverages. This suggests that older adolescents may be more susceptible to the social appeal of unhealthy foods, such as the perception that they are cool or trendy. This study is in sync with Critchlow et al.'s study which showed that younger adolescents were more susceptible to the influence of food advertisements, indicating a higher likelihood of believing they were the intended target audience and expressing a stronger urge to consume the advertised brands (Critchlow et al., 2020).

Adolescents from wealthier families were more likely to react positively to advertisements for unhealthy foods, particularly fast-food noodles and sugar-sweetened beverages. Adolescents in

the third, fourth, and fifth wealth quintiles were more likely to find these advertisements appealing, perceive the products as healthy, and experience the temptation to try them. These findings emphasize the role of socio-economic status in shaping adolescents' responses to fast-food marketing. Higher wealth quintiles may be associated with increased susceptibility to the temptations presented in these advertisements. These findings are consistent with previous research, which found that children from higher socioeconomic backgrounds were more likely to be exposed to unhealthy food marketing and consume unhealthy foods. This is likely due to a number of factors, including: Wealthier families are more likely to have access to television and other media, which are saturated with unhealthy food advertisements. Wealthier families are more likely to live in neighborhoods with more fast-food restaurants and convenience stores. Parents in wealthier families may be more likely to purchase unhealthy foods for their children, either because they have more disposable income or because they believe that these foods are convenient and tasty.

The study's findings reveal that adolescents who experience severe food insecurity have significantly different perceptions of unhealthy food advertisements compared to food-secure adolescents. Specifically, severely food-insecure adolescents were less likely to perceive fast food noodles and sugar-sweetened beverages as healthy, popular, fun, or appealing. They were also less likely to report feeling tempted to try these products after viewing the advertisements. These findings suggest that food insecurity may influence adolescents' susceptibility to unhealthy food marketing. It also highlights the potential protective effect of food insecurity, as adolescents facing food scarcity may be less influenced by the health-related appeals in fast-food advertisements. It is possible that food-insecure adolescents are more focused on the basic need to consume food and less influenced by the persuasive tactics used in food advertisements. Additionally, food-insecure adolescents may be more aware of the negative health consequences of consuming unhealthy foods.

The study's findings suggest that overweight adolescents have a more negative perception of fast-food noodle advertisements compared to their normal-weight counterparts. Overweight adolescents were less likely to find the advertisements appealing to their age group or fun. This suggests that overweight adolescents may be more critical of the persuasive tactics used in food advertising. The study also found that adolescents with higher levels of nutritional knowledge had more positive reactions to both fast food noodle and sugar-sweetened beverage advertisements. This suggests that nutritional knowledge may influence adolescents' susceptibility to unhealthy food marketing. Adolescents with higher levels of nutritional knowledge may be more likely to believe the claims made in food advertisements and to be influenced by social norms and peer pressure.

The influence of marketing on youth is a topic of great concern, particularly in relation to unhealthy products and lifestyles (S. M. Sawyer & Patton, 2015). Additionally, research has implicated marketing of energy-dense nutrient-poor foods and beverages as a major contributor to the prevalence of overweight and obesity among young people. Furthermore, there is a need for research on strategies to mitigate the negative impact of target marketing on youth (Grier, 2023). Additionally, research has implicated marketing of energy-dense nutrient-poor foods and beverages as a major contributor to the prevalence of overweight and obesity among young people.

6.5 Conclusion

In conclusion, the study highlights the importance of marketing in shaping and reinforcing attitudes towards unhealthy products/brands, particularly among young people. The research findings suggest that adolescents in the Volta and Oti regions of Ghana had a generally positive reaction to the two HFSS food adverts. The study underscores the need for policy and public health interventions to address the diverse factors influencing adolescents' reactions to fast-food

advertisements. It emphasizes the importance of considering socio-economic status, food security, weight status, and nutritional knowledge in designing interventions aimed at promoting healthier dietary behaviors among adolescents. Furthermore, these findings provide a foundation for future research to explore additional factors contributing to adolescents' responses to food marketing and to develop targeted interventions that address the unique challenges faced by different subgroups within this population.

Declarations

Ethical Approval

Ethical approval for this study was obtained from the Institutional Review Board of the Noguchi Memorial Institute for Medical Research (NMIMR-IRB), University of Ghana (NMIMR-IRB CPN 051/20-21, Appendix 9)



7.0 A MIXED-METHODS STUDY OF PERCEIVED BARRIERS AND ENABLERS TO OPTIMAL DIETS AMONG ADOLESCENTS IN THE VOLTA AND OTI REGIONS OF GHANA

Abstract

Background: Unhealthy diets among adolescents in Ghana contribute to rising obesity and non-communicable diseases. This mixed-methods study investigates perceived barriers and enablers to optimal diets among adolescents in the Volta and Oti Regions of Ghana.

Objectives: To identify factors influencing adolescent dietary behaviours and explore their experiences and perceptions of healthy eating.

Methods: A sequential explanatory mixed-methods design was employed, integrating quantitative and qualitative approaches to collect and analyse data on dietary behaviour. This involved a survey of 675 adolescents, complemented by in-depth interviews with 23 participants. A two-stage sampling method was employed to select participants for face-to-face interviews. Purposive sampling was utilized to identify adolescents for the qualitative component. Multivariate analysis was used to examine dietary behaviours and their associated factors. Thematic analysis was applied to interpret qualitative data, allowing for a nuanced understanding of adolescent dietary habits. A data triangulation strategy was adopted to merge and report findings from both quantitative and qualitative analyses, ensuring a comprehensive understanding of the research topic.

Results: Key findings included low consumption of fruits and vegetables, high consumption of salty snacks and staple carbohydrates. Most adolescents typically consumed three meals daily, yet a significant proportion skipped meals, particularly breakfast. Despite 55.9% displaying healthy dietary behaviours, unhealthy practices were prevalent. Notably, 41.3% did not consume vegetables, and energy-dense local dishes were common. While traditional energy-dense staples like roots, tubers, and cereals remain essential to their culture, there is a notable shift towards consuming rice, noodles, and fried foods. Healthy dietary behaviours were significantly predicted by high adolescent and maternal education, having fathers in farming [cOR = 2.0 (95% CI= (1.09-3.65), p=0.024)], being in the fourth wealth quintile [cOR = 2.39 (95% CI= (1.42-4.04), p<0.001)], and possessing medium [cOR = 1.61 (95% CI= (1.08-2.41), p=0.020)] or high [cOR = 1.47 (95% CI= (1.01-2.13), p=0.044)] nutritional knowledge. Authoritative parenting also correlated with healthier diets compared to neglectful parenting [aOR=0.44 (95% CI= (0.29-0.68), p<0.001)]. The findings highlight the complex interplay of individual, household, cultural, food environment, marketing, and socio-economic factors influencing dietary behaviour. Family food environment, parenting styles, parental role-modelling of healthy eating, peer influences, availability and affordability of healthy food options, food marketing and advertising, food prices, convenience, and cultural preferences play a substantial role in shaping their food choices and dietary behaviours of adolescents. Limited resources and lack of refrigeration facilities hindering healthy eating habits. Unhealthy foods being more affordable than healthier options

Conclusion: The findings of this study underscore the multifaceted nature of adolescent dietary behaviours. Targeted interventions that address socioeconomic factors, parental influence, and nutritional education may be effective in promoting healthy eating habits among this population. While these findings highlight the importance of education and parental influence, it is essential to consider that other factors, such as cultural context and socioeconomic status, may also significantly impact adolescent dietary behaviours, suggesting a multifaceted approach to understanding these dynamics. To enable adolescents to make healthier dietary

choices, it is crucial to consider the following factors: family environment, affordability of healthy food options and availability of healthy food options. By understanding these factors, we can develop effective strategies to promote healthier dietary habits among adolescents. The study's findings have implications for the development of targeted interventions to promote healthy dietary behaviours among adolescents in Ghana and other similar settings. Strategies could include nutrition education, cooking skills training, and initiatives to increase access to affordable healthy food options and using fiscal measures.

7.1 Introduction

Unhealthy diets are associated with obesity and various non-communicable diseases (NCDs), including high blood pressure, high cholesterol, type 2 diabetes, heart disease, stroke, certain types of cancers, and associated mortality (WHO, 2020b). The prevalence of obesity and NCDs remains high and is rising in low- and middle-income countries (LMICs). In particular, rising adolescent obesity has been linked to diet and physical inactivity behaviours (Doku & Neupane, 2015b; Kansra et al., 2021; Mbogori & Mucherah, 2019; Sanyaolu et al., 2019). In Ghana, dramatic shifts in dietary patterns have occurred in the general population over the last three decades, including among adolescents (Abizari & Ali, 2019b). These changes mirror rapid globalisation, urbanisation, and socio-economic development which have increased the availability and accessibility of unhealthy foods, particularly through supermarkets, corner stores, and street vendors (Andam et al., 2018; Laar et al., 2022). These changes translate into suboptimal dietary choices. Several studies have reported inadequate consumption of fruits and vegetables below what is recommended among adolescents in Ghana. At the same time, sales and consumption of sugar-sweetened beverages, added sugar, energy-dense cereals and snacks, fast foods and vegetable oils are increasing (Abizari & Ali, 2019a; Akoto et al., 2022b; Hormenu, 2022c; Madzorera et al., 2023c; Seidu et al., 2020). The changes in diets are not only current but also have childhood origins. Unhealthy eating habits established during childhood can persist into adulthood and influence behaviours in adulthood, warranting policy action (Afrifa–Anane et al., 2015; Aliche et al., 2017; Osei-Kwas et al., 2017; Winpenny et al., 2018).

Studies have explored the factors that hinder or support healthy eating habits in adolescents, revealing that individual factors like nutritional knowledge and attitudes play a significant role (Cheng, 2015; Moitra & Madan, 2022; Zalewska et al., 2018).

However, interventions focusing solely on individual-level factors may have limited success in the long-term (Brug et al., 2017; Lakerveld et al., 2012). Combining individual approaches with environmental changes can enhance effectiveness (Brug et al., 2017; Sawyer et al., 2021). Additionally, interpersonal factors like parenting styles, peer influence, and support (Ali et al., 2021; Amos et al., 2012b; Scaglioni et al., 2018; Tamrakar et al., 2020), school environments, cultural background (Agaba et al., 2022; Kroll et al., 2019b; R  ih   et al., 2006; Zalewska et al., 2018), financial resources, and media influence (Pirouznia, 2001) also significantly impact adolescents' eating habits. To tackle obesity, comprehensive policies and interventions addressing these multilevel factors across individual, family, socio-environmental, and systemic levels are crucial. This study investigated the dietary behaviour of adolescents in Ghana by identifying perceived enablers and barriers to healthy eating. It is essential to understand these enablers and barriers in order to develop effective interventions and strategies promoting healthy eating among adolescents.

7.2 Methods

A mixed-methods study was conducted to gain insight into adolescents' dietary behaviour.

7.2.1 Study Setting

This study was conducted in 26 districts in the Volta (18 districts) and Oti (8 districts) regions of Ghana. The spatial scope of the study would cover the Volta and Oti regions of Ghana, located at the eastern border of Ghana. The Volta and Oti regions are two of the sixteen administrative regions of Ghana. The two regions were one (Volta region) until northern Volta

was carved out of the Volta region by constitutional instrument (C. I. 112) in February 2019 to form the Oti region. The two regions cover a total land area of 20,570 km², representing 8.6% of Ghana, and lie between latitudes 5° 45'N and 8° 45'N. The Volta and Oti regions are located west of Republic of Togo and to the east of Lake Volta. The area is bordered by the Gulf of Guinea to the south, the Northern Region to the north, Bono East Region to the west, and on the northwest by the Savannah Region (Figure 6.1).

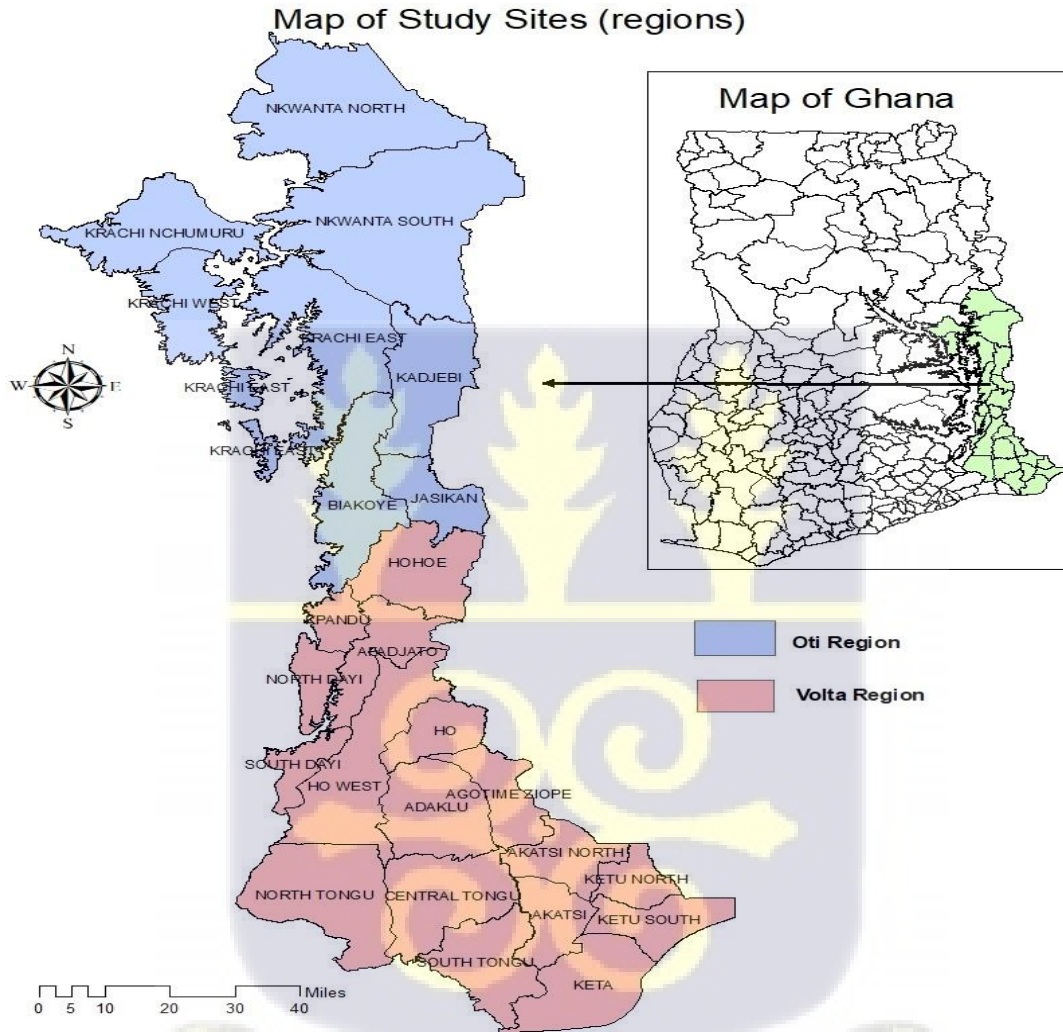


Figure 7.1: Map of Ghana showing the Volta and Oti regions

7.2.2 Survey Participants

The target population comprised adolescents aged 10-19 years, living in the Volta and Oti regions of Ghana.

7.2.3 Study Design

A sequential explanatory mixed-methods design was used to gather data on adolescent dietary behaviours, their experiences, and perceptions of what constitutes barriers and facilitators towards healthy eating. This study was part of a larger study to understand the drivers of adolescent diets, food security, nutritional status, and readiness to adopt sustainable healthy diets.

7.2.4 Quantitative Study Design

A community-based survey collected and analysed data to assess the factors that influence adolescents' dietary behaviours. The study was designed, implemented and reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cross-sectional studies.

7.2.4.1 Sample Size Determination

The sample size was estimated using Yamane's formula, $n = N \div (1 + Ne^2)$, for population proportion (Yamane, 1967). The sample size was estimated based on a 2020 projected adolescent population of 589,513 in the Volta and Oti regions, a confidence level of 95 % (standard value of 1.96) and a 5% (0.05) margin of error. A design effect coefficient of 1.5 and a 10% non-response rate were chosen, resulting in a final sample size of 667.

7.2.4.2 Sampling Procedure

These enumeration areas (EAs) were drawn from the 2017 Ghana Living Standards Survey round 7 (GLSS 7) master sampling frame. The sampling employed a two-stage stratified sampling design. Forty-six (46) enumeration areas (EAs) from a total of 96 enumeration areas were selected to form the Primary Sampling Units (PSUs). The PSUs were allocated into the two administrative regions using probability proportional to population size (PPS). The EAs

were further divided into urban and rural localities of residence. A complete listing of households in the selected PSUs was used as to the Secondary Sampling Units (SSUs). At the second stage, 15 households from each PSU were systematically selected. In total, therefore, a representative sample of 676 eligible households were selected to participate in this study. Maps of each cluster with listed households were used to locate them.

7.2.4.3 Survey Participants

The study population consisted of 675 adolescents aged 10-19 years.

7.2.4.4 Inclusion and Exclusion Criteria

The study included all adolescents aged between 10 and 19 years, resident in the Volta and Oti regions, who indicated willingness to voluntarily participate in the study by providing assent and who received parental consent to participate in the study. Adolescents who met the inclusion criteria but were sick or had physical disabilities that interfered with accurate anthropometric measurements were excluded. Exclusion criteria also included either expression of refusal or discontent, refusal to assent, consent, or lack of parental consent.

7.2.4.5 Quantitative Data Collection

Data were collected using the Kobo Toolbox through face-to-face interviews with a structured pre-tested questionnaire. The questionnaire collected data on sociodemographic characteristics, nutritional knowledge, 24-hour dietary recall of dietary behaviour, parenting styles and parental role-modelling of healthy eating. Prior to data collection, the instrument was pretested among 15 adolescents with similar characteristics to authenticate its validity and reliability. The survey was conducted by six trained nutrition graduates led by the Principal Investigator. They interviewed respondents in English, Ewe, Twi, or other languages as needed. Health education for adolescents was conducted after data collection in each community.

7.2.4.5.1 Assessment of Nutrition Knowledge

Nutrition knowledge among adolescents was assessed using questions adapted from the General Nutrition Knowledge Questionnaire (GNKQ) (Kliemann et al., 2016). The GNKQ has four sections, each containing different types of questions related to nutrition and dietary choices. The questions included a section on recommendations from experts and dietary guidelines. In this section, participants were asked about the general recommendations given by experts and dietary guidelines for various food groups. Examples of questions include: Do experts recommend eating more or less fruits and vegetables? The second section assessed the participants' knowledge about specific foods and their nutrient content. Examples of questions include: Which one of the following nutrients has the most calories for the same weight of food? In the third section (identifying healthier food options), participants were presented with various meal choices, desserts, or different ways of preparing food, and asked to choose the healthiest option among them. Examples of questions include: One of the healthiest ways of cooking is ...? The fourth section focused on the participants' understanding of physical activity. Examples of questions include: How many minutes per day of moderate-to-vigorous intensity physical activity do experts recommend for adolescents? Each question in the questionnaire was designed to have only one correct answer, and participants were awarded one point for each correct response.

7.2.4.5.2 Adolescent Dietary Behaviours

A structured questionnaire was used to collect data on food preferences including both healthy and unhealthy food preferences. The food items were categorised into different groups such as fruits, vegetables, whole grains, processed foods, high fat foods and sugar-sweetened beverages. All 12 items were used to assess healthy and unhealthy food behaviours. Each item had different levels, with different healthy and unhealthy food types. Individuals who chose the healthy option were coded as 1, and those who chose otherwise were coded as 0. The

Cronbach's α reliability coefficient was 0.61. All individual scores were summed. The median was used to dichotomise adolescent dietary behaviours into healthy and unhealthy behaviours. The median was 5. Those below five were classified as unhealthy behaviours and those from five and above as healthy.

7.2.4.5.3 Adolescent-Reported Parenting Styles

Based on earlier works (den Exter Blokland et al., 2001; S. Kremers et al., 2013; S. P. J. Kremers et al., 2003; Lamborn et al., 1991; Robinson et al., 1995; Steinberg et al., 1989), a 29-item instrument was developed and used to assess the parenting style dimensions of warmth/involvement (subfactor 1) and strictness/demandingness/control (subfactor 2) (den Exter Blokland et al., 2001). Each item in each of the instruments was measured on a 5-point answering scale, where 1 = "completely disagree", 2 = "disagree", 3 = "neither agree nor disagree", 4 = "agree" and 5 = "completely agree." The median was used to classify each factor as low or high.

Nineteen items were used to assess subfactor 1 (the parenting style dimensions of warmth, responsiveness, love and involvement). For example, "I can count on my parents to help me out if I have some kind of problem." The median score was 52 and Cronbach's α reliability coefficient was 0.88. Parental strictness was assessed by asking adolescents about parental monitoring and supervision. Ten items were used to assess sub-factor 2 (the parenting style dimension of strictness/demandingness and control). For example, "How much do your parents try to know where you go out at night"). The median score was 32 and Cronbach's α reliability coefficient was 0.82.

All parents who were rated below the median were classified as low and those who were above the median were classified as high. Composites were created for both subfactors 1 and 2 and

used to assign each parent to one of four parenting styles: authoritative, authoritarian, permissive, or neglectful. These parenting styles are based on the Baumrind parenting model, which categorises parenting styles into three categories (Baumrind, 1971), and which was expanded into four categories by Maccoby and Martin (Maccoby & Martin, 1983). The framework shows the four parenting styles in a quadrant, as suggested by Maccoby and Martin (1983) (Figure 7.2). A parent who was rated high in both subfactors 1 (warmth and involvement) and 2 (strictness, demandingness and control) was categorised as authoritative and a parent who was rated low in both subfactors 1 and 2 as neglectful. A parent who was rated high in subfactor 1 and low in subfactor 2 was categorised as permissive, and one who was rated low in subfactor 1 and high in subfactor 2 was categorised as authoritarian.

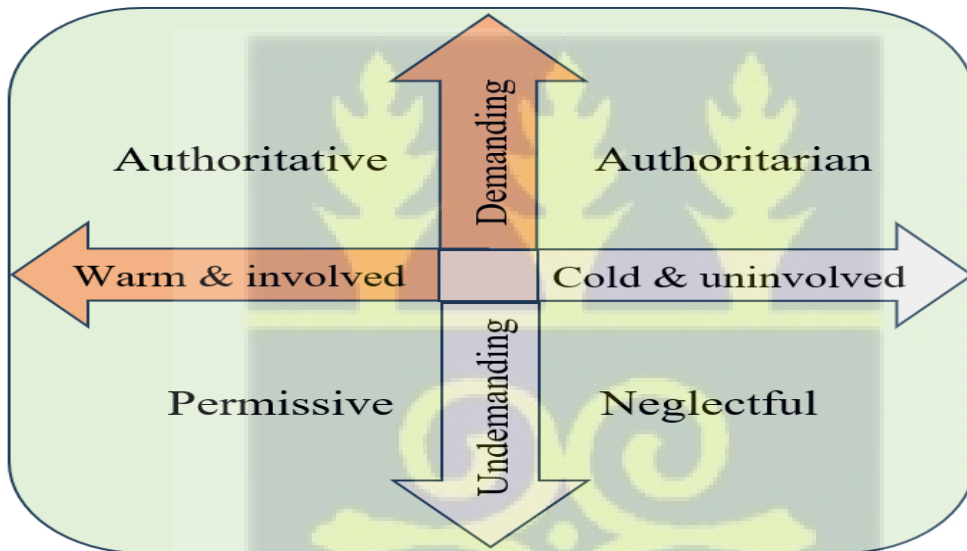


Figure 7.2: Types of parenting styles

7.2.4.5.4 Perceived Parental Modelling of Healthy Eating

Eight items were used to measure parental role-modelling of healthy eating. Adolescents' reports were used to assess parental role modelling of healthy eating. Adolescents were asked if their parents or primary caregiver ate fruit, vegetables, and low-fat foods while with them at snacks, and if their parents ate fruit, vegetables, or salad while with them at lunch, supper, and in restaurants. Adolescents were also asked if their parents or primary caregiver drank 100% juice, ate low-fat dressing, and ate low-fat mayonnaise while with them. For example: "When

I am with my parent(s) or caregiver they eat fruit as a snack” and “when I am with my parent(s) or caregiver they eat green salad at dinner”. All items were measured using a 4-point Likert scale (1 = Never; 2 = Hardly ever; 3 = Sometimes; 4 = Usually/Always). A higher score on each scale reflects greater agreement with the item. The median was used to classify each factor as low or high. Composites were created for each of the factors, and all parents who were rated below the median were classified as having unhealthy dietary behaviours and those who were above the median were classified as having healthy dietary behaviours. The Cronbach’s α reliability coefficient was 0.92.

7.2.4.5.5 Quantitative Data Analysis

Data were analysed using the statistical software package STATA 17. Data on the online Kobo Toolbox platform were exported as Excel files. Excel files containing the data were imported into STATA 17 for analysis. Descriptive analysis determined means, frequencies and percentage distribution for variables. Bivariate and multivariate analyses were performed to evaluate associations between dependent (dietary behaviour) and independent variables. Dietary behaviour was dichotomised into healthy and unhealthy dietary behaviours. Statistical significance was set at $P < 0.05$. Odds ratios with 95 % confidence intervals were derived where appropriate. Fisher’s exact test was used when the sample sizes were too small. Independent variables were included in the multivariate analysis if they had a significant association ($P < 0.05$) with a dependent variable in the bivariate analysis.

7.2.5 Qualitative Study

The Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist was followed to guide the design, data collection, analysis and reporting of the study (Tong et al., 2007).

7.2.5.1 Study Participants

Twenty-three adolescent participants, 10-19- year-old from the Volta and Oti regions of Ghana were interviewed for qualitative aspects of the study. The adolescents received an information letter that provided a comprehensive explanation of the study objectives and processes, as well as an assent or informed consent form to sign. After informed consent was obtained, the researchers and participants selected an appropriate date and setting to conduct the interviews. Sampling was continued until data saturation was reached.

7.2.5.2 Qualitative Study Design

The study employed a phenomenological approach to explore and identify dietary behaviours and the underlying drivers from the perspectives of adolescents. Phenomenology is a qualitative research method that seeks to capture the essence and meaning of lived experiences related to a particular phenomenon, which in this case is dietary behaviour.

7.2.5.3 Phenomenon of Interest

- To explore adolescents' perceptions of barriers and facilitators related to healthy eating.
- To understand their experiences, attitudes, and behaviours regarding food choices.

7.2.5.4 Qualitative Sampling, Recruitment and Data Collection

A purposive sampling approach was used to recruit participants for in-depth interviews (IDIs). An interview guide consisting of open-ended questions was developed to guide the discussions on the various issues that influence adolescent dietary behaviour. The guide was developed based on a review of the literature on adolescent nutrition (Daly et al., 2022c; Hanemaayer et al., 2022; A. D. M. Sawyer et al., 2021) and adapted to the local context of Ghana (Hormenu, 2022b; Liguori et al., 2022a). The guide included the following: Introduction and rapport-building; background information (age, sex, etc.); definition and understanding of healthy

eating; dietary habits: What do you typically eat in a day? Barriers to healthy eating: What challenges do you face in maintaining a healthy diet?; and facilitators of healthy eating: What helps you make healthier food choices? These were organised into personal food choices, preferences, knowledge, skills, and perceptions; parental and peer behaviours, influences, and support; availability, accessibility, affordability, and quality of foods in home, school, and community settings; socio-cultural norms, values, and beliefs related to food and eating; economic and policy factors affecting food choices; suggestions for improving healthy eating among adolescents; and closing remarks.

The guide was pilot-tested and subsequent changes were made to improve the natural flow of the conversation and to allow for more probing questions. All IDIs were conducted in English, Twi, or Ewe (the languages commonly spoken by the participants). Probes (neutral prompts) and follow-up questions were used to elicit additional information or more detailed responses.

A research team of five, including the researcher and four public health nutrition graduates (two females and two males), conducted the interviews. Each interview lasted approximately 48 min. All IDIs were audio-recorded using a digital voice recorder and transcribed verbatim, with some personal information deleted to preserve anonymity and confidentiality. In addition, descriptive field notes on the interviewer-interviewee interaction (descriptive field notes) were taken during the interviews to circumvent any recall challenges. Debriefing sessions were held daily by the researcher and research assistants after the fieldwork to discuss issues and themes emerging from the interviews and to ensure consistency in the meaning of the questions.

7.2.5.5 Data Handling and Analysis

Preliminary analysis was conducted concurrently with the continued administration of interviews to identify emergent themes and subthemes to be pursued in subsequent interviews.

Sampling was continued until data saturation was reached. In all, twenty-three in-depth interviews were conducted among similar adolescents, varying in education and socioeconomic status. The transcribed interviews were translated into English by research assistants. Four of the transcribed interviews were randomly selected for quality check by an external local bilingual transcriber. The transcripts were reviewed for accuracy, completeness and familiarisation and imported into ATLAS.ti software (version 22 Windows) (ATLAS.ti Scientific Software Development GmbH., 2022) for coding. Thematic content analysis was used to analyse the data (Braun & Clarke, 2006), and themes were identified according to the questions asked in the interview guide. This approach organises qualitative data into codes and themes.

Guided by the objectives of the study, the transcripts were coded and an initial code book was developed. The initial codes were all reviewed by the researcher and research assistants, and any disagreements in code names or coded quotes were resolved through discussions and coder consensus. The initial codebook included code names, definitions, and sample quotes. The researcher and two research assistants coded the transcripts and thematic analysis used to identify and interpret themes or patterns in the data pertinent to the study's aims. Each identified theme was evaluated by the research team, modified, merged, and deleted so that the final themes were accurate and meaningful and did not overlap. This was done until thematic saturation, the point at which transcripts do not reveal new information (Saunders et al., 2018), was reached using the data. The candidate themes were reviewed in relation to the coded data and the entire dataset. The purpose was to ensure that the themes were useful and accurately represented the data. The themes were compared with the collated extracts of the data. Codes that did not work with the collated data were discarded, used to create new themes, relocated under another theme, or the boundaries of the themes were redrawn to make them more useful and accurate so that they could capture the relevant data more meaningfully.

7.2.6 Data Triangulation

Triangulation refers to the collection of two or more complimentary yet distinctly different data on the same topic which can then be integrated for analysis and interpretation (Almalki, 2016; Yeasmin, 2012). Triangulation is based on the premise that ‘no single method ever adequately solves the problem of rival or counter explanations’ (Patton, 1999; Patton, 2002), and that the weaknesses of one method can be compensated for by the counter-balancing strengths of the other (Teddlie & Tashakkori, 2010). Since this is a mixed methods study, employing both quantitative and qualitative methods to collect and analyse data, a data triangulation strategy would be employed to merge, integrate, and report the findings of the study in order to achieve a deeper understanding of the study objectives. The quantitative and qualitative results of this study would be integrated after concurrent, yet separate and independent collection and analysis of data. The quantitative and qualitative findings were compared for convergence, divergence and relation. Triangulation techniques are helpful for cross-checking data validity and are used to provide confirmation and completeness when two or more different types of research data collection strategies are used. The approach was therefore be employed to increase the credibility and validity of both the qualitative and quantitative results (Bekhet & Zauszniewski, 2012; Denzin, 2012; Fielding, 2012; Yeasmin, 2012). Moreover, comprehensive field notes were recorded to capture non-verbal signals, contextual nuances, and reflections on the interview process. These notes offered additional data that enhanced the interpretation during the analysis. Throughout the research process, reflexivity was upheld to recognize and address the researchers' positionality, potential biases, and their impact on data interpretation. The team participated in regular debriefing sessions to consider power dynamics, emotional reactions, and interpretive assumptions that might influence the research process.

7.2.7 Ethical Consideration

This study was carried out with the approval of the Noguchi Memorial Institute for Medical Research Institutional Review Board (NMIMR-IRB), University of Ghana (approval number: NMIMR-IRB CPN 051/20-21), ensuring adherence to ethical standards. All potential participants received detailed information about the study, including its purpose, methods, potential risks and benefits, and data management procedures. Participation was voluntary, and individuals could withdraw at any time without consequences. Confidentiality and anonymity were guaranteed, with clear explanations of data protection measures and plans for disseminating research findings. For minors (under 18), both their assent (through signed assent forms) and parental/legal guardian consent (through signed consent forms) were obtained prior to participation. For participants 18 years and older, direct consent via signed consent forms were obtained. Participants were free to withdraw their consent at any time, and without providing a reason. Throughout the research process, participants' rights and wellbeing were prioritized, ensuring their protection at all stages.

7.3 Results

7.3.1 Quantitative results

The target sample size for this study was 667, but this goal was exceeded by collecting data from 675 participants. Following a thorough review for completeness and data cleaning, the final analysis included 667 participants, meeting the initial sample size requirement.

7.3.1.1 Adolescent Dietary Patterns

Table 7.1 shows the dietary patterns of 667 adolescents surveyed. The majority (73.6%) of adolescents ate out in the last seven days and this included 36.9% who ate out 3 days or more, 32.9% who ate out 1-2 days in the last week and 3.8% who ate daily. Only 26.4% never ate out at all. Nearly 71% of all the adolescents reported eating some take-away within the last seven

days and this included 34.6% who ate take-away 3-6 days in the last week, 34.3% who ate 1-2 days in the last seven days and some 1.7% ate take-away daily. However, 29.4% reported never eating any take-away in the last seven days. Nearly 94% of the adolescents had their evening meal cooked from scratch at home and eaten at home including 40.3% who had their evening meal cooked from scratch at home and eaten at home daily. Only 6.5% never had their evening meal cooked from scratch at home and eaten at home. Only 57.6% adolescents reported eating 5 portions of fruits and vegetables 1-3 times in a week and 18% did so 4 days or more in the last seven days. However, 24.4% reported never eating five portions of fruits and vegetables in the last seven days. Sixty-four per cent of participating adolescents reported consuming salty snacks, including 49.2% who reported eating salty snack products 1-3 days in the last seven days and 14.8% who did so 4 days or more in the last seven days preceding the survey. Some 36% never ate any salty snack in the seven days preceding the survey. The most common number of meals consumed in a day was three (68.4%), followed by four and above (15.3%). Most (68.4%) adolescents consumed three meals in a day, followed by four and above (15.3%). Almost 83% of the adolescents surveyed skipped some form of meal and this included 44.8% who skipped snacks and 22.2% who skipped breakfast. More than half of the adolescents (55.9%) had a healthy overall dietary behaviour, while 44.1% had an unhealthy one.

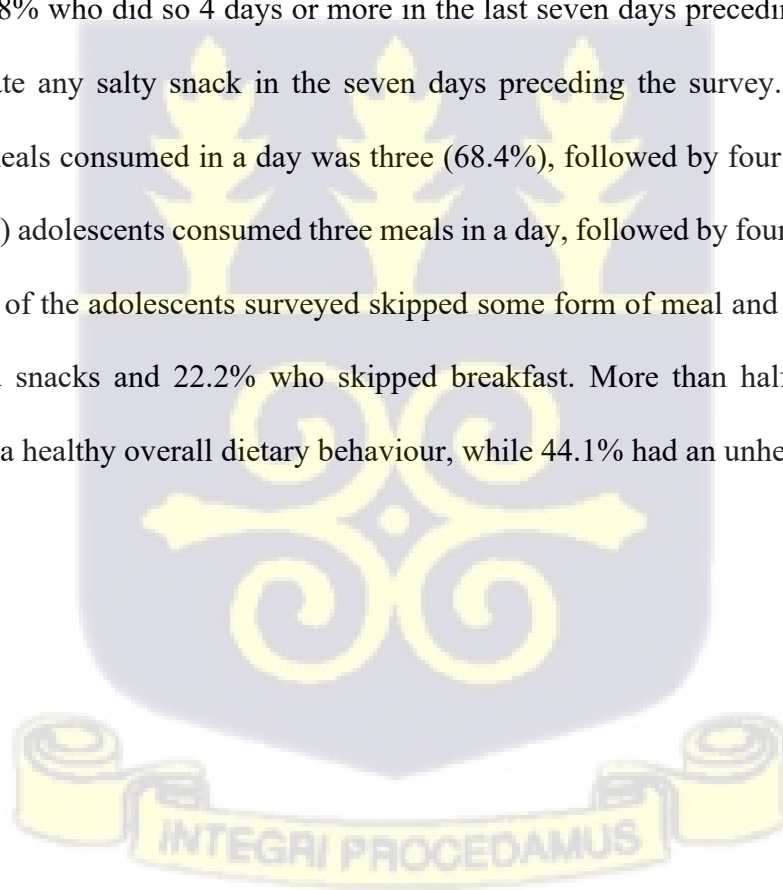


Table 7.1: Adolescents dietary patterns

Variable	Frequency (n=667)	Percentage (%)
Frequency of eating out in last seven days		
Never	176	26.4
1-2 days	220	32.9
3-6 days	246	36.9
Daily	25	3.8
Frequency of eating take-away food in last seven days		
Never	196	29.4
1-2 days	229	34.3
3-6 days	231	34.6
Daily	11	1.7
Number of times evening meal cooked from scratch at home and eaten at home in last seven days		
Never	43	6.5
1-2 days	120	18.0
3-6 days	235	35.2
Daily	269	40.3
Frequency of eating five portions of fruits and vegetables in last seven days		
Never	163	24.4
1-3 days	384	57.6
4 days or more	120	18.0
Frequency of salty snack consumption in last seven days		
Never	240	36.0
1-3 days	328	49.2
4 days or more	99	14.8
Number of meals consumed in a day		
One	14	2.1
Two	95	14.2
Three	456	68.4
Four and above	102	15.3
Meal skipping		
Breakfast	148	22.2
Lunch	86	12.9
Snack	299	44.8
Supper	17	2.6
None	117	17.5
Overall dietary behaviour		
Unhealthy	294	44.1
Healthy	373	55.9

7.3.1.2 Multivariate Analysis of Dietary Behaviour and Associated Factors

Table 6.2 shows multivariate analysis between dietary behaviour and demographics, nutritional knowledge and parenting styles and parental role-modelling of healthy eating. Multivariate analysis showed that adolescents in the Volta region were less likely to observe healthy dietary behaviour compared to their counterparts in the Oti region [aOR=0.61 (95% CI= (0.39-0.94), p=0.024]. Also, middle (15-17 years) and older (18-19 years) adolescents were less likely to practice healthy dietary behaviours compared to younger adolescents [aOR=0.36 (95% CI= (0.21-0.59), p<0.001] and [aOR=0.29 (95% CI= (0.15-0.59), p<0.001], respectively. Adolescents who had a single parent were three times [cOR = 3.07 (95% CI= (1.29-7.34), p=0.011] and adolescents with dual parents were two and half times [cOR = 2.53 (95% CI= (1.12-5.74), 0.026] more likely to have healthy dietary behaviours compared to their counterparts who had no parents. Adolescents who had some form of education including senior high school [aOR=22.79 (95% CI= (5.62-92.41), p <0.001], junior high school [aOR=12.41 (95% CI= (3.25-47.35), p<0.001], tertiary education [aOR=7.63 (95% CI= (1.31-44.52), p=0.024] and primary education [cOR = 6.29 (95% CI= (1.8-21.9), p=0.004] were 23 times, 12.4 times, 8 times and 6.3 times, respectively, more likely to have healthy dietary behaviours compared to those who had no formal education. Adolescents with mothers who had junior high school education [cOR = 2.13 (95% CI= (1.33-3.41), p=0.002] and senior high school level of education [cOR = 2.71(95% CI= (1.6-4.58), p<0.001] were 2.1 times and 3 times, respectively, more likely to have healthy diets compared to adolescents whose mothers had no form of formal education.

Adolescents whose fathers were farmers were two times more likely to have healthy dietary behaviour compared to those whose fathers were artisans [cOR = 2.0 (95% CI= (1.09-3.65), p=0.024]. Having larger household sizes, including 6-7 member households [cOR = 0.34 (95% CI= (0.18-0.65), 0.001] and eight member or more household [cOR = 0.25 (95% CI= (0.13-

0.48), <0.001] was less likely to be associated with healthy diet behaviours compared to adolescents who belonged to households with less than four member. Adolescents in the fourth wealth quintile were 2.4 times more likely to have healthy diet behaviour compared to those in the first wealth quintile [cOR = 2.39 (95% CI= (1.42-4.04), $p<0.001$]. Adolescents who had medium nutritional knowledge and high nutritional knowledge were 1.6 times and 1.5 times more likely to have healthy diet behaviours, [cOR = 1.61 (95% CI= (1.08-2.41), $p=0.020$] and [cOR = 1.47 (95% CI= (1.01-2.13), $p=0.044$], respectively. Having an authoritative parent was associated with healthy diet compared to a neglectful parent [aOR=0.44 (95% CI= (0.29-0.68), $p<0.001$].



Table 7.2: Association between dietary behaviour and demographics, nutritional knowledge and parenting styles and parental role-modelling of healthy eating.

Variable	Dietary behaviour		X ² (p-value)/Fisher's exact	cOR (95% CI), p-value	aOR (95% CI), p-value
	Unhealthy 294(44.1%)	Healthy 373(55.9%)			
Region			14.992(<0.001)		
Oti	65(32.7)	134(67.3)		ref	ref
Volta	229(48.9)	239(51.1)		0.51(0.36-0.71), <0.001	0.61(0.39-0.94), 0.024
Gender			1.619(0.203)		
Female	183(46.1)	214(53.9)		ref	
Male	111(41.1)	159(58.9)		1.22(0.89-1.67), 0.203	
Age			6.642(0.040)		
10-14	94(38.4)	151(61.6)		ref	ref
15-17	131(45.5)	157(54.5)		0.75(0.53-1.06), 0.098	0.36(0.21-0.59), <0.001
18-19	69(51.5)	65(48.5)		0.59(0.38-0.89), 0.014	0.29(0.15-0.59), <0.001
Religion			6.850(0.033)		
Christianity	241(42.1)	332(57.9)		ref	
Islam	33(55.0)	27(45.0)		0.59(0.35-1.01), 0.056	
Traditionalist	20(58.8)	14(41.2)		0.51(0.25-1.03), 0.059	
Residence			0.106(0.745)		
Rural	184(43.6)	238(56.4)		ref	
Urban	110(44.9)	135(55.1)		0.959(0.69-1.30), 0.745	
Parental status			6.798(0.033)		
None	18(66.7)	9(33.3)		ref	ref
Single parent	54(39.4)	83(60.6)		3.07(1.29-7.34), 0.011	1.33(0.47-3.72), 0.593
Dual parent	222(44.1)	281(55.9)		2.53(1.12-5.74), 0.026	0.91(0.35-2.36), 0.845
Educational level			56.969(<0.001)		
None	31(91.2)	3(8.8)		ref	ref
Primary	64(62.1)	39(37.9)		6.29(1.8-21.9), 0.004	3.77(0.96-14.77), 0.057
JHS/JSS	105(38.0)	171(62.0)		16.83(5.02-56.42), <0.001	12.41(3.25-47.35), <0.001
SHS/SSS	84(35.4)	153(64.6)		18.82(5.59-63.41), <0.001	22.79(5.62-92.41), <0.001
Tertiary	10(58.8)	7(41.2)		7.23(1.57-33.37), 0.011	7.63(1.31-44.52), 0.024
Marital status			0.002(0.964)		
Never married	278(44.1)	353(55.9)		ref	
Married/living together	16(44.4)	20(55.6)		0.98(0.5-1.94), 0.964	
Mother's occupation			21.034(<0.001)		
Artisan	12(40.0)	18(60.0)		ref	
Professional	90(55.9)	71(44.1)		0.53(0.24-1.16), 0.113	
Office worker	33(54.1)	28(45.9)		0.57(0.23-1.37), 0.208	
Trader	117(35.9)	209(64.1)		1.19(0.55-2.56), 0.654	
Farmer	42(47.2)	47(52.8)		0.75(0.32-1.73), 0.495	
Mother's educational level			18.182(0.001)		

No formal education	72(56.3)	56(43.7)	ref	ref
Basic	83(46.9)	94(53.1)	1.46(0.92-2.3), 0.107	1.42(0.82-2.44), 0.207
JHS	61(37.7)	101(62.3)	2.13(1.33-3.41), 0.002	1.20(0.68-2.11), 0.519
SHS	37(32.2)	78(67.8)	2.71(1.6-4.58), <0.001	1.19(0.62-2.28), 0.592
Tertiary	41(48.2)	44(51.8)	1.38(0.79-2.39), 0.252	0.65(0.32-1.33), 0.238
Father's occupation			21.452(<0.001)	
Artisan	27(50.0)	27(50.0)	ref	ref
Professional	124(53.7)	107(46.3)	0.86(0.48-1.56), 0.626	0.86(0.37-2.03), 0.737
Office worker	41(47.7)	45(52.3)	1.09(0.56-2.17), 0.789	0.84(0.33-2.17), 0.724
Trader	27(38.0)	44(62.0)	1.63(0.79-3.33), 0.182	1.11(0.4-3.08), 0.840
Farmer	75(33.3)	150(66.7)	2.0(1.09-3.65), 0.024	1.24(0.51-3.04), 0.634
Household size			48.765(<0.001)	
<4	25(29.4)	60(70.6)	ref	ref
4-5	68(30.4)	156(69.6)	0.96(0.55-1.65), 0.871	0.86(0.45-1.63), 0.641
6-7	90(51.4)	85(48.6)	0.39(0.23-0.68), 0.001	0.34(0.18-0.65), 0.001
8+	111(60.7)	72(39.3)	0.27(0.16-0.47), <0.001	0.25(0.13-0.48), <0.001
Wealth quintiles			17.034(0.001)	
First	44(55.0)	36(45.0)	ref	ref
Second	60(53.1)	53(46.9)	1.08(0.61-1.92), 0.794	0.82(0.41-1.68), 0.599
Third	117(45.4)	141(54.6)	1.47(0.89-2.44), 0.132	0.78(0.18-0.65), 0.475
Fourth	73(33.8)	143(66.2)	2.39(1.42-4.04), 0.001	1.13(0.53-2.41), 0.744
Nutritional knowledge			6.249(0.044)	
Low	97(51.6)	91(48.4)	ref	ref
Medium	80(39.8)	121(60.2)	1.61(1.08-2.41), 0.020	1.42(0.85-2.36), 0.180
High	117(42.1)	161(57.9)	1.47(1.01-2.13), 0.044	1.67(0.99-2.81), 0.055
Parenting styles			28.830(<0.001)	
Neglectful	76(33.9)	148(66.1)	ref	ref
Authoritative	150(56.6)	115(43.4)	0.39(0.27-0.57), <0.001	0.44(0.29-0.68), <0.001
Permissive	31(36.9)	53(63.1)	0.88(0.52-1.48), 0.625	0.72(0.39-1.33), 0.297
Authoritarian	37(39.4)	57(60.6)	0.79(0.48-1.30), 0.356	0.82(0.46-1.48), 0.515
Parental role-modelling			0.332(0.564)	
Poor	140(42.9)	186(57.1)	ref	
Good	154(45.2)	187(54.8)	0.91(0.67-1.24), 0.564	

7.3.2 Qualitative results

7.3.2.1 Background Characteristics of Study Participants in the In-Depth Interviews

Table 7.3 shows the demographic characteristics of the study participants. In all 23 participants were interviewed, 56.5% of the participants were male and the majority of participants were between the ages of 15 to 17 (52.2%) followed by those between 10 to 14 (30.4%) and 18 to 19 (17.4%). The mean age of the participants was 15.8 ± 1.3 . All participants were single, and the majority of them were from the Volta region (60.9%). The most common ethnicity was Ewe (39.1%), followed by Guan (17.4%) and Kokomba (13%). The majority of participants identified as Christian (91.3%). Most participants had completed Junior High School (JHS) (60.9%), followed by Senior High School (SHS) (26.1%). The majority of participants were students (73.9%).



Table 7.3: Background characteristics of study participants

Variable	Frequency (N=23)	Percentage
Sex		
Male	13	56.5
Female	10	43.5
Age		
10 to 14	7	30.4
15 to 17	12	52.2
18 to 19	4	17.4
Mean age	15.8±1.3	
Marital status (single)	23	100
Region		
Volta	14	60.9
Oti	9	39.1
Ethnicity		
Ewe	9	39.1
Guan	4	17.4
Kokomba	3	13
Kotokli	2	8.7
Ga	2	8.7
Adele	2	8.7
Akan	1	4.3
Religion		
Christianity	21	91.3
Islam	1	4.3
African traditional	1	4.3
Educational level		
None	2	8.7
JHS	14	60.9
SHS	6	26.1
Tertiary	1	4.3
Residence	2	8.7
Occupation		
Student	17	73.9
Apprentice	2	8.7
Food vendor	2	8.7
Unemployed	2	8.7

7.3.2.2 Dietary Habits of Study Participants

The most frequently preferred foods by the study participants were local dishes dominated by local staples largely consisting of energy dense foods, including roots and tubers and cereals. The most commonly consumed staple foods were akple with pepper and fish, fufu with palmnut soup and bush meat, fufu with light soup, banku with groundnut soup, banku with groundnut soup and green leaves, banku with okro soup, jollof rice, rice with stew, waakye with stew and

salad, indomie with fried eggs, noodles, tuo zaafi with ayoyo soup, fried yam, boiled yam, kokonte, and gari and beans with fried plantain, and plantain with kontomire stew. These choices reflect the culinary patterns specific to the geographical location, the types of cultivated food crops, and cultural and traditional practices. Participants expressed a preference for these foods in large quantities.

7.3.2.3 Perception of Healthy Diets

Some adolescents perceived healthy diets as diets that give strength, energy and contributes to well-being. Exemplifying quotations: *“It is a food that when we eat, it gives us strength. I have a positive attitude towards eating healthily because I believe it contributes to my overall well-being, makes me more attractive and I don’t get too big (16 years old Male, from Salifu)”*. *“I see healthy foods as a source of energy and vitality, which motivates me to choose them.” (15 years old Male, from Salifu)*. Most study participants expressed their understanding of healthy diets in terms of foods containing fruits and vegetables, foods supplying vitamins and minerals. Exemplifying quotations: *“Any food that has a lot of fruits and vegetables as well as the other foods.” (15 years old Male from Lolobi-Kumasi)*. *“Knowing the importance of vitamins and minerals, I try to include a variety of fruits and vegetables in my diet.” (18 years old Male from Hohoe)*. Other study participants expressed their understanding of healthy diets in terms of balanced diet. Exemplifying quotation: *“Healthy food is having a balanced diet, not much oil or fat, not too salty, with some fruits and vegetables.” (15 years old Male from Hohoe)*. Some adolescents considered healthy diets from the perspective of safety, cleanliness and protection from illness. *“I consider healthy food as food that is nicely prepared, clean, nutritious and gives me strength.” (13 years old Female from Fodome)*. Some of the study participants also perceived healthy diets from the perspective of disease prevention. Exemplifying quotation: *“It is food that will not make you sick, but rather protect you. It should have proteins, leaves and vegetables.” (18 years old Female from Hohoe)*. Other study participants perceived healthy

diets from the perspective of bodybuilding, keeping strong and slim. *“A healthy diet builds your body and keeps you well. It contains leaves and vegetables.”* (16 years old Female from Hohoe). Another adolescent said, *“It is food that would not make you fat or too slim. Healthy food are foods with nutrients that keep you strong and healthy.”* (17 years old Female from Ho)

7.3.2.4 Barriers to and Enablers of Adolescent Healthy Eating Behaviours

This study explored the enablers and barriers to healthy eating among adolescents using mixed methods. The results show diverse barriers to and enablers of healthy eating behaviours across the four levels of the social-ecological model. The barriers and enablers were organised into themes along with exemplifying quotations (Tables 4 and 5). Key emerging themes included, individual (nutritional knowledge and culinary skills, taste of food), social environmental (influence of parents and peers, socio-cultural factors, social norms and food taboos), physical environment (availability, accessibility of food) and macrosystem (income, cost, food prices convenience, advertisement of food products) factors. Some factors were perceived as both enablers and barriers, and thus, are present in both tables.

7.3.2.5 Perceived Enablers of Healthy Eating: Individual level Enablers – Knowledge

Adolescents mentioned that having nutrition knowledge and understanding of nutrition information helped them make healthier food choices. For example, a 13-year-old from Fodome stated, *“I know what is good, so I try to eat healthy foods.”* Some adolescents cited school, online sources and books as the sources of nutrition knowledge. Adolescents who said they had good nutrition knowledge were more inclined say that they choose healthier food choices. For instance: an 18-year-old female from Hohoe said, *“I learned a lot about nutrition from school and online. I know how to read labels and choose healthier options.”* While adolescents’ nutrition knowledge was mentioned as an enabler of healthy eating healthy, the lack of dietary knowledge was seen as a barrier to making changes to one’s eating pattern and dietary

behaviour. However, adolescents recognised the importance of healthy food. One 15-year-old male from Salifu stated, *“I don’t have knowledge on how certain foods have to be consumed in moderation is the main problem that causes me to have such significant portions of snacks that I consume almost daily. More accessible knowledge about healthy eating could help to encourage children to eat more healthy food.”* Another 17-year-old male from Salifu added, *“I don’t know much about nutrition or how to cook healthy meals. I just eat what is available or what my parents or friends give me. I don’t know how to choose healthy foods or prepare them.”* (17 years old Male from Salifu.

7.3.2.6 Individual Level Enablers and Barriers– Cooking and Food Preparation Skills

Cooking skills and the ability to prepare meals were identified as crucial for maintaining a healthy diet. For example, one 17-year-old male from Hohoe expressed, *“I have learned a lot about nutrition and how to cook healthy meals from school, online, and books. I know how to select healthy foods and prepare them. I can make salads, soups, stews, and smoothies with fruits and vegetables.”* Many more adolescents acknowledged that limited food preparation and cooking skills were barriers to healthy eating. Some also perceived cooking as complicated. For example, one 18-year-old male from Hohoe expressed, *“Cooking healthy meals seems complicated; I stick to what I know. I don’t really know what healthy foods are.”* Another 14-year-old female from Hohoe added, *“I don’t know how to cook healthy meals. I wish I knew more about what’s healthy; it’s all so confusing. I’ve never been taught about dietary guidelines or what’s good for me. Cooking healthy meals just seems too complicated.”* Additionally, a 19-year-old male from Hohoe added, *“I think my biggest barrier is definitely not knowing what foods are healthy and which ones are unhealthy. Sometimes, I just don’t know what food to buy, in order to eat healthy.”*

7.3.2.7 Individual Level Enablers – Food preference (Taste)

Adolescents reported that ‘taste’ was an important factor influencing their food choices. While taste can lead to unhealthy eating, it can also promote healthy choices. The taste of fresh fruits was identified as an enabler. Exemplifying Quotations: *I genuinely enjoy the taste of fresh fruits, which makes it easy for me to include them in my daily meals (14 years old male from Hohoe).* Some adolescents expressed that while vegetables may not always be tasty; they recognised their health benefits: *We always have leaves in our soups. The leaves are healthy, but they don’t taste the best... you don’t really enjoy eating [laughs] (16-year-old female from Salifu).* Others found enjoyment in traditional food, stating: *It is our traditional food. It tastes good and is very rich. It can take you the whole day (17-year-old male from Hohoe).*

7.3.2.8 Individual Level Enablers – Body Image, Appearance and Intention to Stay Fit

Adolescents mentioned their own body image as a factor that can influence their eating behaviours. Some male adolescents mentioned that the desire to have ideal bodies, the desire to appear fit and the desire to maintain good health influenced their dietary behaviours. For example, one 16-year-old male from Salifu stated: *“I have a positive attitude towards eating healthily because I believe it contributes to my overall well-being, makes me more attractive and I don’t get too big.” (16 years old male, from Salifu);* Another 16-year-old male from Ho added, *“I want to stay fit and look good, so I try to eat healthy foods.”*

7.3.2.9 Individual Level Enablers – Willpower and Self-Discipline

Some participants said that personal determination plays a crucial role in making healthy food choices. For example, one 17-year-old participant from Salifu stated, *“I’ve made a conscious decision to prioritize my health, and that drives my food choices.”*

7.3.2.10 Social Environmental Level Enablers -Positive Parental Influence

Some adolescents perceive certain family-level factors as facilitators of healthy dietary behaviours. These included positive parental attitudes towards healthy eating, parental healthy food preferences and choices, as well as the modelling of healthy eating by parents. For example: *“My mother sells fruits and vegetables in the market, she always brings home some fruits and vegetables for the family”* (14-year-old female from Hohoe); Another 19-year-old male from Hohoe expressed that, *“My parents eat healthy foods and follow dietary guidelines. They eat fruits and vegetables every day, they avoid processed foods and sugar-sweetened beverages, and they eat breakfast regularly. I follow their example.”* The role of parents in providing healthy food options at home was also highlighted as well as their role in healthy food preparation. For example: *“We always have healthy options at home because my mom insists on it. My mom is the one who cooks everything for us. We have no say in what we eat or want to eat. We have to have what she gives us.”* (14 years old from Nkwanta); Another 14-year-old male from Hohoe added *“My mom often prepares delicious, balanced meals for the family, and it sets a good example for me. Family meals are a chance for us to bond, and my parents use this time to teach us about the benefits of balanced nutrition.”* In contrast, some participants felt that their parents were not eating healthy or following dietary guidelines but rather consumed junk foods and processed foods: *“My parents don't eat healthy foods or follow dietary guidelines. They don't eat fruits and vegetables, they eat a lot of processed foods and sugar-sweetened beverages, and they skip breakfast. I do the same as them”* (15-year-old male from Salifu); *“My parents rarely eat fruits and vegetables, so it's not a big deal for me either. If my family followed dietary guidelines, it would make it easier for me. I've grown up eating the way my parents do, so it's hard to change”* (16-year-old female from Salifu).

Adolescents mentioned that parents have a major influence on the eating behaviours of adolescents, from providing healthy food at home to teaching them about healthy eating habits.

According to one 17-year-old male from Hohoe, *"It's all upon parents to provide healthy food at home and teach us about healthy eating. When they give me vegetables and fruits, I'll eat it. Whatever they give me, even if it is junk foods I eat, I have no option. It is just the training they have given us all."* Another 17-year-old female from Ho mentioned, *"My parents set clear expectations about our food choices, and it's helped me develop healthy habits."* (17 years old Female from Ho).

The home food environment plays a crucial role in shaping adolescents' eating habits, as they identified having a variety of food at home as an important factor that encourages healthy eating. For instance, one participant mentioned, *"We have diverse food options in the house, we eat different foods all the time; fruits, vegetables, fish..."* (19-year-old male from Hohoe). This demonstrates how access to different types of food influences their dietary choices and promotes a balanced diet. *"We eat different foods all the time. Sometimes you have a choice as to what is cooked and what you want to eat. It helps me eat different healthy foods"* (14-year-old male from Hohoe); *"We have all kinds of foods at home. I eat different kinds of fruits and vegetables and various other foods every day."* (17-year-old-female from Kpasa). In contrast, other adolescents believed that limited variety of food items in the home environment makes it sometimes hard for them to make healthy choices. Exemplifying quotations: *"We lack diversity of food options at home, which limits the food we eat."* (16 years old Female from Hohoe); *"We lack diverse food options in the house"* (15-year-old male from Lolobi-Kumasi). Not cooking dinner at home was also identified as a reason for not eating healthy. Exemplifying Quotation: *"My parents don't cook dinner often, so we eat out a lot. My parents don't eat healthy, so I don't either"* (17-year-old male from Salifu).

7.3.2.11 Social Environmental Level Enablers -Positive Peer Influence

After family, participants also highlighted that their friends influenced their dietary behaviours. Adolescents mentioned the influence of social support, motivation, encouragement, and competition from peers on their eating habits. Eating together with friends was perceived as a facilitator to healthy eating behaviour; those with friends who had healthy dietary behaviours tended to eat healthier while those whose friends preferred unhealthy options displayed similar tendencies in their own dietary behaviours. Adolescents believed that peer support played a significant role in their eating behaviour, especially through encouragement. For example, *“My friends and I motivate each other to opt for healthier snacks during school breaks”* (13 years old male from Fodome) exemplifies how peer modelling of healthy eating was identified as a key enabler of healthy eating behaviour among adolescents. This is further supported by the quotation: *“My friends eat healthy food. Sometimes we contribute and buy the food together and eat”* (19-year-old male from Hohoe). Another participant mentioned that they and their friends motivate each other to choose healthier snacks during school breaks. This peer modelling of healthy eating is seen as a significant factor in fostering healthy eating behaviour among adolescents.

Adolescents considered peer-to-peer healthy eating competition to be a major motivator for making healthier food choices. For some, peers had the most impact on their dietary behaviours. Peer influence was identified as both an encouragement and a barrier to healthy eating habits among adolescents. One 15-year-old male from Fodome stated, *“At our school, we have a friendly competition to see who can bring the healthiest lunch, which encourages us all to choose wisely.”* Many participants recognized peer pressure as a key factor influencing adolescents' dietary habits and acknowledged that friends had the greatest impact on their eating behaviours. It included pressure, the desire to fit in, and avoid judgment from friends. Friends' preferences and peer pressure could significantly sway food choices according to participants' experiences. For example, *“My friends influence me a lot when it comes to food choices. They*

pressure me to eat what they eat, like fast foods, street foods, snacks, and soda. They tease me if I eat fruits and vegetables or bring my own lunch. I want to fit in with them” said one 16-year-old male from Salifu, describing how his friends influenced him towards less healthy options like fast foods and snacks while teasing him for choosing fruits or bringing his own lunch. Another participant explained how they didn't want to feel left out by ordering unhealthy foods when going out with friends: “My friends often order unhealthy foods when we go out, and I don't want to be the odd one out” (16 years old Male from Ho). Additionally, there were instances where peer influence led them into consuming unhealthy foods just because everyone else was doing so: “Sometimes my friends pressure me to eat unhealthy foods with them...we all want...fit in” conveys another perspective shared by an adolescent female also located in Ho.

7.3.2.12 Physical Environment Enabler – Food Availability and Variety in the Community

Adolescents indicated that their eating habits may depend on the environment in which they find themselves and the foods available. The community environment can influence adolescents to make healthy or unhealthy food choices, as exemplified by a 19-year-old male from Hohoe: “*There are many healthy options at the local food markets... However, some places don't have good food, so you eat what is there.*” This highlights how environmental factors can shape adolescents' dietary choices and may influence them to consume both nutritious and less healthy foods based on availability. Some adolescents expressed their struggles with finding healthy food options in their environment. One 16-year-old male participant from Salifu noted, “*All the shops and restaurants sell fast food, chips, sweets, and sugary drinks. It's hard to find fruits and vegetables.*” Another 15-year-old male from Salifu mentioned, “*There are no healthy food options nearby, only fast-food outlets and shops selling junk food.*” Additionally, concerns were raised about the inadequate quality of school meals discouraging healthy eating habits. For instance, one 14-year-old female student remarked that their school's meals lacked richness as they didn't include essential elements like egg or vegetables. Another 15-year-old male from

Lolobi confirmed this *"The school food they provide us lack richness, they don't include egg, meat or fish, the soup is watery without any vegetables."*

7.3.2.13 Macrosystem - Food Prices, Cost, Income and Financial Resources and Ease of Access to Unhealthy Foods

Participants mentioned that food product prices, cost, and their income levels significantly influenced their food choices. Some adolescents with resources expressed how it facilitated healthy eating. For instance, one 16-year-old female from Hohoe stated: *"I have the resources to eat healthy foods. Healthy foods are not that expensive and easy to find."* Similarly, a 15-year-old male from Lolobi-Kumasi shared, *"I have enough money to buy healthy food."* However, only a few participants believed they had the financial means to consistently support healthy eating habits.

Adolescents also expressed the belief that unhealthy foods were more affordable than healthier options, serving as a barrier to making healthier food choices. Participants conveyed their financial struggles and limited income, which heavily influenced their food decisions and often determined what their families could afford. One 15-year old male participant stated,

"I don't eat a healthy meal until I get back home at the end of the day because I have to go to work, and I don't have money."

Another, a 17-year-old, explained how buying vegetables separately from the main food made it expensive to eat healthily with vegetables.

"The food vendor sells the vegetables separately from the main food so to top my rice up with vegetables, I need extra money. This makes it expensive to eat healthy with vegetables. Healthy foods should be cheaper so that we can all buy, and unhealthy foods should become more expensive so people would be discouraged from consuming them."

They emphasized the need for healthy foods to be more affordable while suggesting that unhealthy options should become costlier to discourage consumption. Adolescents also

identified the lack of resources or refrigeration facilities which results in perishable foods like fruits and vegetables going bad as a barrier to healthy eating. They expressed concern about the impact on taste, safety, and overall health when bananas, oranges, and leafy greens deteriorate due to lack of proper preservation. For example, *"Sometimes our fruits and vegetables like bananas, oranges and some leaves go bad and don't last long and rot away. ...This is because we don't have a fridge. This can make them taste bad or unhealthy or unsafe."*

7.3.2.14 Marketing, Media and Advertising of Food

Participants felt that their food choices and dietary behaviours were influenced by marketing, media, and advertising. One 17-year-old female from Ho exemplified this influence, stating, *"Yes, adverts influence my food choices. It is how you get to know about new products in the market."* Similarly, a 16-year-old male from Salifu shared his experience saying, *"When I see food advert on television, I always feel like going to get some; they always make it look nice and I feel like it because I see it on television."*

7.3.2.15 Socio-Cultural Norms and Values

Participants felt that their eating habits were deeply rooted in cultural traditions. They mentioned that traditional energy-dense staples like banku, fufu, kokonte, and akple remain essential but noted an increasing shift towards the consumption of rice, noodles, and fried foods as well. One 18-year-old male from Hohoe expressed this by saying: *"The banku, fufu, kokonte and akple are always there but now rice, noodles, and a lot of fried foods are here too."* Similarly, a 14-year-old female from Hohoe stated that *"Our traditional foods are usually energy dense; it's part of our culture,"* while another participant (a 17-year-old male) shared *"They eat more staple foods like banku, but we also consume gari and beans in palm oil."*

Table 7.4: Key enablers of healthy eating among adolescents in the Volta and Oti regions of Ghana

Level	Facilitator	Exemplifying Quotation
Individual	Nutritional knowledge	<i>"I learned a lot about nutrition from school and online. I know how to read labels and choose healthier options." (18 years old Female from Hohoe)</i> <i>"I know what is good, so I try to eat healthy foods." (13 years old from Fodome)</i> <i>"I can select healthy foods from unhealthy ones." (16 years old Female from Hohoe)</i>
	Cooking skills and the ability to prepare some meals were identified as important for eating a healthy diet.	<i>"I have learned a lot about nutrition and how to cook healthy meals from school, online, and books. I know how to select healthy foods and prepare them. I can make salads, soups, stews, and smoothies with fruits and vegetables." (17 years old Male from Hohoe)</i> <i>"I know healthy and unhealthy foods. I can also prepare some meals." (14 years old Male from Hohoe)</i> <i>"I have some knowledge about what is healthy food. I also have some cooking skills." (17 years old Female from Kpasa)</i>
	Taste	<i>I genuinely enjoy the taste of fresh fruits, which makes it easy for me to include them in my daily meals. (14 years old Male from Hohoe)</i>
	Body image, appearance and intention to stay Fit:	<i>"I have a positive attitude towards eating healthily because I believe it contributes to my overall well-being, makes me more attractive and I don't get too big." (16 years old male, from Salifu)</i> <i>"I want to stay fit and look good, so I try to eat healthy foods." (16 years old Male from Ho)</i>
	Willpower and self-discipline	<i>"I've made a conscious decision to prioritize my health, and that drives my food choices." (17 years old from Salifu)</i>
Social environment	Parental role modelling of healthy eating	<i>"My parents are very health conscious. They always eat fruits and vegetables and cook balanced meals. They also encourage me to eat healthy." (18 years old Male from Hohoe)</i> <i>"My mother sells fruits and vegetables in the market; she always brings home some fruits and vegetables for the family." (14 years old Female from Hohoe)</i> <i>"My parents eat healthy foods and follow dietary guidelines. They eat fruits and vegetables every day, they avoid processed foods and sugar-sweetened beverages, and they eat breakfast regularly. I follow their example." (19 years old Male from Hohoe)</i> <i>"My parents set a good example by eating lots of fruits and vegetables. We always have fruits and vegetables." (17 years old Female from kpasa)</i>
	Parental provision and food preparation	<i>"My mother prepares my food for me to take to school and it has everything in it." And what is everything? I mean rice or waakye, or yam with stew, vegetables, meat or egg or fish and a banana or orange or pawpaw or some kind of fruit." (18 years old Female Hohoe)</i> <i>"We always have healthy options at home because my mom insists on it. My mom is the one who cooks everything for us. We have no say in what we eat or want to eat. We have to have what she gives us." (14 years old from Nkwanta)</i> <i>"My mom often prepares delicious, balanced meals for the family, and it sets a good example for me. Family meals are a chance for us to bond, and my parents use this time to teach us about the benefits of balanced nutrition." (14 years old Male from Hohoe)</i>

	The home food environment. Having variety at home.	<i>We have a lot of diverse food options in the house. We eat a lot of fruits and vegetables as a family. We always have some at home. It is very healthy. (14 years old female from Hohoe)</i> <i>"We have diverse food options in the house, we eat different foods all the time, fruits, vegetables, fish, eggs, meat, all of them." (19 years old Male from Hohoe)</i> <i>"We eat different foods all the time. Sometimes you have a choice as to what is cooked and what you want to eat. It helps me eat different healthy foods." (14 years old Male from Hohoe)</i> <i>"We have all kinds of foods at home. I eat different kinds of fruits and vegetables and various other foods every day." (17 years old Female from Kpasa)</i> <i>"We have diverse foods in the house." (13 years old Female from Fodome)</i> <i>"I have access to healthy food at home and school." (16 years old Female from Hohoe)</i>
	Parental teaching, provision and control	<i>"It's all upon parents to provide healthy food at home and teach us about healthy eating. When they give me vegetables and fruits, I'll eat it. Whatever they give me, even if it is junk foods I eat, I have no option. It is just the training they have given us all." (17 years old Male from Hohoe)</i> <i>"My parents set clear expectations about our food choices, and it's helped me develop healthy habits." (17 years old Female from Ho)</i>
	Peer influence on healthy eating. Peer support, motivation and encouragement	<i>"My friends support me a lot when it comes to food choices. They encourage me to eat healthy foods, like fruits, vegetables, nuts, and water. They respect me if I eat differently from them or bring my own lunch. I feel comfortable with them." (17 years old Male from Hohoe)</i> <i>"My friends eat healthy food. Sometimes we contribute and buy the food together and eat." (19-year-old male from Hohoe)</i>
	Peer modelling of healthy eating	<i>"My friends and I motivate each other to opt for healthier snacks during school breaks." (13 years old male from Fodome)</i>
	Peer competition on healthy eating	<i>"At our school, we have a friendly competition to see who can bring the healthiest lunch, which encourages us all to choose wisely." (15-year-old male from Fodome)</i>
Physical environment	Food environment. Availability of healthy food in the community	<i>"There are many healthy options at the local food markets. Where there is good food, we eat. However, some places don't have good food, so you eat what is there" (19 years old Male from Hohoe)</i> <i>"There are many healthy options around here. There are shops and restaurants that sell salads, smoothies, and juices. There are also markets that sell fresh fruits and vegetables." (17 years old from Kpasa)</i> <i>"The environment around me is conducive to healthy eating. There are many healthy food options nearby, such as supermarkets, restaurants, markets selling fresh fruits and vegetables. There are also fruits and vegetables at home and at school." (14 years old Female from Nkwanta)</i>
Macrosystem	Cost, finance, income	<i>"I have the resources to eat healthy foods. Healthy foods are not that expensive and easy to find. I can buy fruits, vegetables, yogurt, eggs, fish, and chicken with my pocket money or allowance." (16 years old Female from Hohoe)</i> <i>"I have enough money to buy healthy food." (15 years old Male from Lolobi-Kumasi)</i>

Table 7.5: Key barriers to healthy eating among adolescents in the Volta and Oti regions of Ghana

Level	Barrier	Exemplifying Quotation
Individual	Lack of nutritional knowledge and limited food preparation and cooking skills	<i>"I don't really know what is healthy and what is not. I just eat what I like or what is available."</i> (16 years old Male from Salifu) <i>"I don't have knowledge on how certain foods have to be consumed in moderation is the main problem that causes me to have such significant portions of snacks that I consume almost daily. More accessible knowledge about healthy eating could help to encourage children to eat more healthy food."</i> (15 years old Male from Salifu) <i>"I don't know much about nutrition or how to cook healthy meals. I just eat what is available or what my parents or friends give me. I don't know how to choose healthy foods or prepare them."</i> (17 years old Male from Salifu) <i>"Cooking healthy meals seems complicated; I stick to what I know. I don't really know what healthy foods are."</i> (18 years old male from Hohoe) <i>"I don't know how to cook healthy meals. I wish I knew more about what's healthy; it's all so confusing. I've never been taught about dietary guidelines or what's good for me. Cooking healthy meals just seems too complicated."</i> (14 years old Female from Hohoe) <i>"I think my biggest barrier is definitely not knowing what foods are healthy and which ones are unhealthy. Sometimes, I just don't know what food to buy, in order to eat healthy."</i> (19 years old Male from Hohoe) <i>"No. I don't have good knowledge or skills about food."</i> (13 years old Male from Fodome)
	Taste	<i>Sometimes our fruits and vegetables like bananas, oranges and some leaves go bad and don't last long and rot away. ...This is because we don't have a fridge. This can make them taste bad or unhealthy or unsafe/</i> <i>We always have leaves in our soups. The leaves are healthy, but they don't taste the best. I want to enjoy my food, but with the leaves you don't really enjoy eating [laughs].</i> (16-year-old female from Salifu) <i>It is our traditional food. It tastes good and is very rich. It can take you the whole day.</i> (17-year-old male from Hohoe)
Social environment	Parental and family influence. Parental role modelling of healthy eating	<i>"My parents don't eat fruits and vegetables, so I don't either. They always buy junk food and soda for the house."</i> (16 years old Male from Salifu) <i>"My parents don't eat healthy foods or follow dietary guidelines. They don't eat fruits and vegetables, they eat a lot of processed foods and sugar-sweetened beverages, and they skip breakfast. I do the same as them."</i> (15 years old Male from Salifu) <i>"My parents rarely eat fruits and vegetables, so it's not a big deal for me either. If my family followed dietary guidelines, it would make it easier for me. I've grown up eating the way my parents do, so it's hard to change."</i> (16 years old Female from Salifu)
	No cooking at home	Exemplifying Quotation: <i>"My parents don't cook dinner often, so we eat out a lot. My parents don't eat healthy, so I don't either."</i> (17 years old Male from Salifu)

	Limited Variety at Home. Lack of diverse food options within households affects dietary choices.	<i>"We lack diverse food options in the house." (16 years old Male from Salifu)</i> <i>"We have limited variety of food choices at home." (17years old Male from Salifu)</i> <i>"Limited variety of diverse food choices at home." (18 years old Female from Hohoe)</i> <i>"Most of the time we lack variety of foods in the house." (19 years old Male from Ho)</i> <i>"We lack diversity of food options at home, which limits the food we eat." (16 years old Female from Hohoe)</i> <i>"We lack diverse food options in the house." (15 years old Male from Lolobi-Kumasi)</i>
	Peer influence on unhealthy eating. Peer pressure and desire to fit in	<i>"My friends influence me a lot when it comes to food choices. They pressure me to eat what they eat, like fast foods, street foods, snacks, and soda. They tease me if I eat fruits and vegetables or bring my own lunch. I want to fit in with them." (16 years old Male from Salifu)</i> <i>"Sometimes I eat what my friends eat to fit in and avoid judgment." (18 years old Female from Hohoe)</i> <i>"Sometimes, I feel pressure from my friends to eat unhealthy foods. It's easier to fit in when you eat what everyone else is eating. (15 years old Male from Salifu)"</i> <i>"We influence each other's food choices, for better or worse. When my friends eat unhealthy food, so do I." (17 years old Male from Salifu)</i> <i>"My friends often order unhealthy foods when we go out, and I don't want to be the odd one out." (16 years old Male from Ho)</i> <i>"Sometimes, my friends pressure me to eat unhealthy foods with them. We all want to fit in, so we end up eating the same things." (17 years old Female from Ho)</i>
Physical environment	Unhealthy food environment. Limited availability of fresh produce at home or in the community affects access.	<i>"There is no healthy food around here. All the shops and restaurants sell fast food, chips, candy, and soda. It's hard to find fruits and vegetables. (16 years old Male from Salifu)"</i> <i>"This place is not conducive to healthy eating. There are no healthy food options nearby, only fast-food outlets, street vendors, shops selling junk food and soda. There are no fruits and vegetables at home or at school." (15 years old Male from Salifu)</i> <i>"There are a lot of fast-food restaurants near my school. There are also many stores near my house, where they sell sweet drinks so it's hard to buy healthy food." (18 years old Male from Hohoe)</i> <i>"I can't find fresh produce easily where I live." (14 years old Male from Ho)</i>
	Food safety	<i>Yes. I am very careful with eating vegetables because some of them are sprayed with chemicals." (16-year-old male from Salifu)</i>
	School food environment. Inadequate quality of school meals discourages healthy eating.	<i>"My school doesn't serve healthy food. There are no fruits and vegetables in my house." (17 years old Male from Hohoe)</i> <i>"My school doesn't serve healthy food but there are fruits and vegetables in my house." (14 years old Female)</i> <i>"The school food they provide us lack richness, they don't include egg, meat or fish, the soup is watery without any vegetables." (15 years old Male from Lolobi-Kumasi)</i>
Macrosystem	Food prices, cost, financial constraints, ease of access to unhealthy foods	<i>"I don't eat a healthy meal until I get back home at the end of the day because I have to go to work, and I don't have money. Eating out is so expensive, so I usually eat soakings [gari and sugar] and that's not healthy." (15 years old Male from Salifu)</i>

		<i>"I don't have the resources to eat healthy foods. Healthy foods are too expensive and hard to find. I have to eat cheap and filling foods like bread, rice, noodles, beans, and corn." (16 years old Female from Salifu)</i> <i>"I would love to eat healthier, but the cost of healthy options is too high." (18 years old male from Hohoe)</i> <i>"Healthy food is too expensive. I don't have enough money to buy healthy food." (17 years old Male from Hohoe)</i> <i>"The food vendor sells the vegetables separately from the main food so to top my rice up with vegetables, I need extra money. This makes it expensive to eat healthy with vegetables. Healthy foods should be cheaper so that we can all buy, and unhealthy foods should become more expensive so people would be discouraged from consuming them." (17 years old Female from Kpasa)</i> <i>"Healthy foods are too expensive and often we go for what our money can buy. Had both healthy and unhealthy food been the same price we would all go for healthy food." (17 years old Female from Ho)</i>
	Lack of resources	<i>Sometimes our fruits and vegetables like bananas, oranges and some leaves go bad and don't last long and rot away. ...This is because we don't have a fridge. This can make them taste bad or unhealthy or unsafe.</i>
	Marketing, advertisement of unhealthy foods. Aggressive marketing of high-fat, high-salt, high-sugar products influence choices.	<i>"Yes, adverts influence my food choices. It is how you get to know about new products in the market." (17 years old Female from Ho)</i> <i>"When I see food advert on television, I always feel like going to get some; they always make it look nice and I feel I like it, but also because I see it on television." (16-year-old male from Salifu)</i> <i>"Yes, they make you feel like you are getting the best thing." (17 years old Female from Kpasa)</i> <i>"Yes, adverts influence my food choices. It is how you get to know about new products in the market." (17 years old Female from Ho)</i>
Socio-cultural norms	Traditional energy-dense staples dominate diets due to cultural preferences.	<i>"The banku, fufu, kokonte and akple are always there but now rice, noodles, and a lot of fried foods are here too." (18 years old Male from Hohoe)</i> <i>"Our traditional foods are usually energy-dense; it's part of our culture." (14 years old Female from Hohoe)</i> <i>"We eat more staple foods like banku, but we also consume gari and beans in palm oil." (17 years old Male from Hohoe)</i>



7.4 Discussion

The purpose of this mixed method study was to explore diet behaviour among adolescents in Volta and Oti regions of Ghana with a focus on identifying the perceived enablers and barriers to healthy eating. The result provides valuable insights into the dietary behaviours of adolescents, shedding light on their enablers and barriers to healthy eating. Understanding these enablers and barriers is crucial in order to develop effective interventions and strategies to promote healthy eating among adolescents (Wise, 2015). The dietary patterns of 667 adolescents surveyed showed that the majority ate out in the last seven days, with a significant portion eating take-away and having their evening meal cooked from scratch at home. Fruits and vegetable consumption was low, while a high percentage of adolescents reported consuming salty snacks. The most common number of meals consumed was three per day, with many adolescents skipping some form of meal, especially breakfast. Overall, more than half of the adolescents (55.9%) had a healthy overall dietary behaviour. Unhealthy dietary practices included meal skipping and consumption of junk foods. This study identified energy-dense dietary pattern among adolescents. The majority of adolescents consumed local dishes rich in energy-dense staples, reflecting their cultural background and geographical location. Fruits and vegetable intake was low among the adolescents and a significant proportion report skipping meals, especially breakfast. This dietary pattern is consistent with findings from other studies on children and adolescent diets across LMICs (Abizari & Ali, 2019a; Isabirye et al., 2020a; Ogum-Alangea et al., 2020; Wiafe, Apprey, et al., 2023c). However, more than half of the adolescents surveyed exhibit healthy overall dietary behaviours.

7.4.1 Associations and Influences

Adolescents in the Volta region were less likely to observe healthy dietary behaviour compared to their counterparts in the Oti region. Previous studies extensively show that children's chances of consuming food items and food groups differed across the different regions of Ghana

(Anane et al., 2021) Middle (15-17 years) and older adolescents (15-19 years) were less likely to maintain healthy dietary habits. This may be due to various influences such as peer pressure, media, and social norms (Chung et al., 2021; Ragelienė & Grønhøj, 2020). Evidence also that older adolescents may experience more autonomy over their food choices (Patton et al., 2018b). The results from the quantitative study showed that parental education, occupation, household size, and wealth directly influence adolescents' eating patterns. The study provides insight on family structure differences, suggesting that adolescents living single parent homes were more likely to have healthy dietary behaviours compared to their counterparts who had no parents. Larger family size was a factor contributing to unhealthy diet behaviours. Similar findings have been reported in Ghana (Batame, 2023). Adolescents' education and maternal education were associated with healthy dietary behaviours. This finding is similar to another finding which show that maternal education levels influences eating behaviours (van Ansem et al., 2014). Adolescents whose fathers were farmers were more likely to have healthy dietary behaviour compared to those whose fathers were artisans. Low socio-economic status was associated with unhealthy diet behaviour. Understanding the importance of nutrition knowledge and its influence on adolescent food choices is crucial for promoting healthy eating habits (Martínez et al., 2010). Inadequate nutritional knowledge was associate with unhealthy diet behaviours. Previous studies extensively show that people with lower socioeconomic status (SES) generally exhibit less healthy eating behaviours (Alkerwi et al., 2015; Anane et al., 2021; Weil et al., 2023).

The findings also show that factors in the home food environment play an important role in dietary behaviour. Having an authoritative parent was associated with healthy diet behaviours. Authoritative parenting style has been shown to positively influence healthy eating habits (Berge et al., 2014; Gouveia et al., 2019). In contrast, authoritarian and neglectful styles, are associated with a greater likelihood of adolescents developing unhealthy dietary behaviour

(Berge et al., 2014; Gouveia et al., 2019; Krug et al., 2016; Robertson, 2020). Although the quantitative did not show significant association between parental role-modelling of healthy eating and adolescent eating behaviours, in the qualitative study one of the key themes was that parental dietary behaviours influence adolescent dietary behaviours. Parenting styles, parental role modelling and involvement play a crucial role in shaping the dietary behaviours and habits of children and adolescents, including their consumption of fruits and vegetables (Draxten et al., 2014b; Webber & Loescher, 2013). Parents serve as primary influencers and sources of guidance for their children, and their own eating behaviours can significantly impact the food choices and preferences of adolescents. Child and adolescent dietary behaviours are influenced by a myriad of factors, both within and outside the family unit, along with various social-psychological processes (Haines et al., 2019b). Household-level factors can present challenges to support the nutritional needs of children and adolescents (Eicher-Miller et al., 2023). Among these factors, parenting styles and parental role modelling have emerged as important factors that influence dietary behaviour among children and adolescents (Amos et al., 2012c; Scaglioni et al., 2018). Authoritative parenting has been identified as protective factor against risks for malnutrition (Burke et al., 2019b). In contrast, authoritarian and permissive parenting styles have been linked with unhealthy eating (Burke et al., 2019b). However, studies examining the association between parenting practices and child and adolescent diet quality and dietary outcomes have focused on families in high-income countries and western societies such as North America and Europe (Burke et al., 2019b; Reicks et al., 2015b; Scaglioni et al., 2018).

Adolescents who had a single parent were more likely to have healthy dietary behaviours compared to their counterparts who had no parents. Adolescents who had some form of education including senior high school and above were more likely to have healthy dietary behaviours compared to those who had no formal education. Adolescents with mothers who had at least junior high school level of education were more likely to have healthy diets

compared to adolescents whose mothers had no form of formal education. Adolescents whose fathers were farmers were more likely to have healthy dietary behaviour compared to those whose fathers were artisans. Adolescents who were members of larger household sizes were less likely to have healthy diet behaviours compared to adolescents who belonged to households with less than four members. Low socio-economic status was associated with unhealthy diet behaviour. Inadequate nutritional knowledge was associated with unhealthy diet behaviours. Having an authoritative parent was associated with healthy diet behaviours.

7.4.2 Perception of Healthy Diets

Most adolescents view healthy diets as providing strength, energy, and overall well-being. They associate healthy eating with fruits, vegetables, vitamins, minerals, and a balanced diet. Additionally, they consider healthy diets as food that is clean and protects against illness or aids in bodybuilding while keeping them strong and slim.

7.4.3 Perceived Enablers and Barriers to Healthy Eating

Adolescents associate healthy diets with strength, energy, and well-being, highlighting their understanding of its importance. Having nutrition knowledge proves beneficial, but some lack understanding of healthy food preparation. These results suggest that interventions aimed at promoting healthy eating habits among adolescents should focus not only on providing nutrition education and knowledge, but also on fostering positive parental and peer support, addressing the cost of healthy foods, and highlighting the value that healthier food choices can bring (Mokhtari et al., 2017).

Taste plays a significant role, with some valuing traditional flavours alongside appreciating the health benefits of fruits and vegetables. In other studies, adolescents mentioned that the appearance, smell, temperature, variety, and how food is prepared or served all influence their

food choices (Staiano et al., 2012). To encourage healthier food choices among adolescents, it is important to make healthy foods look more appealing.

Individual willpower and self-discipline emerge as crucial enablers of healthy eating. Adolescents mentioned that having nutrition knowledge helped them make healthier food choices, citing school, online sources and books as their sources. However, some also expressed a lack of dietary knowledge as a barrier to making changes in their eating patterns. Cooking skills and meal preparation are crucial for maintaining a healthy diet. Many adolescents expressed that their limited cooking knowledge acted as a barrier to eating healthily, finding it complicated and confusing to know what foods are healthy or how to prepare them. This lack of understanding makes it difficult for them to make informed decisions about food choices. Adolescents emphasized the influence of taste on their food choices. While they enjoyed the taste of fresh fruits, some acknowledged that vegetables may not always be tasty but still recognized their health benefits. Additionally, traditional food was mentioned as being both enjoyable and rich in flavour by some adolescents. Adolescents mentioned their body image as a factor influencing their dietary behaviours. Some expressed the desire to have ideal bodies and maintain good health, linking it to eating healthily and staying fit.

7.4.4 Family and Social Influences

Family dynamics also play a crucial role in shaping adolescents' nutrition choices (Fitri et al., 2020). The family environment, including the presence of healthy foods and mealtime routines, significantly influences the dietary choices of adolescents (Akman et al., 2010). Parents who prioritize and model healthy eating behaviours create an environment that supports and encourages their adolescent children to make similar choices. Parental role modelling of healthy eating has been found to have a significant impact on adolescent healthy eating behaviour. Adolescents who observe their parents engaging in healthy eating habits are more likely to

adopt those habits themselves (de Souza et al., 2023). Various studies found a strong influence of parenting styles and parental dietary habits on the dietary behaviours of children and adolescents, irrespective of demographic factors such as gender, age, socioeconomic background and location (Mahmood et al., 2021c). Adolescents may be influenced by their peers' eating behaviours, as well as societal perceptions of food and social status. While peer influence becomes more prominent during adolescence, parents still play a crucial role in shaping adolescents' dietary behaviours through various food-related parenting practices (Piatkowski et al., 2021b). Overall, parental role modelling of healthy eating is a key factor in shaping adolescent eating behaviours. Therefore, parents could promote healthy nutritional behaviours among teenagers by recommending health foods and preparing food at home. It is important for parents to provide guidance and support in promoting healthy eating habits for their adolescents (Piatkowski et al., 2021b).

Adolescents are influenced by their family and friends in their dietary behaviours. Adolescents' dietary behaviours are influenced by family-level factors such as positive parental attitudes, healthy food preferences, and modelling of healthy eating habits. Some adolescents highlighted the role of parents in providing and preparing healthy food options at home. However, others expressed challenges when their parents did not prioritise healthy eating or follow dietary guidelines. Not cooking dinner at home was identified as a reason for unhealthy eating practices.

Adolescents perceived peer influence as a significant factor in their dietary habits, serving as both encouragement and a barrier to healthy eating. Other studies also show that positive parental attitudes, healthy food preferences, and modelling of healthy eating habits support better choices (Mahmood et al., 2021b; Palfreyman et al., 2014; Scaglioni et al., 2008). Access to varied healthy options at home encourages balanced eating. Peer influence can play a

significant role, both positively and negatively, depending on social pressures and encouragement.

7.4.5 Physical Environment – Availability

These findings suggest that the affordability and availability of healthy food options are important factors in enabling adolescents to make healthier dietary choices (Fuchs et al., 2015). Evidence from this study suggests that the availability of unhealthy food options in the in the school and community environments act as a barrier to adolescents' food healthy eating behaviours. Similar findings have been reported by other researchers (D. Ryan et al., 2022). The food environment influences the availability of healthy or unhealthy food options in their community. Some participants struggle to find nutritious foods, as fast-food outlets and shops selling junk food are more common than fruits and vegetables. Concerns were also raised about the inadequate quality of school meals discouraging healthy eating habits, with some adolescents noting a lack of essential elements like egg or vegetables in their school's meals. Concerns about the quality of school meals highlight the need for improvement in institutional food systems. The food environment can be categorised as obesogenic if it promotes the consumption of high-energy, nutrient-poor foods and beverages (Hebebrand et al., 2014). Obesogenic environments include the availability of unhealthy food options, the marketing and promotion of these foods, the ease of access to them, and the social and cultural factors that shape individuals' food choices (Moreno-Padilla et al., 2020). Studies have shown that the school food environment, combined with a sedentary lifestyle, contribute to the obesogenic school environment, which influences the nutritional status of children and adolescents (França et al., 2022).

7.4.6 Macrosystem

Economic access and affordability of nutritious foods in the local area are also critical elements of adolescents' food environment. The participants highlighted the significant influence of food prices, cost, and convenience on their food choices. They expressed that unhealthy foods were more affordable than healthier options, which served as a barrier to making healthier choices. Limited resources and lack of refrigeration facilities also contributed to difficulties in maintaining healthy eating habits by causing perishable foods to go bad quickly. Other studies confirm the findings that price, convenience, and social norms play a role adolescent food choice (Bodega et al., 2023). Several studies show that healthier foods are generally more expensive, unaffordability and this constrains the consumption of nutritious and healthy diets (Kern et al., 2017; Mockshell et al., 2022). In contrast, street foods are perceived as less expensive, implying that the poor are more able to afford and have access to the less healthy street food (R. Annan et al., 2022c).

7.4.7 Media, Marketing and Advertisement

Adolescents in the study acknowledged that media, marketing, and advertising had a significant impact on their food choices. They mentioned that advertisements for fast food and unhealthy snacks were persuasive and influenced their cravings and preferences. They also mentioned that the presence of marketing and advertising for unhealthy foods in their physical environment, such as billboards or commercials, made it harder to resist temptation and choose healthier options. These findings suggest that adolescents are susceptible to the influence of media and marketing when it comes to their food choices (Knöll & Roe, 2017). The study also showed that adolescents' dietary behaviours are influenced by marketing, media, and advertising. Similar findings have been reported by other researchers in Ghana (Amevinya et al., 2022a; Kalog et al., 2022). Policy measures, such as limiting the promotion of unhealthy foods in environments frequented by young people, are essential to safeguard adolescents from such promotional practices (Amevinya et al., 2022a). It is also important to promote media literacy among adolescents.

7.4.8 Socio-Cultural Factors

Furthermore, the research suggests that socio-cultural factors also play a significant role in shaping adolescent food choices (Fitzgerald et al., 2008). The study participants identified local dishes dominated by energy-dense staples like roots, tubers, and cereals as some of the preferred foods they commonly consumed. Adolescents in the study expressed that traditional energy-dense staples are essential to their culture, but noted a shift towards consuming rice, noodles, and fried foods. Other studies confirm that adolescents in developing countries including Ghana engage in the intake of energy dense staples (Abizari & Ali, 2019a; Wiafe, Apprey, et al., 2023c). However, there is evidence that many adolescents are shifting cultural preferences towards adopting more processed foods like rice and noodles deserve further investigation (Abizari & Ali, 2019a; M. Islam et al., 2019; Ogum-Alangea et al., 2020).

7.5 Conclusion

Diet-related diseases such as obesity, diabetes, and heart disease are becoming increasingly prevalent among adolescents in LMICs (Kimani-Murage et al., 2010; Lassi et al., 2017c; Ofori-Asenso et al., 2016a). These health issues are often attributed to poor dietary choices, including a high intake of sugar and fat and a low consumption of fruits and vegetables (Clemente-Suárez et al., 2023). The overall goal of this study was to identify the enablers and barriers related to healthy eating among adolescents, to develop effective strategies and interventions to promote healthy eating habits in this population. Understanding adolescent eating habits and barriers to healthy eating is especially important because adolescents may be open to healthy eating recommendations (Wise, 2015). The findings of this study highlight the complex interplay of various factors that enablers and barriers to achieving healthy eating behaviours. These factors include individual level factors, affordability, lack of resources, and cultural norms and wider environmental factors. While educational interventions have been commonly used to address these dietary behaviours, their effectiveness in isolation has shown mixed results (DeCosta et al., 2017; Verdonschot et al., 2023). Educational interventions are reliant on making deliberate dietary decisions and this do not often take into consideration the influence of the food

environment (Devine, Hill, et al., 2023). Recent research suggests that solely relying on education may not be sufficient to promote positive dietary change among adolescents. Studies have shown that the food environment, which includes factors such as access to healthy foods and the availability of unhealthy options, plays a significant role in shaping adolescents' dietary behaviours (Riggsbee et al., 2018). To effectively promote healthier dietary choices among adolescents, it is important to consider both educational interventions and improvements in the food environment (Hormenu, 2022c).

A comparative analysis of educational interventions versus the food environment suggests that a multicomponent approach combining both strategies may be more effective in promoting positive dietary change among adolescents (Pinto et al., 2019). Such an approach should aim at improving the home, school and community food environments in combination with nutrition education. Furthermore, it is crucial for adolescents to develop critical media literacy skills to be able to discern the true nutritional value of advertised foods and resist the influence of advertising. It is important to acknowledge and address the influence of social norms on eating habits to promote healthier choices. It is important to implement policies that make healthy foods more affordable and increase the availability of refrigeration facilities. By subsidizing the cost of fruits and vegetables and providing incentives for grocery stores to invest in proper refrigeration, adolescents would have greater access to fresh and nutritious foods that can be preserved for longer periods. By combining education and changes in the food environment, a multicomponent intervention approach can be implemented. This approach would involve providing adolescents with education on healthy eating habits and nutrition, while also implementing strategies to make healthier food choices more accessible and affordable. This can include interventions such as increasing the availability of fresh fruits and vegetables in schools, promoting healthier options in vending machines and cafeteria menus, and providing nutrition education in community settings. This multicomponent approach would address the individual-level factors through education, while also tackling the environmental factors that influence adolescents' dietary choices. Overall, it is crucial to recognise and address the various

factors that influence adolescents' food choices, including appearance, taste, social pressure, and cultural norms - and to develop comprehensive strategies that provide them with the knowledge, resources, and support needed to make informed and healthier food choices. It is important to promote healthy eating habits and behaviours, increase access to healthy foods, and create supportive environments that encourage healthy eating.

Strength of study: Most studies on adolescent nutrition have used quantitative methods to assess dietary intake or nutritional status of adolescents. However, qualitative methods can offer valuable insights into how adolescents think, feel, and act regarding healthy eating. Qualitative studies can also reveal the underlying motives for dietary behaviours and the context-specific factors that enable or hinder healthy eating among adolescents (K. S. N. Liu et al., 2021b; Muzenda et al., 2022; Vidal et al., 2023). To date, only few such studies have explored perceptions of these influences among adolescents living in Ghana. This is despite the fact that Ghana is undergoing rapid nutrition transition which has adversely affected adolescents. Moreover, most of the studies have been conducted in urban settings and have not captured the diversity of socio-economic and cultural contexts in Ghana. Therefore, the aim of this study was to explore the barriers and facilitators to healthy eating among adolescents in Ghana using qualitative methods.

Consuming healthy diets during adolescence is essential for optimal growth and development, and can help to protect against malnutrition (stunting, wasting, micronutrient deficiencies, obesity) and noncommunicable diseases (NCDs) (Branca et al., 2015; Madzorera et al., 2023c). Dietary behaviours are influenced by multiple and interrelated factors at different levels of influence (Liguori et al., 2022b; Magalhães et al., 2022). These factors can act as barriers or facilitators to healthy eating depending on the contexts and circumstances. Research suggests interventions that exclusively target individual-level determinants like knowledge, beliefs, and habits tend to have limited, if any, long-term impact (Brug et al., 2017; Lakerveld et al., 2012). However, when integrated with environmental-change components, these individual

approaches become more effective in improving health behaviours (Brug et al., 2017; A. D. M. Sawyer et al., 2021). Understanding these factors is crucial for designing and implementing effective nutrition interventions that target adolescents.

7.5.1 Competing interests

The authors declare that they have no competing interests.



8.0 PREVALENCE AND CONTRIBUTING FACTORS FOR ADOLESCENT OVERWEIGHT, OBESITY AND STUNTING IN THE VOLTA AND OTI REGIONS OF GHANA

Abstract

Background: In recent decades, low- and middle-income countries in Africa have witnessed a concerning rise in the prevalence of overweight and obesity among adolescents, while simultaneously grappling with the persistent issue of undernutrition, including stunting. This phenomenon highlights the double burden of malnutrition which poses significant challenges to public health and development in the region.

Objectives: To identify the prevalence and contributing factors for adolescent overweight, obesity and stunting in the Volta and Oti regions of Ghana

Methods: This was a cross-sectional study involving 667 adolescents aged 10-19 years in the Volta and Oti regions of Ghana. A pretested structured questionnaire was used to collect data on sociodemographic characteristics, nutritional literacy, parenting style, and food insecurity status. Height and weight were measured using standard methods. Stunting and BMI were calculated as a basic indicator of nutritional status using WHO standards for adolescents. Bivariate and linear regression analysis were conducted to determine the factors contributing to overweight, obesity and stunting.

Results: The results reveal that 39.3% of adolescents were stunted, 32.1% are overweight or obese, and 22.2% were both overweight and stunted. Socio-economic disparities significantly influenced these outcomes with adolescents in higher wealth quintiles showing increased odds of overweight (cOR = 1.76 to 3.44). Adolescents with high nutritional knowledge were more likely to be overweight (cOR = 1.67). Food secure adolescents had significantly lower odds of being overweight compared to their insecure counterparts. Authoritative and authoritarian parenting reduced the likelihood of overweight by 45% and 44%, respectively. Adolescents with authoritative or authoritarian parents were approximately twice as likely to experience stunted growth compared to those with neglectful parenting styles (aOR = 2.10, CI = 1.22-3.60 and cOR = 2.20, CI = 1.36-3.58, respectively). Urban adolescents were 48% less likely to be stunted compared to their rural counterparts (cOR = 0.52, CI = 0.38-0.72). The likelihood of stunting decreased significantly with maternal education: adolescents whose mothers had completed basic school, junior high school, senior high school, and tertiary education were approximately 51% (cOR = 0.49, CI = 0.31-0.76), 65% (cOR = 0.35, CI = 0.22-0.57), 76% (cOR = 0.24, CI = 0.14-0.41), and 71% (cOR = 0.29, CI = 0.17-0.53) less likely to be stunted, respectively, compared to those whose mothers had no education. Additionally, adolescents with fathers who were farmers had a 57% lower likelihood of being stunted compared to those whose fathers were artisans (cOR = 0.43, CI = 0.23-0.77). Adolescents in the third and fourth wealth quintiles had 76% (cOR = 0.24, CI = 0.15-0.41) and 91% (cOR = 0.09, CI = 0.05-0.15) lower odds of stunting, respectively, compared to those in the first wealth quintile. Furthermore, adolescents with moderate and high nutritional knowledge had 59% (cOR = 0.41, CI = 0.27-0.61) and 61% (cOR = 0.39, CI = 0.26-0.56) lower odds of being stunted compared to those with low nutritional knowledge. Lastly, adolescents exhibiting good dietary behaviour had 41% lower odds of stunting compared to their peers with poor dietary behaviour (cOR = 0.59, CI = 0.43-0.80).

Conclusion: The findings highlight a concerning dual burden of malnutrition among adolescents, with significant disparities influenced by socioeconomic factors, food security, and

parenting styles. The prevalence of stunting and overweight is alarmingly high, particularly among those facing food insecurity and lower maternal education levels.

Keywords: Adolescent, adolescent obesity, contributing factors for obesity, adolescent stunting, overweight or obesity, obesity, overweight

8.1 Introduction

Nutrition plays a crucial role in the overall health and well-being of individuals, particularly during adolescence, which is a critical period for growth and development. Ensuring adequate nutrition during adolescence is crucial for physical growth, cognitive function, and emotional well-being. However, adolescent undernutrition and obesity have become significant public health concerns in many low- and middle-income countries, including among adolescents. Adolescent malnutrition remains a serious public health challenge in low-income countries and in LMICs. While there has been progress in reducing childhood undernutrition rates, there has been a simultaneous increase in overweight and obesity rates among both children and adolescents (FAO et al., 2022).

Data from various LMICs such as Myanmar, Sri Lanka, Guatemala, Bangladesh, Ethiopia, and Ghana indicate varying but relatively high rates of stunting ranging from 10.2% to 52% in certain communities (Black et al., 2013b; Caleyachetty et al., 2018; Gyamfi et al., 2019; KT & M, 2016; Teji et al., 2016). These findings highlight the persistent presence of malnutrition and its impact on the growth and development of adolescents within these populations (Akombi et al., 2017a; Black et al., 2013b; Prendergast & Humphrey, 2014). While the extent and severity of wasting among adolescents are less clear in comparison with the effects in children under 5 years of age, it is expected to be similar or even worse (Akseer et al., 2017; UNICEF, 2013)). Adolescent nutritional vulnerability is further compounded by micronutrient deficiencies.

The specific situation in Ghana is of particular concern. Ghana, like many other LMICs, is grappling with the dual burden of malnutrition among adolescents. On one hand, there is a high

prevalence of stunting, which reflects chronic undernutrition and growth restrictions during critical periods of growth. On the other hand, there is an emerging issue of overweight and obesity among adolescents, which poses a significant risk for non-communicable diseases such as cardiovascular diseases, diabetes, and certain types of cancer (Gyamfi et al., 2019; KT & M, 2016; Teji et al., 2016). The prevalence of both undernutrition and overweight/obesity among adolescents in Ghana highlights the need for a comprehensive assessment of nutritional status and associated factors.

In contrast, there is a significant number of children and adolescents (aged 5-19 years) worldwide, who are grappling with overweight and obesity (WHO, 2021). This can be attributed to the nutrition transition, changes in dietary patterns towards high-calorie but nutrient-poor foods, as well as reduced physical activity levels especially in urban areas. Statistics indicate that the global count of overweight children and adolescents was around 340 million in 2016, which is a substantial increase of 54% from an estimated 28 million cases back in 1990. The majority of these cases (32 million) were found in low- and middle-income countries. Recent research indicates that Ghana reflects this trend as well; studies show varying prevalence rates for stunting (15-50.3%), underweight (7-19.4%), and overweight/obesity (6.9–17%) among teenagers across different regions within the country (Appiah Kubi Prince & Laar Amos, 2014; Aryeetey et al., 2017; Azupogo et al., 2020; Ogum Alangea et al., 201).

It is crucial to understand the specific contextual variations within Ghana in order to develop targeted interventions and effective public health strategies aimed at addressing the increasing rates of overweight and obesity among children and adolescents. The aim of the study was to identify the prevalence and contributing factors for adolescent overweight, obesity and stunting in the Volta and Oti regions of Ghana. Childhood and adolescent overweight and obesity are linked to a number of immediate and long-term cardiometabolic risks, including high

cholesterol, triglycerides, high blood glucose, type 2 diabetes, high blood pressure and an increased risk of developing adult obesity and the associated complications (Bendor et al., 2020). This research is significant for multiple reasons. Firstly, it aims to gain a thorough understanding of the nutritional status of adolescents in the Volta and Oti regions of Ghana, which has been relatively understudied until now. Such information will prove valuable for health policymakers and practitioners in devising tailored interventions that address the specific nutrition-related needs and difficulties faced by adolescents in these areas. Furthermore, this study will add to the existing knowledge on adolescent nutrition in Ghana, specifically with regards to addressing both undernutrition and issues related to obesity.

8.2 Methods

8.2.1 Study design

A cross-sectional community-based quantitative survey was conducted among adolescents aged 10–19 years in the Volta and Oti regions of Ghana. The study design, implementation and reporting of results followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cross-sectional studies.

8.2.2 Study population

Adolescents, 10-19 years, from communities in the Volta and Oti regions of Ghana were selected for this study. Adolescents, within the 10-19-year bracket, who had some form of physical disability that could not allow accurate determination of their true height were excluded.

8.2.3 Sample size and sampling procedure

The sample size was determined using Yamane's formula for population proportion (Yamane, 1967), with the following assumptions: a 95% confidence level (standard value of 1.96), 5%

margin of error, 14.7% obesity prevalence (p) (Aryeetey et al, 2017), 10% non-response rate and a design effect of 1.5. The regional population was projected to be 2,667,478 in 2020 and the adolescent population was estimated to be 22.1% of the total population. Therefore, N = the adolescent population size was estimated to be 589,513 in 2020.

$$n = \frac{z^2 p(1-p)N}{z^2 p(1-p) + Ne^2} \quad \text{-----} \quad 1$$

Where: n= the minimum sample size

Since both the numerator and denominator for equation (1) contain $z^2 p(1-p)$, equation (1) can be simplified to: $n = N/(1 + Ne^2)$

$$\text{Therefore, } n = \frac{N}{(1 + Ne^2)}$$

$$\begin{aligned} n &= \frac{589513}{1 + 589513 * 0.05^2} \\ &= 399.7 \approx 400 \end{aligned}$$

A design effect of 1.5,

$n = 400 * 1.5 = 606$ and a 10% non-response rate, $n = 606 * 0.1 = 667$

Total sample size 667.

In anticipation of losses to follow up, delays in receiving parental consents and parental unavailability or refusal to participate in the study, the total number of respondents was increased by 10%. Therefore, the final sample size was 667.

8.2.4 Sample Size and Sampling Procedure

The study drew its sample from the 2017 Ghana Living Standards Survey round 7 (GLSS 7) master sampling frame, utilizing a two-stage stratified sampling design. Initially, 46 out of 96 enumeration areas (EAs) were selected as Primary Sampling Units (PSUs). The PSUs were allocated into the two administrative regions using probability proportional to population size (PPS). The EAs were further categorised into urban and rural localities of residence. A complete listing of households within each PSUs served as the Secondary Sampling Units (SSUs). At the

second stage, 15 households were systematically selected from each PSU, yielding a total sample size of 675 households across the two regions. To facilitate data collection, maps of each cluster with listed households were used to locate and identify the selected households.

8.2.5 Data Collection

Data were collected through a face-to-face interview using a structured pre-tested questionnaire. Two kinds of data were collected. First, questionnaires were used to collect information on the background characteristics, wealth quintile, nutritional knowledge, dietary diversity and food security of the adolescents. The questionnaire was developed specifically for the purposes of this study based on extensive literature review. It was however pretested on a total of 20 adolescents aged 10–19 in two other communities not included in the actual study. Second, anthropometric measurement including the weight and height of each adolescent was collected to enable calculation of nutritional status including, stunting, body mass index (BMI) and weight status. The height of each participant was measured using a freestanding stadiometer (model: HM200P Charder height measurement, Charder Electronic Company Limited, USA). For height measurement, each participant was made to stand bare footed on the footboard of the stadiometer, with the head held upright, the heels close together, legs as straight as possible, shoulders in a relaxed position, and arms hanging freely, with their head, buttocks and heels touching the body of the stadiometer. The measurement was taken when the participant took in a deep breath. Height measurements were recorded to the nearest 0.5cm. An Omron HBF 400 body fat monitor with a digital scale (Omron Co., Ltd, Japan) was used to measure weight of the participants. Participants were asked to remove their shoes, wear light clothing and stand on the balance before being weighed. Weight was recorded to the nearest 0.1kg. Child and adolescent nutritional status were calculated using the WHO AnthroPlus software (AnthroPlus 2007) specifically designed for assessing the growth and nutritional status of children and adolescents aged 5-19 years. The software utilises reference data from the WHO Child Growth

Standards and the WHO Reference 2007 for 5-19 years to calculate various anthropometric indicators, including weight-for-age. These classifications are specific to the age and sex of the individual being assessed. The nutritional status of the children and adolescents were based on the Body Mass Index (BMI) for age (BAZ) and height for age (HAZ). The weight classification categories for the children and adolescents according to WHO AnthroPlus were as follows:

Severe Thinness: A weight-for-age z-score less than -3 standard deviations (SD) below the median.

Moderate Thinness: A weight-for-age z-score between -3 SD and -2 SD below the median.

Mild Thinness: A weight-for-age z-score between -2 SD and -1 SD below the median.

Normal Weight: A weight-for-age z-score between -1 SD and +1 SD around the median.

Overweight: A weight-for-age z-score between +1 SD and +2 SD above the median.

Obesity: A weight-for-age z-score greater than +2 SD above the median.

The height classification categories for the children and adolescents were based on the WHO 2007 reference as follows:

Severe stunting: A height-for-age z-score less than -3 standard deviations (SD) below the median.

Moderate stunting: A height-for-age z-score between -3 SD and below -2 SD below the median.

Normal height: A height-for-age z-score between -2 SD and below +3 SD around the median.

Extreme tallness: A height-for-age z-score greater than +3 SD above the median.

8.2.6 Ethical consent

Within each selected households, an informed consent statement was read out to a parent or adult with primary care responsibility for the adolescent, who may accept or decline to allow the adolescent to participate. Only eligible children and adolescents whose parents or guardians consented were interviewed. Children and adolescents aged below 18 years signed an assent form and those above 19 years signed consent forms.

8.2.7 Data Quality Control

Three days of training was provided to data collectors and supervisors. A pre-test was conducted on eligible adolescents in comparable settings not involved in the research. Throughout the entire data collection period, supervisors and researchers provided thorough supervision. Administered questionnaires were checked for completeness before being collected from the data collectors on a daily basis. The functionality of stadiometer and measuring scales were checked prior to anthropometric measurements.

The data collection tool was pretested on a sample of 30 children and adolescents in a non-selected district in order to identify any potential issues with the instrument, the instructions, or data collection procedures. To ensure that all personnel involved in the data collection were familiar with the protocols and techniques, data collectors and supervisors underwent a two-day training session. The training covered various aspects such as the data collection instrument, anthropometric measurements, consent form, interview techniques, and data collection procedures. Two well-trained data collectors were responsible for taking and recording anthropometric measurements. One collector helped position the child or adolescent correctly on the instruments, while the other recorded the measurements. The anthropometric measurements were repeated to ensure accuracy and identify any potential errors or outliers. Children and adolescents whose anthropometric values were flagged by WHO AnthroPlus

during data entry or those with extreme values were revisited within two days. Supervisors monitored the day-to-day activities of the data collectors, ensuring the completion of questionnaires and the clarity of responses. During data processing, the data were checked, coded, and entered properly. Appropriate cleaning procedures were implemented to identify and correct any inconsistencies, missing values, or errors in the dataset.

8.2.8 Data Processing and Analysis

Data were analysed using STATA 17 (StataCorp., 2021). Data were analysed using descriptive and inferential methods. Categorical variables were presented as tables with relative and absolute frequencies. Means and median were calculated and standard deviation and interquartile range determined, respectively. Measures of dispersion were reported for continuous variables. Bivariate analysis was used to examine the relationship between each potential factor (independent variable) and the outcome variables (dependent variables) (overweight, obesity, underweight and stunting) individually, without considering the influence of other variables. The level of significance was set at 5% ($p \leq 0.05$ is considered statistically significant). Then, stepwise logistic regression was used to select the most influential predictors that showed a significant association with the outcome variables.

Finally, the significant factors were included in subsequent multilevel analysis to explore their hierarchical effects on overweight and stunting, taking into account the nested structure of the data. The data analysis included the construction of three multiple regression models to determine the predictors of overweight, stunting and overweight with concurrent stunting. The first model aimed to identify the predictors (independent variables) that are associated with overweight (dependent variable). The second model was aimed at identifying the predictors (independent variables) that significantly influence the occurrence of stunting (dependent

variable). The third model specifically focused on determining the predictors (independent variables) of overweight in individuals who also had concurrent stunting (dependent variable).

8.3 Results

8.3.1 Nutritional Status of Children and Adolescents

In total, 667 adolescents participated in this study. Of the 667 respondents, 39.3% were stunted, 32.1% were overweight or obese and 22.2% were both overweight/obese and stunted (Figure 8.1).

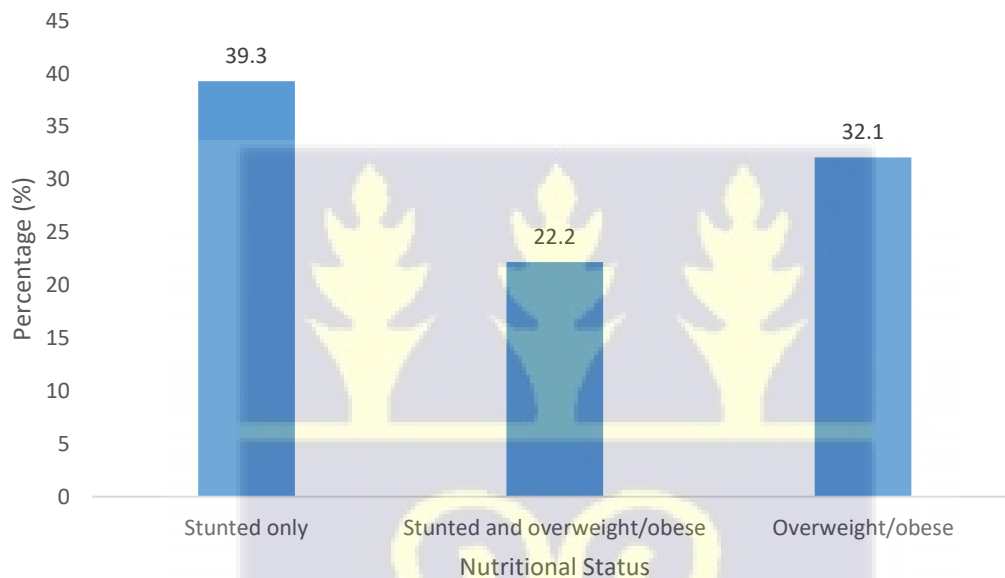


Figure 8.1: Prevalence of malnutrition among respondents (n= 667)

8.3.2 Body Mass Index of the Respondents and Associated Factors

Chi-square analysis showed that parental status ($\chi^2=11.06$, $P=0.026$), respondent's educational level ($\chi^2=18.87$, $P=0.016$), mothers' occupational status ($\chi^2=18.39$, $P=0.019$), mother's educational level ($\chi^2=19.19$, $P=0.014$), wealth quintiles ($\chi^2=32.26$, $P<0.001$), nutritional knowledge ($\chi^2=15.84$, $P=0.003$), food security ($\chi^2=74.33$, $P<0.001$), parenting styles ($\chi^2=21.26$, $P=0.002$) and parental role modelling ($\chi^2=6.33$, $P=0.042$) were associated with the BMI of respondents (Table 8.1).

Table 8.1: Chi-square analysis of the factors associated with the weight status of respondents (n= 667)

Variable	Body Mass Index (BMI)			χ^2 (P-value)
	Underweight (n=48)	Normal (n=405)	Overweight (n=214)	
	n (%)	n (%)	n (%)	
Region				4.59(0.101) ¹
Oti	11(5.3)	133(66.8)	55(27.6)	
Volta	37(7.9)	272(58.1)	159(34.0)	
Gender				0.06(0.970) ¹
Female	29(7.3)	242(61.0)	126(31.7)	
Male	19(7.0)	163(60.4)	88(32.6)	
Age				1.75(0.781) ¹
10-14	19(7.8)	142(57.9)	84(34.3)	
15-17	21(7.3)	181(62.9)	86(29.8)	
18-19	8(6.0)	82(61.2)	44(32.8)	
Residence				0.14(0.932) ¹
Rural	31(7.4)	254(60.2)	137(32.4)	
Urban	17(6.9)	151(61.6)	77(31.5)	
Marital status				1.62(0.445) ²
Never married	47(7.5)	384(60.8)	200(31.7)	
Married	1(2.8)	21(58.3)	14(38.9)	
Parental status				11.06(0.026) ²
None	4(14.2)	14(51.9)	9(33.3)	
Single parent	12(8.8)	69(50.4)	56(40.8)	
Dual parent	32(6.4)	322(64.0)	149(29.6)	
Educational level				18.87(0.016) ²
None	4(11.8)	10(29.4)	20(58.8)	
Primary	9(8.7)	58(56.3)	36(35.0)	
JHS/JSS	21(7.6)	168(60.9)	87(31.5)	
SHS/SSS	13(5.5)	158(66.7)	66(27.8)	
Tertiary	1(5.9)	11(64.7)	5(29.4)	
Marital status				1.62(0.445) ²
Never married	47(7.4)	384(60.9)	200(31.7)	
Married/living together	1(2.8)	21(58.3)	14(38.9)	
Mother's occupation				18.39(0.019) ²
Artisan	5(16.7)	15(50.0)	10(33.3)	
Professional	6(3.7)	86(53.4)	69(42.9)	
Office worker	3(4.9)	41(67.2)	17(27.9)	
Trader	27(8.3)	205(62.9)	94(28.8)	
Farmer	7(7.9)	58(65.2)	24(26.9)	
Mother's educational level				19.19(0.014) ¹
None	13(10.2)	61(47.7)	54(42.1)	
Primary	8(4.5)	103(58.2)	66(37.3)	
JHS/JSS	11(6.8)	109(67.3)	42(25.9)	
SHS/SSS	9(7.8)	76(66.1)	30(26.1)	
Tertiary	7(8.2)	56(65.9)	22(25.9)	
Father's occupation				10.62(0.224) ²
Artisan	5(9.3)	27(50.0)	22(40.7)	
Professional	16(6.9)	128(55.4)	87(37.7)	
Office worker	7(8.1)	56(65.1)	23(26.8)	
Trader	4(5.6)	45(63.4)	22(31.0)	
Farmer	16(7.1)	149(66.2)	60(26.7)	
Household size				1.84(0.934) ¹
<4	8(9.4)	49(57.7)	28(32.9)	
4-5	16(7.1)	136(60.7)	72(32.2)	
6-7	11(6.3)	104(59.4)	60(34.3)	
8+	13(7.1)	116(63.4)	54(29.5)	
Wealth quintiles				32.26(<0.001) ¹
First	9(11.3)	30(37.5)	41(51.3)	
Second	5(4.4)	62(54.9)	46(40.7)	
Third	23(8.9)	163(63.2)	72(27.9)	

Fourth	11(5.1)	150(69.4)	55(25.5)	
Nutritional knowledge				15.84(0.003) ¹
Low	22(11.7)	99(52.7)	67(35.6)	
Moderate	8(4.0)	121(60.2)	72(35.8)	
High	18(6.5)	185(66.6)	75(26.9)	
Dietary behaviour				3.70(0.157) ¹
Poor	26(8.8)	168(57.2)	100(34.0)	
Good	22(5.9)	237(63.5)	114(30.6)	
Food security				74.33(<0.001) ¹
Food secure	19(7.3)	205(78.9)	36(13.8)	
Mildly food insecure	10(6.8)	83(56.5)	54(36.7)	
Moderately food insecure	10(9.7)	44(42.7)	49(47.6)	
Severely food insecure	9(5.7)	73(46.5)	75(47.8)	
Maternal parenting styles				21.26(0.002) ²
Authoritative	18(6.8)	146(55.1)	101(38.1)	
Permissive	12(14.3)	52(61.9)	20(23.8)	
Neglectful	14(6.3)	154(68.7)	56(25.0)	
Authoritarian	4(4.3)	53(56.4)	37(39.3)	
Parental role modelling				6.33(0.042) ¹
Poor	30(9.2)	203(62.3)	93(28.5)	
Good	18(5.3)	202(59.2)	121(35.5)	

BMI=Body Mass Index, JHS/JSS= Junior High School/Junior Secondary School, SHS/SSS=Senior High School/Senior Secondary School, ¹P-value from Pearson Chi-square test and ²P-value from Fisher's exact

8.3.3 Factors Influencing the BMI of Respondents

Table 8.2 shows the multivariate ordered logistic regression of the factors associated with overweight and obesity. Adolescents who were in primary school and junior high school had 3 times higher odds of being overweight compared to their counterparts with no education (cOR = 2.76, CI = 1.29-5.92 and cOR = 3.29, CI = 1.63-6.65, respectively). Similarly, adolescents in senior high school and tertiary education had 4 times higher odds of being overweight than those with no education (cOR = 4.14, CI = 2.03-8.45 and cOR = 3.80, CI = 1.16-12.43).

The odds of adolescents being overweight were 2 times higher if their mothers had junior high school education (cOR = 2.17, CI = 1.37-3.45), 2 times higher if their mothers had senior high school education (cOR = 2.09, CI = 1.26-3.45) and 2 times higher if their mothers had tertiary level education (cOR = 2.08, CI = 1.19-3.61) compared to those whose mothers had no education. Adolescents with fathers who were farmers had 2 times higher odds of being overweight compared to their counterparts whose fathers were artisans (cOR = 1.92, CI = 1.07-3.44). The odds of adolescents being overweight were 3 times higher in the second wealth

quintile (cOR = 1.76, CI = 1.01-3.08), 2.7 times higher in the fourth wealth quintile (cOR = 2.72, CI = 1.67-4.43) and 3.4 times higher in the fifth wealth quintile (cOR = 3.44, CI = 2.07-5.72), compared to those in the first wealth quintile. Adolescents with high nutritional knowledge had 2 times higher odds of being overweight compared to those with low nutritional knowledge (cOR = 1.67, CI = 1.15-2.41). The odds of being overweight were 67% lower for mildly food insecure adolescents (aOR = 0.33, CI = 0.21-0.53), 78% lower for moderately food insecure adolescents (aOR = 0.22, CI = 0.13-0.37) and 76% lower for severely food insecure adolescents (aOR = 0.24, CI = 0.15-0.38) compared to their counterparts who were food secure. Adolescents with parents exhibiting authoritative parenting styles had 45% lower odds of being overweight (cOR = 0.55, CI = 0.38-0.79) and those exhibiting authoritarian parenting styles had 44% lower odds of being overweight (cOR = 0.56, CI = 0.34-0.91), compared to those whose parents displayed neglectful parenting styles. Multivariable analysis revealed no notable correlations between overweight and obesity and variables such as rural-urban disparities, sex, age, parental status, marital status, maternal occupation, household size, dietary habits, and parental role modelling of healthy eating.

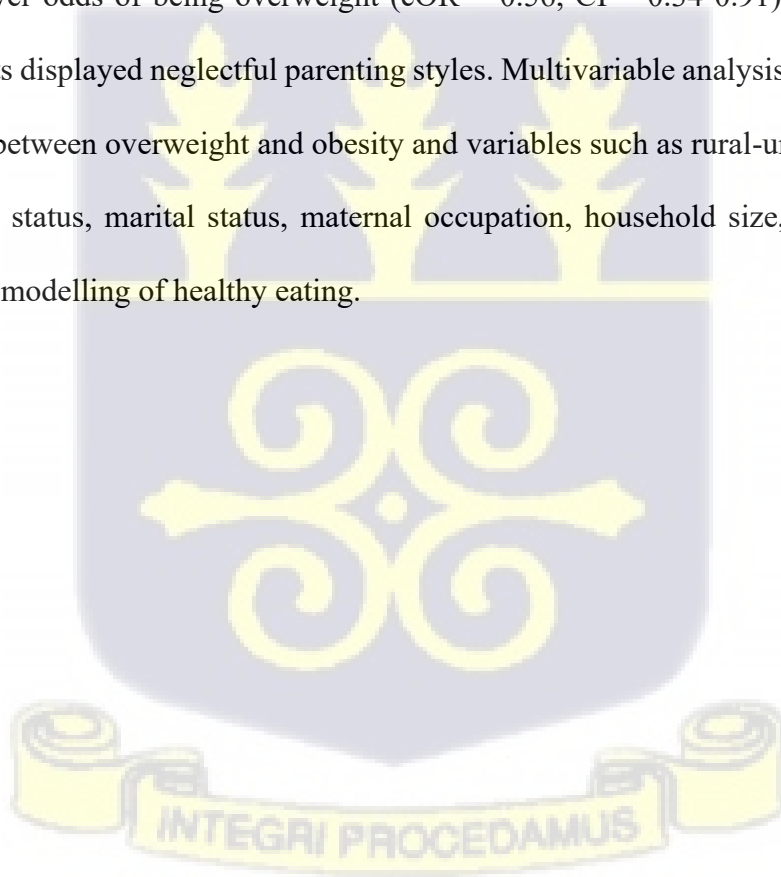


Table 8.2: Ordered logistic regression analysis of factors influencing the weight status of respondents.

Covariates	cOR (95% CI), p-value	aOR (95% CI), p-value
Region		
Oti	Ref	
Volta	0.70(0.50-0.99), 0.046	0.95(0.64-1.39), 0.785
Sex		
Female	ref	
Male	0.97(0.71-1.32), 0.852	
Age		
10-14	ref	
15-17	1.23(0.87-1.72), 0.243	
18-19	1.12(0.73-1.70), 0.610	
Residence		
Rural	ref	
Urban	1.06(0.77-1.45), 0.728	
Parental status		
None	ref	
Single parent	0.85(0.39-1.86), 0.684	
Dual parent	1.45(0.69-3.04), 0.322	
Educational level		
None	ref	ref
Primary	2.76(1.29-5.92), 0.009	2.19(0.95-5.06), 0.064
JHS/JSS	3.29(1.63-6.65), 0.001	2.10(0.95-4.67), 0.068
SHS/SSS	4.14(2.03-8.45), <0.001	2.18(0.95-5.02), 0.066
Tertiary	3.80(1.16-12.43), 0.027	2.53(0.68-9.39), 0.167
Marital status		
Never married	ref	
Married/living together	0.83(0.42-1.63), 0.587	
Mother's occupation		
Artisan	ref	
Professional	0.91(0.44-1.91), 0.810	
Office worker	1.72(0.73-4.04), 0.216	
Trader	1.48(0.73-3.0), 0.276	
Farmer	1.63(0.73-3.62), 0.229	
Mother's educational level		
None	ref	Ref
Basic	1.39(0.89-2.17) 0.142	1.18(0.72-1.93), 0.503
JHS/JSS	2.17(1.37-3.45) 0.001	1.59(0.96-2.67), 0.074
SHS/SSS	2.09(1.26-3.45), 0.004	1.49(0.84-2.65), 0.174
Tertiary	2.08(1.19-3.61), 0.009	1.29(0.67-2.52), 0.443
Father's occupation		
Artisan	ref	ref
Professional	1.19(0.67-2.12), 0.540	1.18(0.61-2.27), 0.620
Office worker	1.86(0.95-3.64), 0.072	1.17(0.54-2.53), 0.682
Trader	1.65(0.82-3.33), 0.161	1.35(0.60-3.03), 0.469
Farmer	1.92(1.07-3.44) 0.028	1.17(0.57-2.40), 0.668
Household size		
<4	ref	
4-5	1.09(0.67-1.80), 0.710	
6-7	1.02(0.61-1.71), 0.925	
8+	1.23(0.74-2.06), 0.420	
Wealth quintiles		
First	ref	ref
Second	1.76(1.01-3.08), 0.046	1.23(0.67-2.26), 0.502
Third	2.72(1.67-4.43), <0.001	1.25(0.67-2.31), 0.483
Fourth	3.44(2.07-5.72), <0.001	1.12(0.56-2.24), 0.754
Nutritional knowledge		
Low	ref	ref
Moderate	1.20(0.81-1.78), 0.356	1.51(0.95-2.41), 0.079
High	1.67(1.15-2.41), 0.007	0.97(0.61-1.54), 0.894
Dietary behaviour		

Poor	ref	
Good	1.26(0.93-1.71), 0.143	
Food security		
Food secure	ref	ref
Mildly food insecure	0.33(0.21-0.51), <0.001	0.33(0.21-0.53), <0.001
Moderately food insecure	0.19(0.12-0.32), <0.001	0.22(0.13-0.37), <0.001
Severely food insecure	0.21(0.14-0.33), <0.001	0.24(0.15-0.38), <0.001
Parenting styles		
Authoritative	0.55(0.38-0.79), 0.001	0.72(0.48-1.07), 0.104
Permissive	0.82(0.49-1.37), 0.452	1.09(0.61-1.92), 0.775
Neglectful	ref	
Authoritarian	0.56(0.34-0.91), 0.019	0.66(0.38-1.12), 0.120
Parental role-modelling of healthy eating		
Poor	ref	
Good	0.82(0.61-1.12), 0.214	

BMI=Body Mass Index, JHS/JSS= Junior High School/Junior Secondary School, SHS/SSS=Senior High School/Senior Secondary School, cOR=Crude Odds Ratio, aOR=Adjusted Odds Ratio.

8.3.4 Height-for-Age and Associated Factors

Table 7.3 below presents the Chi-square analysis of factors associated with respondents height-for-age. Region ($\chi^2=14.29$, $P=0.001$), place of residence ($\chi^2=15.45$, $P<0.001$), parental status ($\chi^2=10.94$, $P=(0.027)$), educational level ($\chi^2=39.48$, $P<0.001$), mother's occupation ($\chi^2=27.90$, $P<0.001$), mother's educational level ($\chi^2=47.99$, $P<0.001$), father's occupation ($\chi^2=34.42$, $P<0.001$), wealth quintiles ($\chi^2=103.26$, $P<0.001$), food security ($\chi^2=398.03$, $P<0.001$), nutritional knowledge ($\chi^2=31.67$, $P<0.001$), dietary behaviour ($\chi^2=11.98$, $P=0.003$), and parenting styles ($\chi^2=32.70$, $P<0.001$) were significantly associated with adolescent height status (Table 7.3).



Table 8.3: Chi-square analysis of factors associated with the Height for age of respondents (n= 667)

Variable	Height for Age (HAZ)			χ^2 (P-value)
	Stunting (n=265)	Normal (n=382)	Extreme Tallness (n=20)	
	n (%)	n (%)	n (%)	
Region				14.29(0.001) ¹
Oti	58(29.2)	136(68.3)	5(2.5)	
Volta	207(44.2)	246(52.6)	15(3.2)	
Gender				0.78(0.676) ¹
Female	158(39.8)	229(57.7)	10(2.5)	
Male	107(39.6)	153(56.7)	10(3.7)	
Age				5.04(0.283) ¹
10-14	95(38.8)	138(56.3)	12(4.9)	
15-17	118(41.0)	165(57.3)	5(1.7)	
18-19				
Residence				15.45(<0.001) ²
Rural	188(44.6)	218(51.7)	16(3.7)	
Urban	77(31.4)	164(66.9)	4(1.7)	
Marital status				0.062(0.970)
Never married	250(39.6)	362(57.4)	19(3.0)	
Married/living together	15(41.7)	20(55.6)	1(2.7)	
Parental status				10.94(0.027) ²
None	12(44.4)	13(48.2)	2(7.4)	
Single parent	69(50.4)	65(47.5)	3(2.1)	
Dual parent	184(36.6)	304(60.4)	15(3.0)	
Educational level				39.48(<0.001) ²
None	23(67.7)	7(20.6)	4(11.8)	
Primary	50(48.5)	51(49.6)	2(1.9)	
JHS/JSS	108(39.1)	158(57.3)	10(3.6)	
SHS/SSS	75(31.7)	159(67.1)	3(1.3)	
Tertiary	9(52.9)	7(41.2)	1(5.9)	
Marital status				0.06(0.970) ²
Never married	250(39.6)	362(57.4)	19(3.0)	
Married/living together	15(41.7)	20(55.6)	1(2.7)	
Mother's occupation				27.90(<0.001) ²
Artisan	12(40.0)	16(53.3)	2(6.7)	
Professional	90(55.9)	68(42.2)	3(1.9)	
Office worker	24(39.3)	36(59.1)	1(1.6)	
Trader	114(35.0)	202(62.0)	10(3.0)	
Farmer	25(28.1)	60(67.4)	4(4.5)	
Mother's educational level				47.99(<0.001) ²
None	71(55.5)	48(37.5)	9(7.0)	
Primary	83(46.9)	94(53.1)	0(0.0)	
JHS/JSS	57(35.2)	101(62.4)	4(2.4)	
SHS/SSS	30(26.1)	82(71.3)	3(2.6)	
Tertiary	24(28.2)	57(67.1)	4(4.7)	
Father's occupation				34.42(<0.001) ²
Artisan	25(46.3)	27(50.0)	2(3.7)	
Professional	113(48.9)	107(46.3)	11(4.8)	
Office worker	29(33.7)	54(62.8)	3(3.5)	
Trader	35(49.3)	36(50.7)	0(0.0)	
Farmer	63(28.0)	158(70.2)	4(1.8)	
Household size				1.576(0.954) ²
<4	34(40.0)	47(55.3)	4(4.7)	
4-5	89(39.8)	128(57.1)	7(3.1)	
6-7	67(38.3)	104(59.4)	4(2.3)	
8+	75(41.0)	103(56.3)	5(2.7)	
Wealth quintiles				103.26(<0.001) ²
First	58(72.5)	18(22.5)	4(5.0)	
Second	65(57.5)	42(37.2)	6(5.3)	
Third	102(39.5)	150(58.1)	6(2.3)	

Fourth	40(18.5)	172(79.6)	4(1.9)	
Nutritional knowledge				31.666(<0.001) ²
Low	98(52.1)	78(41.5)	12(6.4)	
Moderate	72(35.8)	126(62.7)	3(1.5)	
High	95(34.2)	178(64.0)	5(1.8)	
Dietary behaviour				11.976(0.003) ¹
Poor	133(45.2)	148(50.3)	13(4.4)	
Good	132(35.4)	234(62.7)	7(1.9)	
Food security				398.03(<0.001) ²
Food secure	0	255(98.1)	51.9)	
Mildly food insecure	51(34.7)	90(61.2)	6(4.1)	
Moderately food insecure	77(74.8)	18(17.5)	8(7.7)	
Severely food insecure	137(87.3)	19(12.1)	1(0.6)	
Maternal parenting styles				32.70(<0.001) ²
Authoritative	128(48.3)	126(47.6)	11(4.1)	
Permissive	25(29.8)	54(64.3)	5(5.9)	
Neglectful	67(29.9)	155(69.2)	2(0.9)	
Authoritarian	45(47.9)	47(50.0)	2(2.1)	
Parental role modelling of healthy eating				3.60(0.166) ¹
Poor	126(38.7)	194(59.5)	6(1.8)	
Good	139(40.8)	188(55.1)	14(4.1)	

BMI=Body Mass Index, JHS/JSS= Junior High School/Junior Secondary School, SHS/SSS=Senior High School/Senior Secondary School, ¹P-value from Pearson Chi-square test and ²P-value from Fisher's exact.

8.3.5 Factors Influencing the Height-for-Age of Respondents

Table 8.4 presents the bivariate and multivariable ordered logistic regression of factors associated with respondents height- for-age. The bivariate analysis showed that region, place of residence, educational level mother's educational level, father's occupation wealth quintiles, food security, nutritional knowledge, dietary behaviour, and parenting styles were statistically significant. When adjusted in the multivariate analysis, adolescents living in the Volta region had approximately 2 times higher odds of experiencing stunted growth, when compared to the combined categories of extremely tall and normal height, compared to their counterparts in the Oti region (cOR = 1.92, CI = 1.35-2.72). The odds of being stunted was 34 times higher among adolescents who experienced mild food insecurity compared to their food-secure counterparts. Those facing moderate and severe food insecurity had even greater odds, at 253 and 243 times, respectively (aOR = 33.81, CI = 12.66-90.25; aOR = 253.02, CI = 86.45-740.52; aOR = 242.61, CI = 86.96-676.86). Additionally, the odds of being stunted were approximately twice as high among adolescents with parents exhibiting authoritative or authoritarian parenting styles compared to adolescents with parents exhibiting neglectful parenting (aOR = 2.10, CI = 1.22-3.60 and cOR = 2.20, CI = 1.36-3.58, respectively). Multivariate regression analyses

revealed several significant findings regarding the odds of adolescents being stunted. Firstly, the odds of being stunted was 48% lower among adolescents in urban areas compared to their rural dwelling counterparts (cOR = 0.52, CI = 0.38-0.72).

The odds of being stunted were 71%, 66% and 71% lower among adolescents in primary school, junior high school and senior high school, respectively, compared to their counterparts with no education (cOR = 2.76, CI = 1.29-5.92 and cOR = 3.29, CI = 1.63-6.65, respectively). Educational attainment also played a crucial role; adolescents in primary school, junior high school, and senior high school had 71%, 66%, and 71%, respectively, lower odds of being stunted compared to those with no education (cOR = 2.76, CI = 1.29-5.92; cOR = 3.29, CI = 1.63-6.65). Maternal education significantly impacted stunting as well. Adolescents whose mothers had completed basic school, junior high school, senior high school, and tertiary education had 51%, 65%, 76%, and 71%, respectively, lower odds of being stunted, compared to those whose mothers had no formal education (cOR = 0.49, CI = 0.31-0.76; cOR = 0.35, CI = 0.22-0.57; cOR = 0.24, CI = 0.14-0.41; cOR = 0.29, CI = 0.17-0.53). Additionally, adolescents with fathers who were farmers had 57% lower odds of being stunted compared to those whose fathers were artisans (cOR = 0.43, CI = 0.23-0.77). Wealth also influenced the odds of stunting; adolescents in the third and fourth wealth quintiles had 76% and 91%, respectively, lower odds of being stunted compared to those in the first wealth quintile (cOR = 0.24, CI = 0.15-0.41; cOR = 0.09, CI = 0.05-0.15). Nutritional knowledge was another important factor; adolescents with moderate and high nutritional knowledge had 59% and 61%, respectively, lower odds of being stunted than their peers with low nutritional knowledge (cOR = 0.41, CI = 0.27-0.61; cOR = 0.39, CI = 0.26-0.56). The odds of being stunted was 41% lower among adolescents who exhibited good dietary behaviour compared to their counterparts with poor dietary behaviour (cOR = 0.59, CI = 0.43-0.80). Finally, the multivariate analysis revealed no significant correlations between stunting and variables such as sex, age, parental status, marital status, maternal occupation, household size, and parental role modelling of healthy eating.

Table 8.4: Ordered logistic regression between height for age (HAZ) (1= normal, 2= stunting, extreme Tallness) and its predictors

Covariates	cOR (95% CI), p-value	aOR (95% CI), p-value
Region		
Oti	ref	ref
Volta	1.92(1.35-2.72), <0.001	1.36(0.79-2.33), 0.257
Gender		
Female	ref	
Male	1.06(0.78-1.45), 0.705	
Age		
10-14	ref	
15-17	0.91(0.65-1.28), 0.596	
18-19	0.86(0.56-1.32), 0.491	
Residence		
Rural	ref	ref
Urban	0.52(0.38-0.72), <0.001	0.69(0.42-1.14), 0.152
Parental status		
None	ref	
Single parent	0.92(0.41-2.09), 0.848	
Dual parent	0.57(0.26-1.24), 0.157	
Educational level		
None	ref	ref
Primary	0.26(0.12-0.58), 0.001	0.29(0.09-0.88), 0.028
JHS/JSS	0.20(0.09-0.43), <0.001	0.34(0.11-0.98), 0.046
SHS/SSS	0.13(0.06-0.28), <0.001	0.29(0.09-0.89), 0.030
Tertiary	0.39(0.12-1.25), 0.113	1.34(0.26-6.88), 0.727
Marital status		
Never married	ref	
Married/living together	1.07(0.55-2.08), 0.847	
Mother's occupation		
Artisan	Ref	
Professional	1.37(0.63-2.98), 0.429	
Office worker	0.73(0.30-1.76), 0.487	
Trader	0.67(0.31-1.41), 0.290	
Farmer	0.54(0.23-1.25), 0.152	
Mother's educational level		
None	Ref	ref
Basic	0.49(0.31-0.76), 0.002	0.55(0.29-1.03), 0.061
JHS/JSS	0.35(0.22-0.57), <0.001	0.66(0.33-1.28), 0.217
SHS/SSS	0.24(0.14-0.41), <0.001	0.69(0.31-1.52), 0.357
Tertiary	0.29(0.17-0.53), <0.001	1.55(0.63-3.85), 0.341
Father's occupation		
Artisan	ref	ref
Professional	1.17(0.65-2.09), 0.596	2.09(0.85-5.18), 0.110
Office worker	0.60(0.31-1.19), 0.148	2.37(0.78-7.21), 0.128
Trader	0.91(0.46-1.82), 0.788	1.79(0.59-5.47), 0.300
Farmer	0.43(0.23-0.77), 0.005	1.22(0.44-3.39), 0.700
Household size		
<4	ref	
4-5	0.91(0.55-1.49), 0.696	
6-7	0.82(0.49-1.37), 0.444	
8+	0.93(0.57-1.55), 0.780	
Wealth quintiles		
First	ref	ref
Second	0.58(0.32-1.03), 0.064	1.20(0.58-2.50)
Third	0.24(0.15-0.41), <0.001	
Fourth	0.09(0.05-0.15), <0.001	
Nutritional knowledge		
Low	ref	ref
Moderate	0.41(0.27-0.61), <0.001	1.34(0.72-2.47), 0.351
High	0.39(0.26-0.56), <0.001	0.87(0.48-1.59), 0.659
Dietary behaviour		

Poor	ref	ref
Good	0.59(0.43-0.80), 0.001	1.03(0.64-1.64), 0.902
Food security		
Food secure	ref	ref
Mildly food insecure	33.37(12.95-85.95), <0.001	33.81(12.66-90.25), <0.001
Moderately food insecure	247.16(90.49-675.08), <0.001	253.02(86.45-740.52), <0.001
Severely food insecure	235.74(90.03-617.29), <0.001	242.61(86.96-676.86), <0.001
Parenting styles		
Authoritative	2.51(1.73-3.63), <0.001	2.10(1.22-3.60), 0.007
Permissive	1.34(0.79-2.28), 0.277	0.84(0.39-1.83), 0.066
Neglectful	ref	ref
Authoritarian	2.20(1.36-3.58), 0.001	1.67(0.84-3.33), 0.143
Parental role modelling of healthy eating		
Poor	ref	
Good	1.23(0.91-1.67), 0.178	

BMI=Body Mass Index, JHS/JSS= Junior High School/Junior Secondary School, SHS/SSS=Senior High School/Senior Secondary School, cOR=Crude Odds Ratio, aOR=Adjusted Odds Ratio.

8.4 Discussion

This study examined the factors associated with malnutrition, especially, overweight/obesity and stunting and among adolescents aged 10–19 years in the Volta and Oti regions of Ghana. The results showed that 39.3% of the respondents were stunted, 32.1% were overweight or obese and 22.2% were both overweight/obese and stunted. The findings of this study are consistent with recent studies that have shown that malnutrition is a major public health problem among adolescents in low- and middle-income countries (Steyn & Nel, 2022). Malnutrition can manifest in different forms, including stunting, wasting, and overweight/obesity, and can have long-term consequences on the health and well-being of adolescents (Steyn & Nel, 2022). These findings align with the emerging global phenomenon known as the "double burden of malnutrition". The double burden of malnutrition, which refers to the coexistence of undernutrition and overweight/obesity within the populations, is also becoming increasingly prevalent among adolescents in many countries (Global Nutrition Report, 2018). Other studies in Ethiopia have highlighted a concerning prevalence of double burden malnutrition among adolescents, reflecting a growing trend across Africa that is also relevant to Ghana, where similar issues of undernutrition and rising obesity rates are increasingly recognised as public health challenges (Getacher et al., 2023; Gezaw et al., 2023; Ogum Alangea et al., 2018). The

study also found that several factors were associated with the BMI of the respondents. Socio-economic factors, including, parental status, education, wealth quintiles, and food security were significantly associated with both BMI and height-for-age. This aligns with global evidence confirming the association of poverty, food insecurity, and parental education with malnutrition in adolescents (Antwi et al., 2023; Hoteit et al., 2022; Rahman et al., 2021). Mothers' occupation, education, and nutritional knowledge, parenting styles and parental role modelling of healthy eating were linked to both BMI and height-for-age, while fathers' occupation had a significant association with height-for-age. This suggests the importance of parental education, awareness, and role modelling in promoting healthy habits for children (Dallacker et al., 2016). At the individual level, adolescent nutritional knowledge and dietary behaviour were associated with BMI, highlighting the need for nutrition education programs focused on adolescents.

8.4.1 Multivariate analysis Obesity

Previous studies have associated higher educational attainment with healthier diets (Azizi Fard et al., 2021). This study finds otherwise. However, the findings align with research by Ke et al. (2023), which highlighted the association between higher educational levels and an increased risk of overweight and obesity among adolescents (Ke et al., 2023). In Ghana, some studies have significantly associated attending private school with increased likelihood of overweight and obesity (Adom et al., 2019; Ganle et al., 2019). Shifting dietary patterns, including increased exposure to processed foods and sugary drinks have been associated with higher education and urbanisation (Abizari & Ali, 2019a). Also, higher education levels might correlate with higher wealth quintiles, potentially contributing to unhealthy food choices, including greater fast-food intake (Hidaka et al., 2018).

The findings link fathers in farming to higher overweight risk. This may be due to over-reliance on starchy staples and low affordability of healthy food options. Other studies show that the

local food environments in some communities in Ghana are obesogenic, characterised by an abundance of out-of-home cooked foods, convenience stores, and limited fruits and vegetables options (Dake et al., 2016).

The findings also associate higher wealth quintiles with greater overweight risk. This echoes global evidence linking poverty reduction with increased consumption of energy-dense, less nutritious foods. Obesity in sub-Saharan Africa has often been associated with affluence, as it is more prevalent in urban areas and among the wealthy (Dake et al., 2016; Neupane et al., 2015a; Ziraba et al., 2009b). However, recent studies have shown that obesity is also a growing problem among low-income populations in sub-Saharan Africa and affects people of all backgrounds and socioeconomic levels, particularly in urban areas (Neupane et al., 2015b; Owobi et al., 2022).

A good level of nutritional knowledge should enable people to make changes in their diet that will improve their health. Nutritional knowledge can help people understand the importance of consuming a balanced diet that includes a variety of foods from different food groups, and the role of nutrients in maintaining good health (Wu et al., 2022). It can also help people identify unhealthy foods and make healthier choices when eating out or grocery shopping (Scalvedi et al., 2021). However, in this study, high nutritional knowledge was surprisingly linked to higher risk of overweight. This seemingly paradoxical finding could be due to misinterpreted or incomplete knowledge. While it is expected that adolescent with high knowledge will opt for healthy foods, some adolescents with high knowledge might focus on specific aspects like calorie intake while neglecting nutrient composition and portion control.

Food insecurity was inversely associated with overweight. Food insecurity has been negatively associated with overweight in women (Mohammadi et al., 2013). This aligns with the common

assumption that limited food access would deter weight gain. However, some evidence shows a significant association between food insecurity and obesity (Carvajal-Aldaz et al., 2022; Frongillo & Bernal, 2014). While both food insecurity and obesity can be associated with economic and social disadvantage, they are not always directly caused by it and can coexist due to complex factors. In certain situations, the link between food insecurity and obesity may be influenced by additional factors. For instance, children of underweight, overweight, or obese mothers are more likely to experience obesity in persistently food insecure households compared to those in persistently food secure households (Black et al., 2013c; Frongillo & Bernal, 2014). It is crucial to consider the quality of available food during food insecurity, which might be high in energy density and low in nutrients, leading to malnutrition in various forms.

Maternal parenting styles characterized as authoritative, or authoritarian were associated with a reduced likelihood of overweight. This finding is consistent with research that show that maternal and/or paternal authoritative parenting styles is associated with lower BMI increases and decreased risk of obesity in both boys and girls when compared to other parenting styles (Connell & Francis, 2014; Lane et al., 2013). Authoritative parenting may therefore be protective against obesity. However, there is not enough evidence to support the links between authoritarian parenting and a lower risk of overweight. In contrast, authoritarian, permissive, and neglectful parenting styles have been associated with greater risk of being obese (Sokol et al., 2017b). This finding supports the importance of parental guidance and healthy eating habits promotion within the family.

The findings also reveal the influence of regional differences on BMI. Adolescents in the Volta region were less likely to be overweight: This finding requires further investigation, considering factors like availability of specific food types, cultural practices, and

potential regional differences in the perception of body weight. The study did not find associations between specific gender or age groups and risk of overweight and obesity. Dietary habits, while not showing significant correlation with overweight in this study, remain a crucial element to consider in future analyses.

8.4.2 Predictors of adolescent stunting

Multivariate analysis of the factors associated with stunting showed that adolescents in the Volta region had 2 times higher odds of experiencing stunted growth compared to their counterparts in the Oti region. Regional variations in stunting prevalence have been documented in previous studies (Aheto & Dagne, 2021; Akombi et al., 2017b). Evidence from 2014 Ghana Demographic Health Survey revealed substantial geographical variations in prevalence of childhood stunting (Aheto & Dagne, 2021). These differences may be attributed to varying socio-economic, cultural, and environmental factors that impact nutritional status. The findings make a strong link between food insecurity and stunting. The association between food insecurity and stunting is well-established (Gassara & Chen, 2021; Humphries et al., 2015; Patriota et al., 2024). Limited access to diverse and nutritious foods hinders optimal growth and development, particularly during adolescence, a crucial period for physical and cognitive maturation (Lassi et al., 2017c).

The study findings on the protective role of higher education, wealth, and urban residence resonate with established patterns (Kalinda et al., 2024; Ndagijimana et al., 2022; Niragire et al., 2022). These factors generally translate to better access to quality food, healthcare, sanitation, and information, ultimately contributing to improved nutritional outcomes. Higher parental education and the adolescents' own educational attainment are consistently linked to better nutritional outcomes (Makate & Nyamuranga, 2023; Mulubrhan et al., 2017). Education enhances knowledge about health and nutrition practices. Adolescents in the third and fourth

wealth quintiles had lower odds of stunted growth compared to those in the first wealth quintile. Socio-economic status is a well-established determinant of stunting, with higher wealth quintiles often associated with improved living conditions, access to healthcare, and dietary diversity (Nisbett et al., 2023). Urbanisation is often associated with improved access to healthcare, sanitation, and nutrition, contributing to better child growth outcomes (Akombi et al., 2017b). Adolescents with moderate and high nutritional knowledge, as well as good dietary behaviour, had lower odds of stunting. Nutritional knowledge and dietary practices play a crucial role in preventing stunting. Adequate knowledge ensures appropriate food choices and feeding practices (A Annan et al., 2021).

Adolescents with parents adopting authoritative or authoritarian parenting approaches were about twice as likely to experience stunted growth. The association between authoritative and authoritarian parenting and stunting is intriguing. While these styles might foster discipline and structure, they could also restrict autonomy and decision-making, impacting adolescents' nutritional choices and overall well-being. The influence of parenting styles on stunting is less explored but aligns with the broader literature on the importance of a supportive and nurturing family environment for child development (Dewi & Sumarni, 2023). No notable correlations were found between stunting and variables such as sex, age, parental status, marital status, maternal occupation, household size, and parental role modelling of healthy eating. The absence of significant associations in the multivariate analysis emphasizes the multifactorial nature of stunting. Factors like sex, age, and parental role modelling may have less direct impact on stunting when considered alongside other influential variables.

8.5 Conclusion

This study highlights the complex interplay of various factors influencing overweight and obesity among adolescents in Ghana. The study's findings underscore the diverse and

interconnected factors influencing malnutrition, including overweight/obesity and stunting among adolescents in the Volta and Oti regions of Ghana. While some findings align with existing evidence, others raise questions for further investigation. Interventions aimed at addressing adolescent malnutrition should consider regional disparities, socio-economic factors, food security, parenting styles, and educational components to develop comprehensive strategies that tackle the root causes of malnutrition among this vulnerable population.

8.6 Limitation

Dietary intake and food security were assessed using self-reported measures, which may be subject to recall bias and inaccuracies. Participants might underreport or overreport their food intake or experiences of food insecurity, potentially affecting the reliability of the findings. This study was conducted in the Volta and Oti regions of Ghana. The results may not be applicable to adolescents in other contexts, including regions with different socioeconomic conditions, cultural practices, or food environments.



9.0 THE AWARENESS, KNOWLEDGE, PERCEIVED BENEFITS AND READINESS OF ADOLESCENT CONSUMERS TO ADOPT SUSTAINABLE HEALTHY DIET BEHAVIOURS IN VOLTA AND OTI REGIONS GHANA.

Abstract

Introduction: The way we produce and consume food has a profound impact on both human health and the environment, extending far beyond the individual. Adolescents, a crucial demographic, play a pivotal role in shaping the future of food systems through their food choices. These choices not only affect their own health but also carry significant implications for public health, environmental sustainability, and the well-being of future generations. Despite the importance of this issue, there is a lack of research in Ghana on adolescents' understanding, knowledge, willingness to adopt sustainable healthy eating habits, and the obstacles they face in doing so.

Objectives: To assess adolescent awareness, knowledge, perception of the benefits of adopting sustainable diets and their readiness to adopt sustainable healthy diets in Ghana.

Methods: This was community-based descriptive cross-sectional study involving 667 adolescents aged 10-19 years in the Volta and Oti regions of Ghana. A pre-tested structured questionnaire which covers the key aspects of awareness, knowledge, perceived benefits, readiness to adopt sustainable healthy diets and barriers was used to collect data. Descriptive statistics, such as means, standard deviations, frequencies, and percentages, were calculated to summarize participants' demographic characteristics, knowledge of sustainability, perceived benefits of sustainable diets, and readiness to adopt an environmentally sustainable diet. Bivariate and multivariate regression analysis were conducted to examine associations between variables and explore potential differences among subgroups, where applicable.

Results: The findings indicate that a significant portion of adolescents possess a strong understanding of sustainable dietary behaviours, with 57% demonstrating high knowledge levels. Notably, over 60% recognized substantial environmental benefits from practices such as reducing food waste and prioritising plant-based proteins, consuming fruits and vegetables and purchasing local food. Furthermore, 58% of respondents were in the consideration stage for adopting these behaviours, while 17.4% were ready to implement them. Adolescents with a positive view of sustainability were twice as likely to be ready to adopt these practices [aOR=2.69 (95% CI= (1.06-6.84), p=0.038], compared to those facing food insecurity [aOR=0.33 (95% CI=0.13-0.87), p=0.025]. Adolescents with high knowledge of sustainability and good dietary habits showed significantly increased odds of adopting sustainable diet behaviours, aOR=8.13 (95% CI= (3.05-21.64), p<0.001] and [aOR=3.19 (95% CI= (1.37-7.44), p=0.007], respectively. Parenting styles and parental role-modelling of healthy eating did not significantly influence readiness for sustainable dietary changes. However, it is essential to consider that despite high knowledge levels, barriers such as socioeconomic factors and limited agency in food choices may hinder the adoption of sustainable diets among adolescents.

Conclusion: Adolescents in the Volta and Oti regions of Ghana demonstrate a strong understanding and awareness of sustainable dietary practices and recognise their environmental benefits. Their readiness to adopt these behaviours is significantly influenced by their perceptions of sustainability and their level of food security. Despite their knowledge, socioeconomic barriers and food insecurity may hinder the adoption of sustainable diets. These findings underscore the need for targeted interventions that address these barriers and support adolescents in transitioning from awareness to action, thereby fostering healthier and more sustainable dietary behaviours among adolescents. Parents, caregivers, and policymakers must

work together to create an enabling environment that supports adolescents in making informed food choices and adopting sustainable dietary practices. Further research is needed to explore effective interventions that can empower this demographic to make healthier food choices.

9.1 Introduction

Sustainable dietary behaviours are becoming increasingly important as the global population grows, economic development accelerates, and environmental pressures become more pronounced. Food production and consumption not only impact on the environment but also affect human health becomes (FAO & WHO, 2019; Global Nutrition Report, 2022). According to the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO), sustainable healthy diets are those that are healthy, have low environmental impacts, and are socio-culturally acceptable and economically accessible for all (FAO & WHO, 2019). Sustainable diets emphasize the consumption of foods that are not only nutritious but also produced and obtained in a manner that supports ecological balance, biodiversity, and social well-being (Herrero et al., 2023b; Springmann et al., 2018; Willett et al., 2019c). Sustainable diets prioritize consuming seasonal fruits and vegetables, as this reduces the environmental impact of food production and ensures that the dietary choices align with natural cycles and availability of produce (Global Nutrition Report, 2022). Additionally, consuming plant-based diets has been associated with a lower risk of chronic diseases (Wang et al., 2023).

Adolescents play a critical role in shaping current and future food systems through their dietary choices, which not only impact their own health but also have broader implications for the environment and future generations (D. Glover & Sumberg, 2020; Havermans et al., 2021; Hosany et al., 2022). Their dietary habits not only influence their immediate health but also have long-term implications for public health and sustainability (Mahmood et al., 2021d). Previous research has shown that individuals who are aware of the environmental impact of their food choices are more likely to adopt sustainable dietary behaviours (Bimbo, 2023;

Havermans et al., 2021). Adolescents are at a critical stage of development, both physically and socially, making it an opportune time to promote sustainable dietary behaviours (Havermans et al., 2021). By increasing awareness and understanding of the environmental consequences of food production, adolescents can make informed decisions about their diets. This can include choosing plant-based foods over animal products, supporting local and organic food systems, minimising food waste, and considering the carbon footprint of different foods (FAO, 2012b; Havermans et al., 2021). Involving adolescents in sustainable food initiatives and promoting experiential learning can further reinforce sustainable dietary behaviours (FAO, 2012b; Johnston et al., 2014). These behaviours not only benefit the environment but also contribute to their overall health and well-being (Prescott et al., 2019). By adopting sustainable dietary behaviours, adolescents can contribute to mitigating climate change, reducing resource depletion, and protecting biodiversity (FAO, 2012b; Johnston et al., 2014). While much research has focused on sustainability in developed countries (Culliford & Bradbury, 2020b; Ritch & Brownlie, 2016; Schill et al., 2020) and India (P. Singh et al., 2020) and cover various age groups (Culliford & Bradbury, 2020b; Schill et al., 2020). Further research in this area is needed to develop effective policies and interventions to promote sustainable dietary behaviours among adolescents in Ghana and other low-income settings. By conducting this research, we can gain valuable insights into how to support adolescents, especially Ghanaian adolescents in adopting sustainable healthy diet behaviours. This can lead to positive impacts on their health, the environment, and the future of food systems in Ghana. It is also crucial for fostering a sense of environmental stewardship and motivating them to adopt sustainable dietary behaviours from an early age (Hosany et al., 2022). The objective of this study was to assess adolescent awareness, knowledge, perception of the benefits of adopting sustainable diets and their readiness to adopt sustainable healthy diets in Ghana.

9.2 Materials and Methods

9.2.1 Study Design and Participants

A community-based descriptive cross-sectional study design involving the collection of quantitative data was employed for the study. Data was collected from 667 adolescents aged 10-19 years. Data were collected using a structured questionnaire that assessed participants' demographic information and individual characteristics, their awareness, knowledge and readiness to adopt sustainable healthy diet behaviours.

9.2.2 Study Setting

The study was conducted in the Volta and Oti regions of Ghana. These regions were chosen due to their diverse cultural backgrounds and varying levels of urbanisation, which may influence dietary behaviours differently. The study site lies close to the border with the republic of Togo to the east, bordering the Volta Lake to the west and the Northern region to the north.

9.2.3 Study Population

The target population comprised adolescents aged 10-19 years, living in the Volta and Oti regions of Ghana.

9.2.4 Study Design

This was community-based descriptive cross-sectional study design involving the collection of quantitative data. The study was designed, implemented and the results reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cross-sectional studies.

9.2.5 Sample Size Determination

The sample size was calculated using Yamane's formula (Yamane, 1967): $n = N / (1 + Ne^2)$, which estimates the required sample size for a population proportion. Based on a projected 2020 adolescent population of 589,513 in the Volta and Oti regions, a confidence level: 95% (with a standard value of 1.96), 5% (0.05) margin of error, a design effect coefficient of 1.5 and a 10% non-response rate. By applying these parameters, we arrived at a final sample size of 667.

9.2.6 Sampling Procedure

The study utilised the 2017 Ghana Living Standards Survey round 7 (GLSS 7) master sampling frame and employed a two-stage stratified sampling design. In the first stage, 46 out of 96 enumeration areas (EAs) were chosen as Primary Sampling Units (PSUs), allocated to the two administrative regions using probability proportional to population size (PPS). These EAs were further categorized into urban and rural localities. In the second stage, a comprehensive listing of households within each PSU was created, serving as the Secondary Sampling Units (SSUs). From each PSU, 15 households were systematically selected, resulting in a total sample size of 675 households across the two regions. To ensure accurate data collection, maps of each cluster, with the listed households, were utilized to locate and identify the selected households.

9.2.7 Adoption of Environmentally Sustainable Diet

A comprehensive questionnaire that covers the key aspects of awareness, knowledge, perceived benefits, readiness to adopt sustainable healthy diets and barriers to adopting sustainable healthy diets was developed. Questions for the questionnaire were adapted from existing measures and previous research (Culliford & Bradbury, 2020a; García-González et al., 2020; Siegrist et al., 2015; Tobler et al., 2011). The questionnaire consisted of closed-ended (multiple-choice, Likert-scale) questions. Knowledge on Sustainability: Participants' knowledge of sustainability terms was assessed using a set of ten questions adapted from García-González et

al. (2020). Each question had two response options: "Yes" or "No." A composite score was calculated by summing the number of correct responses, with higher scores indicating higher knowledge of sustainability.

9.2.8 Perceived Benefits of Sustainable Diets

Adolescents' perceptions of the benefits of sustainable dietary behaviours were assessed using a set of nine items. These items included behaviours such as avoiding excess packaging, buying locally grown produce, consuming seasonal fruits and vegetables, limiting red and processed meat; prioritising plant proteins, reducing consumption of air freighted foods; choosing sustainable fish; choosing organic produce and reducing food waste. Participants rated the perceived environmental benefit of each behavior on a 5-point Likert scale, ranging from "very small benefit" to "very large benefit" (Culliford & Bradbury, 2020a). A composite score was calculated by summing the ratings across the nine items, with higher scores indicating a greater perception of the benefits of sustainable diets.

9.2.9 Readiness to Adopt an Environmentally Sustainable Diet (RASD)

Adolescent readiness to adopt sustainable diet (RASD) was measured using a set of nine questions (examples: avoiding excess packaging; buying locally grown produce; consuming seasonal fruits and vegetables; limiting red and processed meat; prioritising plant proteins e.g. beans, nuts, lentils; reducing consumption of air freighted foods; choosing sustainable fish; reducing food waste; choosing organic produce) with six response options that corresponded with the stage of change construct of the Trans-Theoretical Model of behaviour change (Booth et al., 1993). The stage of change construct provides a useful cross-sectional measure of an individual's readiness to adopt a particular behaviour and has previously been used to measure readiness to adopt environment and health-related behaviours (Cooper and Hedges, 1994; Marshall and Biddle, 2001). Each question presented six response options corresponding to

different stages of change, including pre-contemplation, contemplation, planning, action, maintenance, and relapse (Booth et al., 1993). A composite score was calculated by assigning numeric values to the stages of change responses and summing the scores across the nine items. The composite score categorized participants into three levels: "Ready," "Consideration stage," and "Not ready."

9.2.10 Data Analysis

Descriptive statistics, such as means, standard deviations, frequencies, and percentages, were calculated to summarize participants' demographic characteristics, knowledge of sustainability, perceived benefits of sustainable diets, and readiness to adopt an environmentally sustainable diet. Statistical analyses, including ordered logistic regression analysis were conducted to examine associations between variables and explore potential differences among subgroups, if applicable.

9.2.11 Knowledge on Sustainability

The composite on knowledge about sustainability: In all, 11 items were used to generate this composite. Each item had two levels each coded as 0 No and 1 Yes. All those who indicated hearing the terms were assigned 1 and those who indicated not hearing were assigned the code 0. All individuals were summed up together but an alpha value of 0.87. The individual summed scores were obtained the knowledge was categorized into two levels based on the median score (which was 6). All those who score below the median were classified as having low knowledge and those who had the cut-off point and above were classified as having high knowledge.

9.2.12 Perceived Benefits of Sustainable Diets

Composite was gotten from eight items. All items had five levels ranging from 0 to 4. but an alpha value of 0.81 was obtained. All individuals were summed up together but an alpha value

of 0.87. The individual summed scores were obtained the knowledge was categorized into two levels based on the median score (which was 20). All those who score below the median were classified as having poor perception and those who had the cut-off point and above were classified as having good perception.

9.2.13 Readiness to Adopt to Sustainable Diet (RASD)

This composite had a total observation of 293 (dependent on those who were aware of then sustainable diets). This composite was created using a set of seven items. Each of these items had six levels. The levels were the same throughout the items. These levels were Pre-contemplation, contemplation, Planning, Action, Maintenance and Relapse. These six levels were reduced into three levels such that Pre-contemplation and contemplation were coded as 1 “PC/P”, Planning and Action were coded as 2 “P/A” and finally maintenance and relapse were coded as 3 “M/R”. All the items were pulled together but before then an alpha of 0.79 was obtained indicating the reliability of the set of items. Individual total scores were generated after combining all the items. The composite was created using cut-off points such that the minimum score was 7 and maximum score was 21. All individuals who scored 21 were categorized as 3 and called “Ready”, all those who scored from 14 to 20 were classified as 2 and given the name “Consideration stage” and finally all those who scored below 14 were classified as 1 and given the name “Not ready”.

9.3 Results

9.3.1 Awareness of Sustainability Behaviours

Table 9.1 shows adolescent awareness of sustainable food production and consumption. More than 75% of adolescents were unaware of the term “ecological footprint”. This aligns with global trends, as a 2020 study found that only 40% of US consumers understand the term. Also, 80.4% of adolescents were unaware of “carbon footprint”. Nearly 55% of adolescents were

unaware of the term “environmental impact”. This is concerning, as understanding the environmental consequences of food production is crucial for informed dietary choices. Some 67.5% of adolescents were unaware of the term “biodiversity”. Biodiversity loss poses significant threats to food security and ecosystem health, yet awareness remains low. Similarly, 66.6% of adolescents were unaware of “greenhouse gas emissions”. Understanding the link between food and emissions is essential for making sustainable choices. The majority of adolescents, including, 73.5%, 67.5%, and 79.5% were unaware of “green-blue-grey water”, climate adaptation, and mitigation, respectively. These terms are crucial for comprehending the water usage and climate resilience aspects of food systems. However, 78.5% were aware of the term “local food”. This is positive, as local food systems often have lower environmental footprints and support local communities.

Table 9.1: Awareness of sustainability terms in relation to food production and consumption

Sustainability terms awareness	n	%
Ecological footprint	165	24.7
Carbon footprint	131	19.6
Environmental impact	301	45.1
Biodiversity	217	32.5
Local food	521	78.1
Greenhouse gas emissions	223	33.4
Green water–blue water-grey water	177	26.5
Climate adaptation	217	32.5
Mitigation	137	20.5
Resilience	135	20.2
Food sustainability	293	43.9

Table 9.2 shows adolescent knowledge of terms related to sustainable food production and consumption. Among those who were aware of the sustainability terms, 56.3% reported that, they did not know the meaning of ecological footprint whiles 85.0% said they knew the meaning of the term “food sustainability”. The majority, 70.0% of the respondents confirmed that, they knew the meaning of “environmental impact” and 53.9% said that they know the meaning of the term “biodiversity”. Moreover, 85.3% of respondents reported that they know the meaning of “local food”, whiles 55.6% said they knew about “greenhouse gas emissions”. More than

half (59.7%) of the respondents did not know the meaning of the term “green water-blue water-grey water” but 56.0% knew the meaning of climate adaptation. Most (69.6%) and 63.5% of respondents reported that they did not know the meaning of “mitigation” and “resilience”, respectively. The majority (57%) of respondents had high knowledge of sustainable diet behaviours.

Table 9.2: Knowledge of sustainability terms in relation to food production and consumption (n=293)

Sustainability terms knowledge	n	%
Ecological footprint	128	43.7
Carbon footprint	103	35.2
Food sustainability	249	85.0
Environmental impact	205	70.0
Biodiversity	158	53.9
Local food	250	85.3
Greenhouse gas emissions	163	55.6
Green water–blue water-grey water	118	40.3
Climate adaptation	164	56.0
Mitigation	89	30.4
Resilience	107	36.5

9.3.2 Adolescents’ Knowledge of Sustainability Terms in Relation to Dietary Behaviours

The majority (57%) of respondents had high knowledge of sustainable diet behaviours (Figure 9.1).

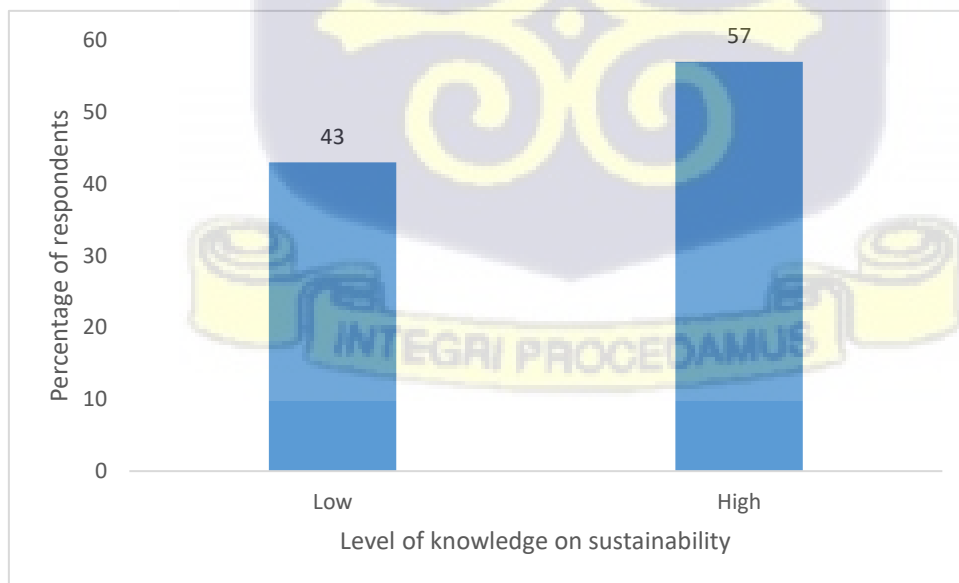


Figure 9.1: Adolescents’ knowledge of sustainable terms in relation to dietary behaviours

9.3.3 Adolescents' Perception of The Environmental Benefits of Adopting Sustainable

Diet Recommendations

The study examined adolescent perceptions of the benefits of adhering to eight selected sustainable diet recommendations. The findings show that among the eight sustainable diet recommendations studied, more than 60% of participants perceived a high environmental benefit for four of them: “reduce food waste”, “prioritize plant protein”, “consume fruits and vegetables”, and “purchase local food”. For two of the eight sustainable diet recommendations studied (“reduce air-freighted food consumption” and “limit processed meat”), more than 50% of participants perceived a high environmental benefit. The research found that less than 50% of participants perceived a high environmental benefit for two of the recommendations (“choose organic produce” and “limit packaging”) (Figure 9.2).

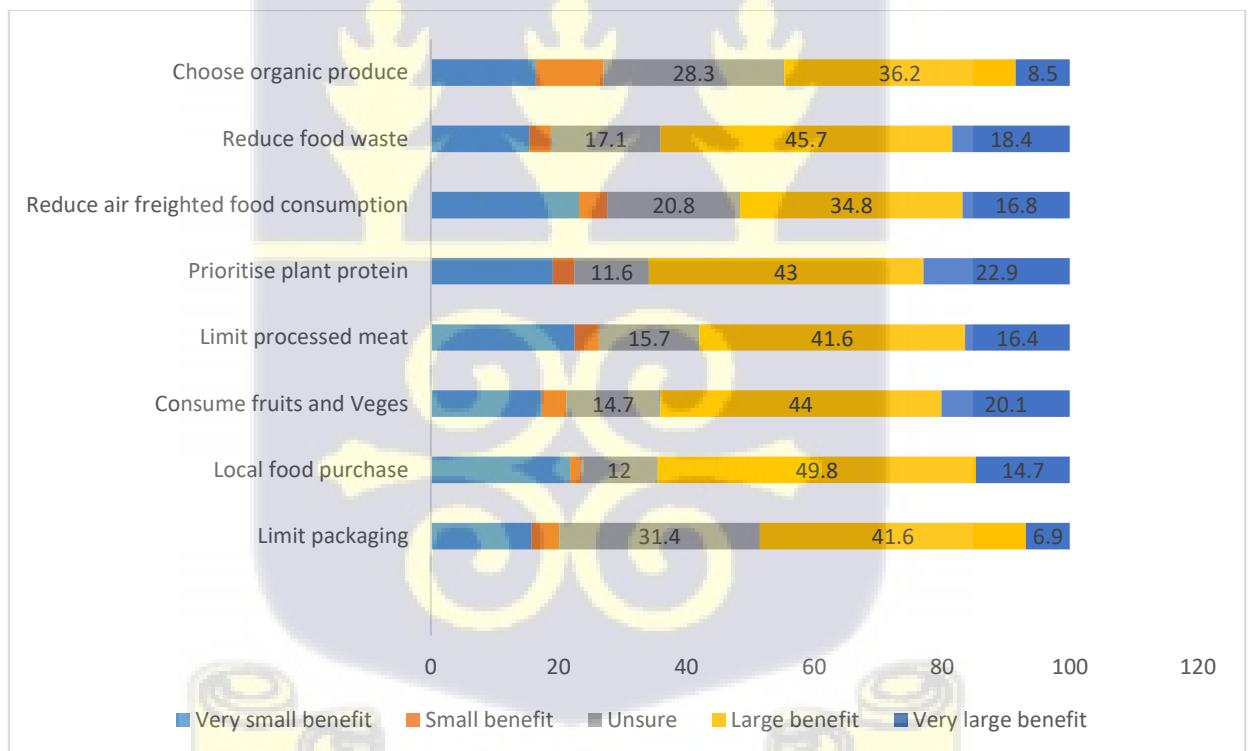


Figure 9.2: Respondents' perception of the environmental benefits of adopting sustainable diet recommendations

Overall, more than half, (50.8%) of respondents had high perceived level of environmental benefits of sustainable diet behaviours (Figure 9.3).

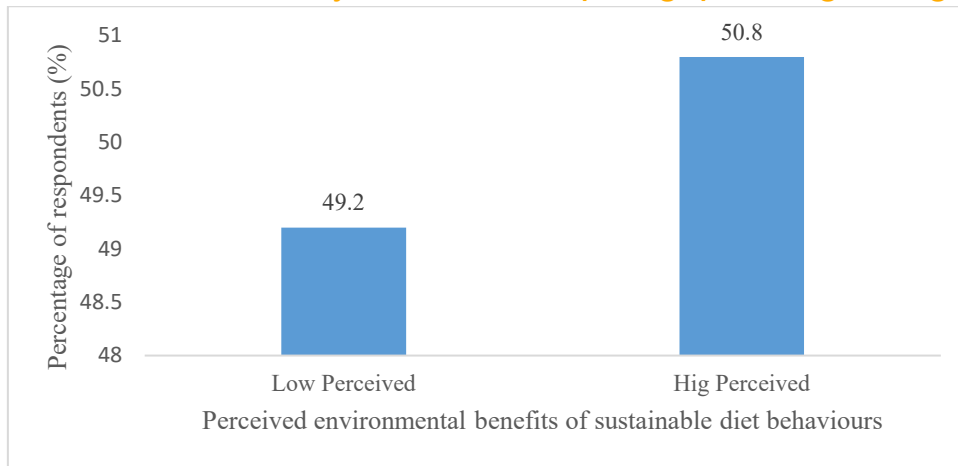


Figure 9.3: Overall perceived benefits of adopting sustainable diet recommendations

9.3.4 Readiness of Adolescents to Adopt an Environmentally Sustainable Diet

Majority, 107(36.5%) of the respondents reported that they are in the Maintenance/Relapse stage of change for avoiding products with excess packaging. More than half, 149 (50.8%) of the respondents were in the Maintenance/Relapse stage of change for buying locally grown produce. Nearly half, 130 (44.4%) of the respondents were in the maintenance/relapse stage of change for limiting red and processed meat while majority, 159 (54.2%) of the respondents were in the maintenance/relapse stage of change for prioritizing plant proteins. Furthermore, 128 (43.7%) of the respondents reported that they were in the maintenance/relapse stage of change for reducing consumption of air freighted foods and 156 (53.2%) of the respondents indicated that they were in the maintenance/relapse stage of change for reducing food waste. Approximately one-third, 110 (37.5%) of the respondents reported that they were in the action or maintenance stage of change for choosing organic produce.

Table 9.3: Adolescent readiness to adopt an environmentally sustainable diet

Item	PC/C	P/A	MR
To avoid products with excess packaging?	83(28.3)	103(35.2)	107(36.5)
To buy locally grown produce?	38(13.0)	106(36.2)	149(50.8)
To limit red and processed meat (e.g. sausages, bacon?)	58(19.8)	105(35.8)	130(44.4)
To prioritise plant proteins?	38(13.0)	96(32.8)	159(54.2)
To reduce consumption of air freighted foods	75(25.6)	90(30.7)	128(43.7)
To reduce food waste?	48(16.4)	89(30.4)	156(53.2)
To choose organic produce?	103(35.2)	80(27.3)	110(37.5)

*PC- pre-contemplation, C- contemplation, P- planning, A-Action, M- Maintenance, R- Relapse

Overall, majority, 58 percent of the respondents reported that they were in consideration stage of their readiness to adopt sustainable diet behaviours (Figure 9.4).

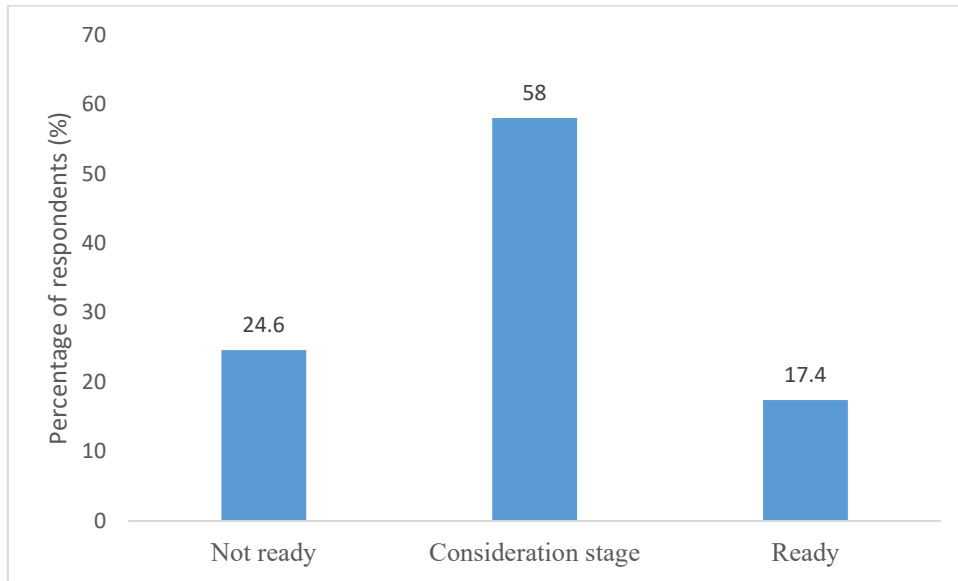


Figure 9.4: Readiness to Adopt Sustainable Diet Behaviours (RASD)

9.3.5 RASD and its Associated Factors

Table 9.4 shows the factors associated with adolescent readiness to adopt sustainable healthy diets. There was an association between region (<0.001), gender (0.004), parental status (0.027), sibling status (0.020), educational level (0.007), wealth quintiles (<0.001), knowledge sustainability (<0.001), diet behaviour (<0.001), perceived benefits of sustainability (0.003), food insecurity (0.009), parental role modelling (0.002) and Readiness to adopt sustainable diet behaviours (RASD).



Table 9.4: Factors associated with adolescent readiness to adopt sustainable healthy diets

Variable	RASD			X ² (p-value)/Fisher's exact
	Not Ready 72(24.6)	Contemplation stage 170(58.0)	Ready 51(17.4)	
Region				<0.001
Oti	7(5.7)	84(68.9)	31(25.4)	
Volta	65(38.0)	86(50.3)	20(11.7)	
Gender				11.1(0.004)
Female	40(30.5)	78(59.5)	13(10.0)	
Male	32(19.8)	92(56.8)	38(23.4)	
Age				4.40(0.354)
10-14	19(19.8)	55(47.3)	22(22.9)	
15-17	34(26.2)	75(57.7)	21(16.1)	
18-19	19(28.4)	40(59.7)	8(11.9)	
Residence				1.75(0.418)
Rural	45(25.6)	97(55.1)	34(19.3)	
Urban	27(23.1)	73(62.4)	17(14.5)	
Parental status				0.027
None	2(40.0)	0(0.0)	3(60.0)	
Single parent	13(30.2)	22(51.2)	8(18.6)	
Dual parent	57(23.3)	148(60.4)	40(16.3)	
Sibling status				0.020
None	8(66.7)	3(25.0)	1(8.3)	
One	7(14.8)	27(57.5)	13(27.7)	
Two	0(0.0)	3(100.0)	0(0.0)	
Three	13(32.5)	21(52.5)	6(15.0)	
Four and above	44(23.0)	116(60.7)	31(16.3)	
Educational level				0.040
None	3(33.3)	5(55.6)	1(11.1)	
Primary	13(39.4)	20(60.6)	0(0.0)	
JHS/JSS	23(22.8)	54(53.4)	24(23.8)	
SHS/SSS	29(21.3)	83(61.0)	24(17.7)	
Tertiary	4(28.6)	8(57.1)	2(14.3)	
Marital status				0.408
Never married	65(23.7)	160(58.4)	49(17.9)	
Married/living together	7(36.8)	10(52.7)	2(10.5)	
Living with Natural mother				0.133
No	5(31.2)	11(68.8)	0(0.0)	
Yes	67(24.2)	159(57.4)	51(18.4)	
Living with Natural father				0.707
No	8(25.0)	17(53.1)	7(21.9)	
Yes	64(24.6)	153(58.6)	44(16.8)	
Mother's occupation				0.055
Artisan	1(20.0)	2(40.0)	2(40.0)	
Professional	21(30.4)	40(58.0)	8(11.6)	
Office worker	12(35.3)	18(52.9)	4(11.8)	
Trader	26(19.0)	78(56.9)	33(24.1)	
Farmer	12(25.0)	32(66.7)	4(8.3)	
Household size				0.007

<4	14(60.9)	5(21.7)	4(17.4)	
4-5	18(19.6)	59(64.1)	15(16.3)	
6-7	19(22.3)	51(60.0)	15(17.7)	
8+	21(22.6)	55(59.1)	17(18.3)	
Wealth quintiles				<0.001
First	4(100.0)	0(0.0)	0(0.0)	
Second	5(62.5)	3(37.5)	0(0.0)	
Third	11(35.5)	19(61.3)	1(3.2)	
Fourth	36(27.2)	81(61.4)	15(11.4)	
Fifth	16(13.6)	67(56.8)	35(29.6)	
Nutritional knowledge				0.053
Low	16(29.1)	35(63.6)	4(7.3)	
Moderate	23(27.4)	50(59.5)	11(13.1)	
High	33(21.4)	85(55.2)	36(23.4)	
Knowledge sustainability				<0.001
Low	50(39.7)	57(45.2)	19(15.1)	
High	22(13.2)	113(67.7)	32(19.1)	
Diet behavior				<0.001
Poor	44(33.8)	75(57.7)	11(8.5)	
Good	28(17.2)	95(58.3)	40(24.5)	
Perceived benefits of sustainability				0.003
Poor	46(31.9)	81(56.3)	17(11.8)	
Good	26(17.5)	89(59.7)	34(22.8)	
BMI				0.819
Severeness	1(14.3)	5(71.4)	1(14.3)	
Moderateness	3(37.5)	3(37.5)	2(25.0)	
Normal	45(23.3)	113(58.6)	35(18.1)	
Overweight	12(29.3)	21(51.2)	8(19.5)	
Obesity	11(25.0)	28(63.6)	5(11.4)	
Food insecurity				0.009*
Food secure	22(17.2)	74(57.8)	32(25.0)	
Mildly food insecurity	17(23.6)	44(61.1)	11(15.3)	
Moderately food insecurity	13(33.3)	24(61.6)	2(5.1)	
Severely food insecurity	20(37.0)	28(51.9)	6(11.1)	
Parenting style				8.5(0.204)
Authoritative	25(22.5)	74(66.7)	12(10.8)	
Permissive	9(23.7)	21(55.3)	8(21.0)	
Neglectful	25(29.8)	42(50.0)	17(20.2)	
Authoritarian	13(21.7)	33(55.0)	14(23.3)	
Parental role modelling of healthy eating				0.002
Poor	32(30.5)	47(44.8)	26(24.8)	
Good	40(21.3)	123(65.4)	25(13.3)	

Table 9.5: Ordered logistic regression between RASD and its predictors.

Covariates	Model 1 empty OR (95% CI), p-value	Model 2 individual level aOR (95% CI), p-value
Residence (Rural)		
Urban		0.62(0.11-3.39),0.582
Gender (Female)		
Male		0.57(0.28-1.15),0.117
Age (10-14)		
15-17		0.76(0.35-1.67),0.500
18-19		0.78(0.29-2.03),0.605
Parental status (None)		
Single parent		0.01(0.0-0.16),0.001
Dual parent		0.01(0.0-0.19),0.002
Perceived benefits of sustainability (Negative)		
Positive		2.69(1.06-6.84),0.038
Knowledge of sustainability (low)		
High		8.13(3.05-21.64), <0.001
Dietary habits (Poor dietary habits)		
Good dietary habits		3.19(1.37-7.44),0.007
Marital status (married)		
Never married		2.39(0.59-9.79),0.224
Parenting styles(Authoritative)		
Permissive		2.24(0.72-7.55),0.156
Neglectful		1.08(0.39-2.96),0.878
Authoritarian		2.41(0.99-5.86),0.053
Role modelling (poor)		
Good		0.38(0.14-1.02),0.055
Food insecurity (Food secure)		
Mildly food insecurity		1.32(0.59-2.96),0.499
Moderately food insecurity		0.60(0.21-1.73),0.348
Severely food insecurity		0.33(0.13-0.87),0.025

The odds of being stunted were 71%, 66% and 71% lower among adolescents in primary school, junior high school and senior high school, respectively, compared to their counterparts with no education (cOR = 2.76, CI = 1.29-5.92 and cOR = 3.29, CI = 1.63-6.65, respectively). Multivariable analysis showed that the odds of being ready to adopt sustainable healthy diet was two times higher among adolescents with a positive perception of the benefits of sustainability compared to those with a negative perception [aOR=2.69 (95% CI= (1.06-6.84), p=0.038]. Additionally, compared to adolescents without parents, those with single or dual parents exhibited significantly reduced odds of adopting sustainable dietary behaviours after adjusting for potential covariates [aOR=0.01 (95% CI= (0.00-0.16), p=0.001] and [aOR=0.01 (95% CI= (0.0-0.19), p=0.002] respectively. Parenting styles and parental role-modelling of healthy eating behaviours were not important predictors of the readiness to adopt sustainable dietary behaviours. Adolescents with high knowledge of sustainability and good dietary habits showed significantly increased odds of adopting sustainable diet behaviours, aOR=8.13 (95% CI= (3.05-21.64), p<0.001] and [aOR=3.19 (95% CI= (1.37-7.44), p=0.007], respectively. Finally, compared to food secure adolescents, severe food insecurity was associated with a 67% reduced likelihood of adopting sustainable diet behaviours among adolescents [aOR=0.33 (95% CI=0.13-0.87), p=0.025]. Ghana Africa.

9.4 Discussion

9.4.1 Adolescent Awareness of Sustainable Healthy Diets in Ghana

The objective of this study was to assess adolescent awareness, knowledge, perception of the benefits of adopting sustainable diets and their readiness to adopt sustainable healthy diets in Ghana. The findings highlight a significant gap in awareness among adolescents 10-19 years in Ghana's Volta and Oti regions regarding key concepts related to sustainable healthy diets.

9.4.2 Awareness of Terms About Sustainable Food Production and Consumption

The results of this study show that most adolescents were not aware of several food sustainability terms, including ecological footprint, carbon footprint, environmental impact, biodiversity, greenhouse gas emissions, green water, blue water, grey water, climate adaptation, and mitigation. However, the study found that the majority of respondents were aware of the term “local food”. Previous research has shown that individuals who are aware of the environmental impact of their food choices are more likely to adopt sustainable dietary behaviours (Havermans et al., 2021). By increasing awareness and understanding of the environmental consequences of food production, adolescents can make informed decisions about their diets. This can include choosing plant-based foods over animal products, supporting local and organic food systems, minimizing food waste, and considering the carbon footprint of different foods (FAO, 2012b; Havermans et al., 2021). Involving adolescents in sustainable food initiatives and promoting experiential learning can further reinforce sustainable dietary behaviours (Pieniak et al., 2016).

9.4.3 Knowledge of Sustainable Diet Behaviours

The findings of the study revealed that a significant portion of the respondents who said they were aware of various sustainable diet concepts did not have sufficient knowledge about concepts in sustainable food production and consumption. For example, among the respondents who said they were aware of "ecological footprint", 56.3% did not know the meaning of “ecological footprint”. This highlights a specific area where awareness needs to be improved to enhance understanding of the environmental impact of individual dietary choices. This lack of awareness and understanding of sustainability terms among adolescents is concerning because it hinders their ability to make informed choices about their diet and food consumption. A study conducted by Hartmann et al. among adults in Switzerland also found that participants had insufficient knowledge of sustainable food production and consumption (Hartmann et al.,

2021). Awareness of terms related to sustainable healthy diets, therefore, does not necessarily translate into knowledge of those terms. While individuals may be aware of the existence of terms such as carbon footprint, environmental impact, biodiversity and greenhouse gas emissions, their understanding and knowledge of these concepts may be limited. This can be attributed to a variety of factors, including the lack of education and information on sustainable healthy diets, the complexity of the topic, and the influence of societal norms and cultural practices (Mazac et al., 2021). However, a high percentage (85.0%) knew the meaning of the term “food sustainability” and 70.0% of respondents knew the meaning of “environmental impact”, showcasing a reasonable level of awareness regarding the consequences of food choices on the environment. Knowledge about "biodiversity" was reported by 53.9% of respondents, indicating room for improvement in understanding the importance of preserving biodiversity through dietary decisions.

The study found that over 85% of adolescents knew about the term “local food”. Approximately 55.6% of respondents knew about “greenhouse gas emissions”, suggesting a reasonable understanding of the environmental impact of certain food choices. However, there is a significant lack of understanding regarding terms like "green water-blue water-grey water," "mitigation," and "resilience," with more than half of the respondents expressing unfamiliarity. The lack of knowledge on the environmental impact of food choices hinders individuals from making informed decisions about their dietary habits (Aguirre Sánchez et al., 2021a). The study emphasises the importance of addressing these knowledge gaps for a comprehensive understanding of sustainable healthy diet behaviours. Overall, 57% of respondents reported a high knowledge of sustainability terms, indicating a foundational awareness and knowledge that can be further developed to encourage more sustainable dietary practices. The study recommends targeted educational programmes to enhance awareness and understanding of specific sustainability terms, emphasising the environmental impact of food choices, and

promoting the benefits of adopting sustainable healthy diet behaviours. Studies in other regions of the world have demonstrated the effectiveness of such interventions in positively influencing individuals' dietary choices, fostering environmentally conscious behaviours and contributing to sustainable food systems (Bimbo, 2023; Johnston et al., 2014).

9.4.4 Perceived Benefits of Adopting Sustainable Diet Recommendations

The study aimed to examine the perceptions and adherence of Ghanaian adolescents in the Volta and Oti regions towards sustainable diet behaviours. The findings revealed that among the eight sustainable diet recommendations studied, more than 60% of participants perceived a high environmental benefit for four of them: "reduce food waste," "prioritize plant protein," "consume fruits and vegetables," and "purchase local food." These findings are consistent with recent studies and evidence in the field of sustainable healthy diet behaviours (Culliford & Bradbury, 2020a; Reipurth et al., 2019; Vanhonacker et al., 2013). Recent studies and evidence in the field of sustainable healthy diet behaviours support the findings of this research among Ghanaian adolescents. For example, reducing food waste is not only beneficial for the environment but also contributes to reducing greenhouse gas emissions (Food Climate Research Network, 2015; World Wildlife Fund, 2024). Another study by Aleksandrowicz et al. highlighted the environmental benefits of prioritizing plant protein, as it requires fewer land and water resources compared to animal protein (Aleksandrowicz et al., 2016). Additionally, a review by Nelson et al. showed that consuming fruits and vegetables contributes to sustainable eating patterns by reducing the environmental impact of agricultural production (Nelson et al., 2016b). Moreover, studies have consistently shown that purchasing local food reduces the carbon footprint associated with transportation and supports local economies (Edwards-Jones et al., 2008; A. J. Stein & Santini, 2022; TraceX, 2023).

Furthermore, participants perceived a high environmental benefit for two other sustainable diet recommendations: "reduce air-freighted food consumption" and "limit processed meat." These findings align with the growing body of research that emphasizes the importance of reducing air-freighted food consumption and limiting processed meat for environmental sustainability. For example, studies have demonstrated the significant environmental impact of air-freighted food, particularly in terms of greenhouse gas emissions (Food Climate Research Network, 2015; Frankowska et al., 2019; Mekonnen & Hoekstra, 2012). Other studies have highlighted the environmental benefits of reducing processed meat consumption, as it is associated with high water and land use, greenhouse gas emissions, and deforestation (Aleksandrowicz et al., 2016; Rabès et al., 2020). Overall, the findings of this research among Ghanaian adolescents are consistent with recent studies and evidence in the field of sustainable healthy diet behaviours. More specifically, the findings align with the importance of reducing food waste, prioritising plant protein, consuming fruits and vegetables, and purchasing local food for environmental sustainability (Willett et al., 2019a). In addition to the supported sustainable diet recommendations, it is important to discuss the two exceptions highlighted in the research: "choose organic produce" and "limit packaging".

The research found that less than 50% of participants perceived a high environmental benefit for these two recommendations. This suggests that there may be lower awareness or understanding among the participants regarding the environmental impact of choosing organic produce and limiting packaging (Aguirre Sánchez et al., 2021b). This low awareness or understanding of the environmental impact of these two recommendations is in line with previous findings from other studies. Consumers may have limited knowledge about the environmental impact of organic farming and may perceive organic produce as more expensive or less accessible (Smoluk-Sikorska et al., 2023). Furthermore, research by Smetana et al (Hansmann et al., 2020), highlighted that consumers may have a lack of awareness about the

environmental implications of packaging choices. In conclusion, the findings of this research among Ghanaian adolescents support the importance of several sustainable diet recommendations, including reducing food waste, prioritizing plant protein, consuming fruits and vegetables, and purchasing local food. These recommendations align with recommendations in the Ghana Food-Based Dietary Guidelines. Policy initiatives aimed at increasing the sustainability of food choices are less impactful when people do not have sufficient knowledge to understand them (Hartmann et al., 2021). There is a need for further education of adolescents on food-based dietary guidelines and sustainable diet behaviours. Overall, the research conducted among Ghanaian adolescents supports the importance of several sustainable diet recommendations for promoting environmental sustainability and can help to achieve the UN sustainable development goals.

9.4.5 Stages of Adolescent Readiness to Adoption Sustainable Diet Behaviours

The findings offer valuable insights into the stages of change for adopting sustainable diet behaviours among adolescents in the Volta and Oti regions of Ghana. For most of the sustainable diet recommendations studied, about 50% or less of participants reported being in the action or maintenance or relapse stage for various behaviours or actions. These behaviours included, avoiding excess packaging, buying local produce, limiting red and processed meat, prioritising plant proteins, reducing air-freighted food consumption, reducing food waste and choosing organic produce. These findings indicate that many adolescents have already initiated action and are maintaining those practices, even if occasional backsliding might occur. This implies that continuous support is needed to help them sustain these habits. To encourage consumer attitudes more aligned with sustainability practice interventions should focus on addressing barriers and facilitating transitions from contemplation stages towards sustained adoption among adolescents in Volta and Oti through tailored educational programmes (Prochaska & DiClemente, 1992). It is important to focus on encouraging and supporting

consumer behaviours and attitudes more aligned with sustainable dietary practices (Kenny et al., 2023). The identified stages of readiness can inform the development of targeted interventions tailored to the specific needs and motivations of adolescents in the Volta and Oti regions.

9.4.6 Factors Associated with the Readiness to Adopt Sustainable Diet Behaviours by Adolescents

The study findings show a significant association between several factors and the readiness of adolescents to adopt sustainable diet behaviours. The factors that were associated with the readiness to adopt sustainable diet behaviours included region, gender, parental status, sibling status, educational level, wealth quintiles, knowledge of sustainability, diet behaviour, perceived benefits of sustainability, food insecurity, parental role modelling, and Readiness to adopt sustainable diet behaviours (RASD).

9.4.7 Predictors of the Readiness to Adopt Sustainable Diet Behaviours

Research has shown that adopting sustainable healthy diet behaviours can lead to improved nutritional status, reduced risk of chronic diseases such as obesity and diabetes, and enhanced cognitive functioning (Agyemang et al., 2022b; Hemler & Hu, 2019). The findings of the study revealed several significant predictors of the readiness to adopt sustainable healthy diet behaviours among adolescents in the Volta and Oti regions of Ghana. Positive perception of the benefits of sustainable diet behaviours was found to be a significant predictor of the readiness to adopt sustainable healthy diet behaviours. Recent studies have also highlighted the importance of positive perception in promoting sustainable healthy diet behaviours among adolescents. Earlier research has indicated that individuals exhibit a favourable attitude toward sustainable diets, yet their daily food selections do not align with sustainable dietary principles (Rejman et al., 2019). Research conducted by Calvén et al. revealed that adolescents held

positive attitudes toward healthy eating, yet fewer than half felt that they successfully maintained a healthy diet (Calvén et al., 2023). High knowledge of sustainable food consumption was another significant predictor identified in the study among adolescents in the Volta and Oti regions. A previous study conducted by Hartmann et al. discovered that Swiss adults with higher knowledge scores were more inclined to create an environmentally friendly menu (Hartmann et al., 2021). This highlights the importance of promoting awareness and understanding of sustainable healthy diets among adolescents. Additionally, the study found that good dietary habits played a significant role in predicting the readiness to adopt sustainable healthy diet behaviours among adolescents. This implies that adolescents with healthier dietary habits were more likely to engage in sustainable food practices, such as organic food consumption and reducing food waste. Furthermore, the study found that certain demographic factors were significant predictors of the readiness to adopt sustainable healthy diet behaviours. One such factor is the occupation of the mother. The study found that adolescents whose mothers worked as office workers, professionals, or farmers were more likely to have a readiness to adopt sustainable healthy diet behaviours. Another significant predictor identified in the study was the region of residence. Adolescents residing in the Oti region were more likely to have a readiness to adopt sustainable healthy diet behaviours. This finding suggests that regional factors may play a role in shaping sustainable dietary behaviours among adolescents.

9.5 Conclusion

An increasing emphasis on sustainable development has highlighted the importance of promoting healthy and sustainable food choices among adolescents. The findings of this study provide valuable insights into the decision-making process of adolescents when it comes to sustainable healthy diet behaviours. Overall, these findings suggest a fertile ground for promoting sustainable diets among Ghanaian adolescents. By building upon their positive perceptions, addressing knowledge gaps, and providing support to overcome barriers, we can

encourage widespread adoption of sustainable dietary practices for the benefit of their health, the environment, and local communities. By adopting sustainable dietary behaviours, adolescents can contribute to mitigating climate change, reducing resource depletion, and protecting biodiversity. These insights can inform the development of tailored interventions and programs to improve adolescent food choices in favour of increased health and sustainability. The interventions can focus on improving awareness and knowledge of sustainability, dietary behaviour, and perception of the benefits of sustainability. Additionally, interventions should consider the regional differences in the adoption of sustainable diet behaviours and the influence of parental role modelling on adolescents' dietary behaviour. Sustainable healthy diets are crucial for achieving the sustainable development goals. Further research is needed to develop effective policies and interventions to promote sustainable dietary behaviours among adolescents in Ghana and other low-income settings.

9.5.1 Implications and Recommendations

- Targeted interventions: Develop educational programs tailored to address knowledge gaps and build skills for adopting sustainable practices, considering regional differences and specific needs of various family structures.
- Promote awareness of benefits: Highlight the positive impacts of sustainable diets on personal health, the environment, and local communities to motivate action.
- Empower through knowledge: Facilitate access to accurate and culturally relevant information about sustainable food systems and practical application methods.
- Leverage role models: Engage individuals and families who successfully practice sustainable diets as mentors and community champions to inspire others.
- Collaborate with stakeholders: Partner with schools, local authorities, farmers, and businesses to create supportive environments and infrastructure for sustainable food choices.

Overall, the research sheds light on the complex interplay of individual, family, and environmental factors influencing adolescents' RASD. By understanding these factors and taking a multi-pronged approach, we can cultivate a generation of young people equipped and empowered to embrace sustainable diets for a healthier future.



10.0 GENERAL DISCUSSION

10.1 Introduction

This chapter presents a general discussion of the key findings of this study. This study aimed to investigate parenting styles, food insecurity, adolescent dietary adequacy, their reaction to food advertisements, dietary behaviours, nutritional status, and readiness to adopt sustainable healthy diets. The chapter has been organised into five sections, each of which examines the results from the five preceding chapters.

Previous research has highlighted the significant transitions that occur during the adolescent-to-young-adulthood period, which are marked by changes in physical, social, and developmental contexts, as well as increased independence and autonomy (Stok et al., 2018). The present study built on this foundation, delving into the unique obstacles and opportunities present in this life stage in relation to dietary behaviour and the need to adopt sustainable healthy diet behaviours. As adolescents transition to young adulthood, they face new social and environmental contexts that shape their dietary behaviours, including living arrangements, academic or work demands, and the availability of healthful food options (Stok et al., 2018). Parenting styles, peer influences, and the evolving social and environmental contexts during this period play a critical role in shaping individual eating patterns and health trajectories (Blum et al., 2019; Stok et al., 2018). Parenting styles influence adolescent dietary behaviour during this stage of increasing autonomy (Stok et al., 2018).

10.2 Discussion of key findings

10.2.1 Adolescent food insecurity

Food insecurity, defined as limited or uncertain food availability or the inability to acquire nutritionally adequate and safe foods in socially acceptable ways, has been associated with a

range of adverse outcomes, including cognitive, emotional, and behavioural problems in children (Hatsu et al., 2022). Food insecurity is a significant global health concern, particularly in low- and middle-income countries (LMICs). According to the Food and Agriculture Organization (FAO), the situation in Ghana will deteriorate in 2022, with the proportion of the population experiencing moderate or severe food insecurity reaching 12.9 million individuals, equivalent to 39.4% of the total population (FAO, 2024b). The findings of this study indicate a significant burden of food insecurity among adolescents in the Volta and Oti regions of Ghana. These findings are similar to those of a previous study that reported that nearly three-quarters of Ghanaian adolescents faced food insecurity, with female adolescents being at a slightly higher risk than male adolescents (Masa et al., 2019).

Adolescents facing food insecurity due to resource challenges resort to undesirable eating habits and coping strategies. This finding agrees with other studies which showed that food insecure adolescents often resort to consuming foods that do not align with their preferences due to limited resources (Belachew, Lindstrom, Gebremariam, et al., 2013; Trübswasser et al., 2022b; Wiafe, Ayensu, et al., 2023). More than half (54%) of the adolescents in this study reported being unable to consume or afford the kinds of foods they preferred due to resource constraints. This leads to reliance on low-cost unhealthy food options, which can exacerbate poor dietary habits and negatively affect overall health (Dush, 2020b; Harper et al., 2022). Findings from this study show that some adolescents resort to eating undesirable foods due to resource constraints, eating smaller meal portions, or skipping meals altogether due to limited financial means or lack of food availability. In extreme cases, some adolescents reported going without food for the entire day and night because of insufficient resources. These findings are consistent with findings from other studies which show that adolescents facing food insecurity often resort to energy-dense, nutrient-poor foods (e.g., processed snacks, sweets, sugary beverages, fast foods) due to limited access to preferred nutritious options like fresh fruits and vegetables (Fram

et al., 2022; Keats et al., 2018; L. Smith et al., 2022). This may be because energy-dense foods composed of refined grains, added sugars, or fats represent the lowest cost option for consumers (Drewnowski & Specter, 2004). The findings showed a high prevalence of monotonous diets among adolescents, with more than half of them reporting limited food variety, highlighting significant concerns regarding their nutritional habits. Many adolescents also consume foods that they find socially unacceptable due to resource constraints. This limited variety often forces adolescents to consume socially unacceptable or undesirable foods owing to resource constraints, further exacerbating their nutritional challenges (Wiafe, Ayensu, et al., 2023). The shift towards a diet dominated by energy-dense, nutrient-poor foods reflects broader trends in adolescent eating behaviours, influenced by socioeconomic factors and the availability of unhealthy food options.

The results from this study showed that seasonality affects food security, with food insecurity peaking from January to March, which coincides with the lean season in Ghana, characterised by prolonged dry periods and limited agricultural productivity (Kubuga et al., 2019). During the lean season, food stocks from the previous harvest are depleted, markets become inaccessible, food prices reach their peaks, wages plummet, and income-generating avenues become limited, worsening food insecurity (Bonuedi et al., 2022; Stephanie Brunelin & Jonathan Lain, 2022; World Food Program USA, 2021). Studies have shown that during the lean season, household food budget shares decrease, indicating the challenges faced by households in allocating resources for food consumption (Addai, 2023). Additionally, micronutrient deficiencies are prevalent during this period, highlighting poor diet quality and food access concerns in northern Ghana (Kubuga & Sienso, 2024b). Research shows that households face difficulties in allocating resources to food consumption during the lean season as their food budget shares decrease (Addai, 2023). Furthermore, micronutrient deficiencies are

widespread during this period, emphasising the subpar diet quality and food access issues in northern Ghana (Kubuga & Sienso, 2024).

De Jager et al., highlighted the importance of considering seasonality in nutrition-sensitive farming in Ghana to ensure enhanced availability of vegetables and fruits throughout the year and year-round nutritious diet (de Jager et al., 2023). In sub-Saharan Africa, where many rural communities rely on rain-fed agriculture for their livelihoods, the lean season is particularly challenging. The failure of rainy seasons, such as short rains and long rains, can have devastating impacts on crop yields and agricultural productivity, leading to food shortages, seasonal variations in food availability, and high food prices (Abokyi et al., 2020; Dennis et al., 2019). The concept of seasonal food security lies between chronic and transitory food insecurity, which share characteristics with both types. While it is predictable and follows a known sequence of events, such as chronic food insecurity, it is also of limited duration and can be seen as recurrent, similar to transitory food insecurity. Seasonal food insecurity occurs due to cyclical patterns of inadequate food availability and access, which are influenced by factors such as seasonal climate fluctuations, cropping patterns, labour demand, and disease prevalence. Ensuring year-round availability of a nutrient-adequate diet requires enhanced availability of vegetables and fruits throughout the year (de Jager et al., 2023). Staple crops alone do not provide the full range of essential nutrients, but increasing their yields can free up space for the production of other nutritious foods, such as vegetables (Sienso et al., 2022).

Globally, there is widespread consensus that climate change poses a significant risk to the long-term sustainability of food security (Tay et al., 2023). In addition, the observed peaks in food insecurity during specific quarters suggest a potential link between seasonal variations and agricultural practices. Understanding these patterns can inform targeted interventions, such as implementing agricultural initiatives to enhance food production during critical periods or

developing strategies to store and preserve food during lean seasons. The seasonal nature of food insecurity underscores the need for proactive measures to address climate-related challenges and ensure the resilience of food systems to safeguard the nutritional needs of vulnerable populations.

Another key finding of this study was that nearly half of the adolescents were worried about their food insecurity status. This finding aligns with an earlier study in Ghana that linked food insecurity to increased anxiety among adolescents (Azupogo et al., 2023b; Posey et al., 2024). Other researchers have shown that food insecurity can lead to heightened anxiety and sleep problems, which in turn contributes to depression among various populations, including single parents in Ghana (Fang et al., 2021; Owusu-Sarpong et al., 2024). These findings underscore the significant psychological impact of food insecurity on adolescents and highlight the need for comprehensive interventions that address both nutritional needs and mental health support. The study further shows that urban residence, higher maternal education, and elevated economic status are correlated with reduced odds of food insecurity. These findings highlight the importance of considering regional and urban-rural differences when addressing food insecurity and implementing targeted interventions. The lower likelihood of food insecurity in urban communities than in rural areas, where individuals are often engaged in agriculture, can be attributed to several interconnected factors. Urban areas typically offer a more diverse range of economic opportunities beyond agriculture (Satterthwaite & Tacoli, 2014). People in urban settings may have access to various employment options in sectors with lucrative earnings (Porter, 2015). This economic diversity can contribute to higher income levels and, consequently, improved access to food. Rural communities often depend on seasonal agricultural activities, and vulnerability to climate-related challenges, such as droughts or floods, can impact food production (Bashir & Schilizzi, 2013; Edame et al., 2011). Urban areas with more diversified economic activities may be less susceptible to such climatic variations.

These dynamics could account for the differences in food security between urban and rural settlements.

The research suggests that higher maternal education levels are associated with lower odds of food insecurity, emphasising the importance of parental education in ensuring food security. The observed correlation between maternal education level and reduced odds of food insecurity can be interpreted within the framework of maternal empowerment and autonomy (Cunningham et al., 2015). Empowerment, stemming from educational attainment, plays a pivotal role in ensuring that adolescents receive adequate and varied nutrition (Belvedere et al., 2021; Cunningham et al., 2015). Moreover, the association between maternal education and adolescent food security is part of a broader narrative on breaking the poverty cycle (Zulu, 2013). The cumulative benefits of maternal education contribute to an environment characterised by stability and resilience against food insecurity challenges for adolescents (Chowdhury et al., 2016). While these associations are evident, it is essential to acknowledge the nuanced interplay between various contextual factors. Socioeconomic conditions, cultural dynamics, and regional peculiarities may modulate the observed relationship.

Higher socioeconomic status was associated with reduced food insecurity. This relationship underscores the importance of parental education and economic conditions in fostering adolescents' food security. Research shows that higher levels of household wealth are associated with reduced odds of food insecurity and better dietary practices, underscoring the vital role of parental economic status in achieving food security (Dwomoh et al., 2023). This correlation aligns with established theories that emphasise the critical role of economic status in shaping access to resources, including nutritionally adequate and diverse food supplies for adolescents (Esturk & Oren, 2013; Yadegari et al., 2017). The observed inverse relationship between higher wealth quintiles and reduced odds of adolescent food insecurity is indicative of

the pivotal influence of economic factors on household food security dynamics (Esturk & Oren, 2013). Individuals in higher wealth quintiles are more likely to possess greater purchasing power (Poleman & Thomas, 1995). This economic advantage translates to increased access to a diverse range of foods, ensuring that adolescents within these households have consistent access to nutritionally adequate meals. Cost-effective multi-sectoral approaches, such as subsidising healthy foods, taxing calorie-dense beverages, and advocating nutrition education, can be potential solutions for fighting food insecurity and malnutrition (Z. Khan & Ali, 2023). Additionally, removing obstacles to the delivery of wholesome foods and recognising the importance of a supply chain that considers nutrition in addressing these issues (Chesoli et al., 2023).

This study showed that living in rural areas is associated with increased odds of food insecurity, owing to factors that limit access to sufficient, affordable, and nutritious food. Other studies also indicate that food insecurity is particularly severe in rural Ghana, where livelihoods often depend on subsistence agriculture (Awoyemi et al., 2023; Kolog et al., 2023). One reason is that subsistence agriculture dominates in Ghana, and adverse weather conditions further challenge food access (Aferiba Tandoh et al., 2024b; Asaki et al., 2024). Rural areas face unique challenges, including limited access to grocery stores and higher transportation costs, leading to reliance on unhealthy food options (Aferiba Tandoh et al., 2024b; Asaki et al., 2024). Despite these findings, urban areas also experience food insecurity due to rising food prices and economic instability, indicating that food security challenges are multifaceted and affect rural and urban populations differently. The 2020 Comprehensive Food Security and Vulnerability Analysis (CFSVA) reported that food insecurity is exacerbated by adverse weather conditions and economic challenges. While urban areas may offer better access to diverse foods, they also face rising prices and economic instability which contribute to food insecurity. Many rural areas are classified as food deserts, lacking grocery stores with fresh and affordable options, which

further exacerbates this issue. Transportation barriers often hinder access to food retailers, forcing families to rely on unhealthy options. The consequences of food insecurity in rural areas are profound, leading to poor health outcomes, including higher rates of chronic diseases such as obesity and diabetes, as well as mental health issues related to the stress of food scarcity.

Studies have revealed that approximately 50% of adolescents in developing countries were already grappling with food insecurity before the onset of the COVID-19 pandemic (Yasmin et al., 2023). The pandemic has further exacerbated the situation, with adolescents from disadvantaged backgrounds, such as urban slum settings, being disproportionately affected (Yasmin et al., 2023). This survey coincided with the global COVID-19 Pandemic and the Russia-Ukraine war which disrupted economic activities and global supply chains, affecting agricultural activities and food supply, and thus worsening food insecurity and dietary diversity. Studies show that the pandemic has disproportionately affected informal urban settlers, exacerbating social inequalities and food insecurity (Joshua Boadi & Foster Julius Billah, 2024). Food prices surged because of supply chain disruptions, making essential commodities less affordable for families during the pandemic (Kawakatsu et al., 2024). Food insecurity has increased during the pandemic owing to partial lockdowns, high food prices, panic buying, limited market information, and underdeveloped food chains (CUTS International, 2020). The Russia-Ukraine war further impacted global food security, affecting nations like Ghana with higher food prices and supply chain issues and worsening existing vulnerabilities in African food systems (Lin et al., 2023; Zainab, 2023). Besides the effects of the global pandemic and fallout of the Russia-Ukraine war, the findings may also relate to the ongoing financial crisis in Ghana, characterised by marginal macro-economic growth, increasing exchange rates, and overall economic stagnation which have contributed to food and non-food inflation reaching unprecedented levels (Aidoo, 2023; Tetteh & Ntsiful, 2023). Household food and non-food expenditures are associated with household food security and dietary diversity. Hence, the spike

in fuel and food prices plausibly influenced household food security and dietary diversity negatively, especially among the middle class and poor without adequate safety nets. This may partly account for the high levels of food insecurity observed in this study.

10.2.2 Dietary Diversity and Associated Factors among Adolescents

This section describes the dietary diversity, adequacy, patterns, and factors influencing dietary diversity among adolescents in the Volta and Oti regions of Ghana. Dietary diversity provides information about the rate at which people eat from different food groups. Maintaining a balanced and diverse diet is crucial for overall health and well-being. Dietary diversity not only ensures sufficient intake of essential nutrients but also supports resilience against future health risks (Dannenberg et al., 2024). Nutritionists have long recognised the importance of dietary diversity, particularly in children, as it is a key element of a high-quality diet and is significantly associated with improved growth and development (Yazew, 2020). Three main dietary patterns were identified: energy-dense starchy carbohydrates, cereals, roots, and tubers; calorie-dense beverages, alcohols, spreads, and toppings; and nutrient-dense foods, animal source foods, fruits, and vegetables. Three distinct dietary patterns emerge among adolescents in the Volta and Oti regions of Ghana: a traditional/staple food pattern, a "treat"/indulgent pattern, and a balanced/varied pattern. These dietary patterns suggest that adolescents in the Volta and Oti regions of Ghana have varying degrees of reliance on traditional staple, indulgent, and nutrient-dense foods, highlighting the need for targeted interventions to promote balanced and healthy eating habits. The study also revealed a heavy reliance on energy-dense foods, particularly starchy staples, including grains and tubers, among adolescents in the Volta and Oti regions of Ghana. This outcome is similar to reports by other researchers which show a heavy reliance on energy-dense staple foods among adolescents in Ghana (Abizari & Ali, 2019a; Gyimah et al., 2021b; Ogum Alangea et al., 2018; Wiafe, Apprey, et al., 2023b). Excessive consumption of energy-dense starchy staples has also been reported among adolescents in other countries,

including Uganda (Isabirye et al., 2020b) and Ethiopia (Abebe et al., 2023b). The overreliance on energy-dense foods raises concerns about the nutritional adequacy of the diets of adolescents, as highlighted by the prevalence of anaemia among both boarding and day students (Asare et al., 2024).

The consumption of fruits and vegetables, animal-source foods, fresh or dried fish or shellfish products, dairy products, and eggs was extremely low. The consumption of plant protein sources, such as beans, peas, lentils, and nuts, was also high. The high intake of plant proteins may compensate for the low intake of animal-source foods. Plant-based proteins can serve as partial substitutes for animal-source foods; however, certain factors must be considered. Plant-based proteins, such as soy and bean proteins, have lower anabolic properties than animal-source proteins owing to differences in digestion, amino acid absorption rates, and amino acid composition (Pinckaers et al., 2021). However, consuming a larger amount of plant-based proteins or using specific blends of plant-based proteins can compensate for the lower quality (Päivärinta et al., 2020). Replacing animal proteins with plant proteins could lead to improvements in dietary fat quality, increased fibre intake, and better blood lipoprotein profiles (Ferrari et al., 2022). Plant protein sources have been linked to better overall health outcomes, particularly in relation to cardiovascular health, and have a lower environmental impact than animal sources (Ferrari et al., 2022; Haghighatdoost et al., 2023). Individuals who consume plant-based diets typically have lower body weights, lower cholesterol levels, and a lower risk of developing diabetes, stroke, cancer, and heart disease than those who consume meat (Sriram, 2023). Additionally, plant-based foods offer several advantages, such as being more easily and efficiently produced, stored, transported, and consumed than animal-source foods (Sriram, 2023). Nevertheless, it is important to ensure adequate intake and status of certain micronutrients, such as vitamin B-12 and iodine, when replacing animal proteins with plant proteins (Pellinen et al., 2022). Encouraging the increased consumption of plant-based foods

and reduced consumption of animal-based foods is recommended for healthy diets and sustainable food production (Langyan et al., 2022; Päivärinta et al., 2020).

In summary, the dietary habits of adolescents in the Volta and Oti regions of Ghana are characterised by a high consumption of energy-dense staple foods and low consumption of animal-source foods, fruits, and vegetables. A traditional/staple food pattern, coupled with a significant "treat"/ "indulgent" pattern, highlights the need for targeted interventions to promote balanced and healthy eating habits. The study found that sex, residence, age, nutritional knowledge, household size, and maternal education level are significant predictors of dietary adequacy. Urban adolescents, middle adolescents, and those with higher nutritional knowledge living in larger households have higher odds of adequate dietary diversity. Conversely, permissive household environments, preference for unhealthy foods, lack of cooking skills, and lower maternal education levels were negatively associated with dietary adequacy. These insights can inform the development of effective interventions to improve the dietary habits and health outcomes of adolescents in these regions.

10.2.3 Adolescents' perception of fast-food and sugar-sweetened beverage advertisements

Adolescents are highly susceptible to food marketing, which significantly affects their preferences and consumption patterns. The findings from this study show a direct link between exposure to HFSS food advertisements and adolescent preference for these foods. The majority of adolescents expressed preferences across six of the eight measures for noodle advertisements and across seven of the eight measures for SSB advertisements. Adolescents who are exposed to advertising for unhealthy foods and beverages are more likely to show a high desire and intention to consume advertised foods (Tsochantaridou et al., 2023c). This influence is especially concerning because young people are more vulnerable to the effects of

marketing owing to their limited cognitive and executive skills (A. S. Khan et al., 2023). Similar findings have been reported among 11-19-year-old adolescents in the UK (Critchlow et al., 2020). Other studies have shown that the exposure of children and young people to HFSS advertisements is likely to contribute to HFSS food consumption (Alfayad et al., 2022). Food marketing involves the use of numerous persuasive techniques to influence children's food attitudes, preferences, and consumption (Amore et al., 2019) and has been shown to negatively impact children's food knowledge, preferences, consumption, diet quality, and health (R. Smith et al., 2019b). Additional evidence shows that unhealthy food and beverage marketing through media popular with children strongly influences consumer behaviour and significantly impacts different diet-related outcomes (Amore et al., 2019; Mc Carthy et al., 2022; Mendes Lübeck et al., 2021). The marketing of unhealthy foods is a significant contributor to childhood obesity and chronic diseases (Amore et al., 2019; Dixon et al., 2018). Marketing plays a significant role in framing unhealthy foods with appealing imagery and branding while downplaying their poor nutritional content (Ertz & Le Bouhart, 2022). The impact of food marketing on adolescents is complex and far-reaching, extending beyond the straightforward cause-and-effect relationship between exposure and consumption (Critchlow et al., 2020). There is a need to promote advertising literacy among adolescents to enhance their critical thinking skills and empower responsible engagement with commercial messages (López-Martínez et al., 2024). The WHO underscores the detrimental impact of food marketing on children's health and eating behaviours, advocating for stronger policies to protect them from harmful marketing techniques such as the use of cartoons and celebrity endorsements (Paglia, 2023).

The WHO recommends various policy interventions, including fiscal measures such as sin taxes, sugar taxes, and fat taxes (WHO, 2022a, 2023a). These taxes aim to reduce the consumption of unhealthy foods and beverages by increasing their prices, thereby discouraging their purchase and consumption (Ribeiro et al., 2018). Ghana has taken a step towards

addressing this issue by passing a law to regulate food marketing (A. Laar et al., 2023; Rampalli et al., 2021). The potential effectiveness of these fiscal measures has been examined in several contexts. Studies have shown that small excise taxes are likely to generate substantial revenue but may have a limited impact on obesity rates (Franck et al., 2013). However, higher taxes have been found to have a more direct effect on weight in at-risk populations, although they may face greater political and public resistance (Franck et al., 2013). The implementation of these measures in Ghana is a subject of particular interest, as the country has recently passed legislation to regulate the marketing of unhealthy foods, particularly for children (Chambers et al., 2015; A. Laar et al., 2023; Rampalli et al., 2021). However, the feasibility and potential impact of fiscal measures in Ghana remain unclear (Rampalli et al., 2021). Policy measures, such as limiting the promotion of unhealthy foods in environments frequented by young people, are essential for safeguarding adolescents from such practices (Amevinya et al., 2022a). It is also important to promote media literacy among adolescents. Furthermore, there is a need for research on strategies to mitigate the negative impact of target marketing on youth (Grier, 2023).

10.2.4 Barriers and enablers to healthy dietary behaviours among adolescents

Parental involvement and the home food environment are key determinants of adolescents' dietary behaviour, with those living with single or dual parents more likely to exhibit healthier eating habits compared to those without parental support. Intiful et al. observed that active parental engagement in meal planning and preparation fosters healthier dietary choices among adolescents, promoting a balanced diet and reducing the likelihood of unhealthy eating behaviours (Intiful et al., 2023). Similarly, Sambu et al. emphasised that parental modelling of healthy eating practices directly correlates with adolescents' food preferences and consumption patterns, suggesting that adolescents are likely to adopt the dietary habits exhibited by their parents (Sambu et al., 2024b). Furthermore, Abubakar et al. found that communication about

nutrition within families enhances adolescents' understanding of healthy eating, thereby encouraging better food choices (Abubakar et al., 2023b). However, Agaba et al. note that socioeconomic factors can limit parental involvement, potentially undermining these positive influences on adolescents' eating habits (Agaba et al., 2022). Overall, these findings underscore the critical role of parental involvement in shaping the dietary behaviours of adolescents in Ghana, while also acknowledging the challenges posed by socioeconomic constraints.

Having an authoritative parent was associated with healthy diet behaviours. Authoritative parenting has been shown to positively influence healthy eating habits (Berge et al., 2014; Gouveia et al., 2019). In contrast, authoritarian and neglectful styles are associated with a greater likelihood of adolescents developing unhealthy dietary behaviour (Berge et al., 2014; Gouveia et al., 2019; Krug et al., 2016; Robertson, 2020). Parenting styles, parental role modelling, and involvement play a crucial role in shaping the dietary behaviours and habits of children and adolescents, including their consumption of fruits and vegetables (Draxten et al., 2014b; Webber & Loescher, 2013). Authoritative parenting has been identified as a protective factor against malnutrition (Burke et al., 2019b). In contrast, authoritarian and permissive parenting styles have been linked to unhealthy eating habits (Burke et al., 2019b).

The findings show that parents who model healthy eating behaviours and provide nutritious meals create an environment that encourages similar habits in their children. Parenting style had a significant impact on adolescents' dietary choices. Active parental engagement and support in dietary practices can promote healthier eating habits among adolescents. Ardakani et al. reported that parental involvement in meal preparation and availability of healthy food options at home are positively correlated with children's dietary choices (Ardakani et al., 2024b). Similarly, Rathi et al. emphasise that adolescents are more inclined to consume fruits and vegetables when their parents actively engage in healthy eating behaviours (Rathi et al.,

2024). Furthermore, Hammad and Kay note that parental attitudes towards food can create a supportive environment that fosters healthy eating habits in adolescents (Hammad & Kay, 2023). However, Arayess et al. caution that while parental influence is significant, other factors, such as peer pressure and media exposure, also play a role in adolescent dietary choices (Arayess et al., 2023). The findings reveal that adolescents whose fathers are farmers tend to have healthier dietary behaviours compared to those whose fathers are artisans. This could be attributed to better access to fresh produce and greater emphasis on agricultural practices that promote healthy eating. These findings underscore the importance of comprehensive strategies involving parents, schools, and communities to promote healthy eating among adolescents. Interventions should focus on enhancing nutrition education, supporting families, and creating environments that facilitate access to healthy food. By addressing these factors, public health initiatives can help improve the dietary practices and overall health outcomes of adolescents in Ghana.

10.2.5 Adolescent nutritional status

This study examined weight status and stunting among adolescents and associated factors. Several factors are associated with the weight status of adolescents in the Volta and Oti regions of Ghana, including parental status, educational levels, and wealth quintiles. Notably, adolescents with higher educational attainment had increased odds of being overweight, suggesting a complex relationship between education and health outcomes. Interestingly, adolescents with high nutritional knowledge are reported to have a twofold higher likelihood of being overweight, indicating that knowledge alone does not necessarily translate to healthier eating behaviours (Sambu et al., 2024c). Additionally, maternal factors such as educational and occupational status significantly influence adolescent BMI, with educated mothers often promoting healthier lifestyles (Sambu et al., 2024c). Additionally, adolescents whose mothers had higher educational levels were more likely to be overweight, suggesting a potential link

between maternal education and lifestyle choices that may contribute to weight gain (Dang et al., 2024). Some studies have shown a high prevalence of obesity among the middle class (Dieteren & Bonfrer, 2020) and educated women in LMICs (Tang et al., 2019). Wealthier adolescents, particularly those in higher wealth quintiles, exhibit a greater likelihood of becoming overweight, which may reflect access to calorie-dense foods (Duskin et al., 2024). Wealth quintiles also play a critical role, as higher socioeconomic status is linked to better access to nutritious food and health resources, which can mitigate the risk of obesity (Amponsem-Boateng et al., 2024). Additionally, those with fathers employed as farmers also show increased odds of being overweight, possibly because of the dietary patterns associated with agricultural lifestyles (Jain et al., 2024b).

Authoritative and authoritarian parenting styles were associated with lower odds of children becoming overweight. Authoritative parenting, characterised by warmth and structure, promotes healthy lifestyle choices and self-regulation in children and can lead to better weight management outcomes (Adha, 2023). Conversely, authoritarian parenting, which emphasises strict discipline and obedience, may also contribute to lower obesity rates by limiting children's access to unhealthy foods and encouraging physical activity through structured routines (Tane et al., 2023). However, it is essential to consider cultural contexts, as parenting styles may have different implications in diverse environments. For instance, while these styles may be protective against obesity, they could also lead to negative psychological outcomes, such as anxiety or rebellion in children, which warrants further investigation (V. O.- Brako, 2022; Hanif, 2023). Conversely, food insecurity was associated with lower odds of being overweight, highlighting a complex relationship between food access and weight status. Overall, the evidence suggests a complex relationship between parenting style and childhood obesity, highlighting the need for culturally sensitive approaches to address this public health issue. These findings highlight the multifaceted nature of BMI determinants, emphasising the need

for targeted interventions that consider educational and socioeconomic contexts to address adolescent obesity in Ghana.

In the case of stunting, various socioeconomic and demographic factors were significantly associated with height-for-age among adolescents in Ghana. Food insecurity is a critical determinant of stunted growth. Parental status, educational level, and occupation, particularly of mothers, were associated with children's nutritional outcomes. For instance, higher maternal education correlates with improved dietary behaviours and nutritional knowledge, which in turn positively affect children's growth metrics (Nsiah-Asamoah et al., 2022). Additionally, wealth quintiles and food security status are strongly linked to height-for-age, with food insecurity being a prevalent issue that exacerbates stunting among children (Atosona et al., 2024; Okyere et al., 2022). Parenting styles also play a role, as supportive and informed parenting can mitigate the adverse effects of socioeconomic disadvantages (Okyere et al., 2022). Food insecurity was significantly linked to stunted growth among adolescents in the Volta and Oti regions. Inadequate access to nutritious food exacerbates this issue (Tamir et al., 2024). Parenting styles also play a crucial role; both authoritative and authoritarian styles are associated with increased odds of stunting, suggesting that family dynamics influence nutritional outcomes (Addae et al., 2024). Geographically, urban adolescents exhibit lower rates of stunting than their rural counterparts, likely because they have better access to resources (Putra et al., 2023). Educational attainment is another critical factor: adolescents with higher educational levels, as well as those whose mothers possess higher education, show reduced odds of stunting (Baffour et al., 2023). Additionally, adolescents from wealthier households and those with fathers engaged in farming are less likely to experience stunting, highlighting the importance of socioeconomic status (Ahmed et al., 2023). Finally, possessing moderate to high nutritional knowledge correlates with lower stunting rates, emphasising the need for nutrition education (Tamir et al., 2024). Overall, these findings underscore the multifaceted nature of stunted

growth influenced by food security, education, socioeconomic factors, and parenting styles. The findings of this study are consistent with those of recent studies that have shown that malnutrition is a major public health problem among adolescents in low- and middle-income countries (Steyn & Nel, 2022).

These findings suggest a strong link between food insecurity and stunting. The association between food insecurity and stunting is well established (Gassara & Chen, 2021; Humphries et al., 2015; Patriota et al., 2024). Limited access to diverse and nutritious foods hinders optimal growth and development, particularly during adolescence, a crucial period for physical and cognitive maturation (Lassi et al., 2017c). Findings on the protective role of higher education, wealth, and urban residence resonate with established patterns (Kalinda et al., 2024; Ndagijimana et al., 2022; Niragire et al., 2022). These factors generally translate into better access to quality food, healthcare, sanitation, and information, ultimately contributing to improved nutritional outcomes. Higher parental and adolescent educational attainment are consistently linked to better nutritional outcomes (Makate & Nyamuranga, 2023; Mulubrhan et al., 2017). Education enhances knowledge of health and nutrition practices. Adolescents in the third and fourth wealth quintiles had lower odds of stunted growth than those in the first wealth quintile. Socioeconomic status is a well-established determinant of stunting, with higher wealth quintiles often associated with improved living conditions, access to healthcare, and dietary diversity (Nisbett et al., 2023). Urban adolescents were 48% less likely to be stunted than rural adolescents. Urbanisation is often associated with improved access to healthcare, sanitation, and nutrition, contributing to better child growth outcomes (Akombi et al., 2017b). Adolescents with moderate and high nutritional knowledge, as well as good dietary behaviour, had lower odds of stunting. Nutritional knowledge and dietary practices play crucial roles in preventing stunting. Adequate knowledge ensures appropriate food choices and feeding practices (A Annan et al., 2021).

10.2.6 Perceived benefits of adopting sustainable diet recommendations

This study aimed to examine the perceptions and adherence of Ghanaian adolescents in the Volta and Oti regions towards sustainable diet behaviours. The findings revealed that among the eight sustainable diet recommendations studied, more than 60% of participants perceived a high environmental benefit for four of them: "reduce food waste," "prioritize plant protein," "consume fruits and vegetables," and "purchase local food." These findings are consistent with recent studies and evidence in the field of sustainable healthy diet behaviours (Culliford & Bradbury, 2020a; Reipurth et al., 2019; Vanhonacker et al., 2013). Recent studies and evidence in the field of sustainable healthy diet behaviours support the findings of this research among Ghanaian adolescents. For example, reducing food waste is not only beneficial for the environment but also contributes to reducing greenhouse gas emissions (Food Climate Research Network, 2015; World Wildlife Fund, 2024). Another study by Aleksandrowicz et al. highlighted the environmental benefits of prioritising plant protein, as it requires fewer land and water resources than animal protein (Aleksandrowicz et al., 2016). Additionally, the consumption of fruits and vegetables contributes to sustainable eating patterns by reducing the environmental impact of agricultural production (Nelson et al., 2016b). Moreover, studies have consistently shown that purchasing local food reduces the carbon footprint associated with transportation and supports local economies (Edwards-Jones et al., 2008; A. J. Stein & Santini, 2022; TraceX, 2023). Furthermore, the study also found that more than 50% of participants perceived a high environmental benefit for two other sustainable diet recommendations: "reduce air-freighted food consumption" and "limit processed meat."

These findings align with the growing body of research emphasising the importance of reducing air-freighted food consumption and limiting processed meat consumption for environmental sustainability. For example, studies have demonstrated the significant environmental impact of air-freighted food, particularly in terms of greenhouse gas emissions (Food Climate Research

Network, 2015; Frankowska et al., 2019; Mekonnen & Hoekstra, 2012). Other studies have highlighted the environmental benefits of reducing processed meat consumption, as it is associated with high water and land use, greenhouse gas emissions, and deforestation (Aleksandrowicz et al., 2016; Rabès et al., 2020). Overall, the findings of this research among Ghanaian adolescents are consistent with recent studies and evidence in the field of sustainable healthy diet behaviours. More specifically, the findings align with the importance of reducing food waste, prioritising plant protein, consuming fruits and vegetables, and purchasing local food for environmental sustainability (Willett et al., 2019a). In addition to the supported sustainable diet recommendations, it is important to discuss the two exceptions highlighted in the research: "choose organic produce" and "limit packaging". The study found that less than 50% of participants perceived a high environmental benefit from these two recommendations. This suggests that there may be lower awareness or understanding among participants regarding the environmental impact of choosing organic produce and limiting packaging (Aguirre Sánchez et al., 2021b). The low awareness or understanding of the environmental impact of these two recommendations is in line with previous findings. Consumers may have limited knowledge of the environmental impact of organic farming and may perceive organic produce as more expensive or less accessible (Smoluk-Sikorska et al., 2023).

Furthermore, research by Smetana et al (Hansmann et al., 2020), highlighted that consumers may lack awareness about the environmental implications of packaging choices. In conclusion, the findings of this study among Ghanaian adolescents support the importance of several sustainable diet recommendations, including reducing food waste, prioritising plant protein, consuming fruits and vegetables, and purchasing local food. These recommendations align with the recommendations in the Ghana Food-Based Dietary Guidelines. Policy initiatives aimed at increasing the sustainability of food choices are less impactful when people lack sufficient knowledge to understand them (Hartmann et al., 2021). There is a need for further education

of adolescents on food-based dietary guidelines and sustainable diet behaviours. Overall, the research conducted among Ghanaian adolescents supports the importance of several sustainable diet recommendations for promoting environmental sustainability and can help achieve UN sustainable development goals.

Adopting environmentally sustainable and healthy eating habits is crucial for achieving the United Nations' Sustainable Development Goals, which aim to ensure a sustainable future (Raghoobar et al., 2024; Willett et al., 2019b). The importance of establishing sustainable and healthy eating habits from an early age cannot be overstated, as dietary patterns formed early in life shape current and future food choices, thereby setting the stage for lifelong dietary patterns (Appannah et al., 2021; Raghoobar et al., 2024).

This finding is consistent with broader research indicating that awareness and understanding of sustainability can significantly influence dietary behaviours. This finding emphasises the importance of promoting positive perceptions of sustainability to foster sustainable eating habits among Ghanaian adolescents, considering local cultural and contextual factors (Hashim et al., 2023; Naatu et al., 2024). Targeted educational interventions are needed to enhance positive perceptions and encourage widespread adoption of sustainable dietary behaviours. Contrary to previous research, this study found no significant association between parental presence, parenting styles, and role-modelling of healthy eating behaviours with adolescents' readiness to adopt sustainable dietary practices (Mahmood et al., 2021b). It is possible that in the context of sustainable diets, other factors such as environmental awareness and personal values play a more critical role in shaping adolescents' dietary behaviours in Ghana. This suggests that parenting styles and parental role modelling of healthy eating behaviours do not significantly predict adolescents' readiness to embrace sustainable diets (M. Brako et al., 2024). This finding contrasts with previous research that emphasises the importance of parental

influence on adolescents' eating habits (R. A. Annan et al., 2024; Sambu et al., 2024d) and raises questions about the effectiveness of parental influence on adolescent dietary choices. This finding underscores the need for targeted interventions that support adolescents from diverse family backgrounds in making sustainable food choices. The findings also showed that fostering knowledge and healthy dietary practices is crucial for promoting sustainability among adolescents in Ghana's Volta and Oti regions. Educational interventions targeting these factors can significantly influence sustainable dietary behaviour adoption. However, further research is needed to explore the underlying mechanisms, potential barriers, and relative importance of additional factors, such as environmental awareness and personal values, in shaping adolescents' food choices (Sambu et al., 2024d).

10.3 Implications and Recommendations

- The Ghana Health Service (GHS), through its regional and district structures, is crucial for both prevention and clinical management.
 - Integrate Screening and Counselling:
 - Action: Mandate the routine screening of all adolescents (10-19 years) during school visits, immunization campaigns, and clinic attendance (including weighing and height measurement to calculate Body Mass Index - BMI).
 - Action: Train Community Health Nurses (CHNs) and clinic staff in both regions to provide culturally sensitive, non-judgmental nutrition and physical activity counselling tailored to the local availability of resources and foods.
 - Establish Referral Pathways:
 - Action: Develop clear referral protocols between school health coordinators (GES) and GHS clinics/dietitians for adolescents identified

as high-risk or obese, ensuring access to specialized care without incurring prohibitive travel costs.

- Capacity Building for Management:

Action: Provide specialized training and resources to district hospitals to manage obesity-related comorbidities (e.g., pre-diabetes, hypertension) in adolescents, moving beyond primary prevention to clinical management.

- Schools are the primary environment for reaching adolescents and influencing behaviour. The GES must lead the institutionalization of healthy practices.

- Enforce School Feeding and Canteen Guidelines:

- Action: Strict and regular monitoring by the GES Inspectorate to ensure school canteens and vendors within and near school premises eliminate the sale of high-sugar, high-fat processed snacks and Sugar-Sweetened Beverages (SSBs).

- Action: Promote the inclusion of local, nutritious foods (e.g., boiled yam/plantain, vegetables) in the Ghana School Feeding Programme menu within the Volta and Oti regions.

- Strengthen Health and Physical Education (PE):

- Action: Integrate mandatory, practical nutrition education into the core curriculum, using modules that emphasize healthy local food preparation, understanding food labels, and the importance of reducing sedentary time.

- Action: Increase the frequency and quality of Physical Education (PE) classes and encourage organized, after-school sports and traditional games, leveraging the cultural value of communal activities.

- Adopt Whole-School Approach:
 - Action: Implement the "Nutrition Friendly Schools" concept across all basic and second-cycle institutions, ensuring the school environment, policies, and curriculum are consistent in promoting healthy eating and physical activity.
- Regional Coordinating Councils (RCCs) and Metropolitan/Municipal/District Assemblies (MMDAs) are essential for creating supportive physical and economic environments.
 - Regulate Local Food Environments:
 - Action: Utilize MMDA bye-laws and zoning regulations to control the location of fast-food outlets and excessive advertising of unhealthy foods around schools and residential areas.
 - Action: Invest in safe, accessible public spaces (parks, community centers, sports fields) to facilitate physical activity, particularly in high-density urban areas like Ho or emerging administrative centers in Oti.
 - Support Local Food Systems:
 - Action: Implement economic initiatives to subsidize or incentivize local farmers in Oti and Volta to produce and distribute a diverse range of fruits, vegetables, and lean protein sources, making them more affordable and accessible than processed options.

Overall, this research sheds light on the complex interplay of individual, family, and environmental factors influencing adolescents' RASD. By understanding these factors and adopting a multi-pronged approach, we can cultivate a generation of young people equipped and empowered to embrace sustainable diets for a healthier future.

10.4 General Conclusions

Based on the findings and discussions in this thesis, the following conclusions were drawn:

1. Food insecurity is pervasive among adolescents in the Volta and Oti regions of Ghana, with 61% experiencing food insecurity and 23.5% facing severe food insecurity.
2. Food insecurity contributes to poor dietary quality, unhealthy eating habits, and adverse effects on physical and mental health.
3. Urban-rural disparities, maternal education, and socioeconomic disparities significantly impacted food insecurity among adolescents.
4. Adolescents in the Volta and Oti regions predominantly consume energy-dense staple foods and sugar-sweetened beverages, with limited intake of nutrient-rich foods such as fruits, vegetables, and animal-source foods.
5. Gender, residence, age, nutritional knowledge, household size, and maternal education level predicted dietary adequacy among adolescents.
6. Parental involvement, nutritional knowledge, and socioeconomic factors are critical factors shaping adolescents' dietary choices.
7. Fast-food and sugar-sweetened beverage advertisements significantly influenced adolescents' dietary choices, with urban, male, and younger adolescents being more susceptible.
8. Adolescents with higher nutritional knowledge are more likely to react positively to fast-food advertisements, highlighting the need for critical thinking skills and media literacy.
9. Fiscal measures such as sin taxes have the potential to reduce unhealthy food consumption but require careful consideration in Ghana.
10. Effective regulation of food marketing, combined with education and critical thinking skills, is crucial for protecting adolescent health.

11. Parental involvement, nutritional knowledge, and economic stability shape adolescents' dietary choices.
12. Socioeconomic factors significantly impact adolescents' access to healthy foods and nutritional knowledge.
13. There is a concerning nutritional landscape among adolescents in Ghana, with a staggering 39.3% affected by stunting, 32.1% struggling with overweight or obesity, and most alarmingly, 22.2% of adolescents face the dual burden of malnutrition.
14. Adolescents' dietary choices are heavily influenced by fast food and sugar-sweetened beverage advertisements, with urban, male, and younger adolescents being particularly susceptible.
15. Parenting styles and the home food environment play crucial roles in shaping adolescent dietary behaviours and nutritional status, highlighting the need for family centred interventions.
16. Promoting sustainable healthy diets among adolescents is essential for improving public health outcomes and achieving broader environmental and sustainability goals.
17. Adopting sustainable and healthy eating habits from an early age is crucial for achieving the United Nations Sustainable Development Goals and ensuring a sustainable future.



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APPENDICES

Appendix 1: Consent Form For Caregiver/Parent Of Adolescent

Title: Drivers of healthy lifestyle behaviour among adolescents in the Volta and Oti Regions of Ghana

Principal Investigator: Norbert Ndaah Amuna

Address: Department of Population, Family and Reproductive Health, University of Ghana, School of Public Health. P. O. Box LG 13. Legon, Accra.

General Information about Research

This consent form is a request for your participation in a research study by Norbert Amuna, a PhD candidate at the School of Public Health, University of Ghana. You will be asked to complete a questionnaire or participate in an interview about adolescent unhealthy lifestyles.

Unhealthy lifestyle behaviours, including poor diets, poor hygiene and physical inactivity behaviours constitute a considerable global public health burden and one of the greatest challenges of the 21st Century. Adolescent poor diet quality, including consumption of energy-dense foods as well as inadequate physical activity can contribute to an increased risk of obesity. It also sets the stage for the onset of chronic diseases like diabetes, hypertension and other heart diseases. We currently do not know the extent of the problem here in the Volta and Oti regions. We also do not have full understanding of the factors that contribute to unhealthy diets and physical inactivity among adolescents in the Volta and Oti regions. This is a community-based study involving adolescents aged 10 – 19 years and their parents. This study seeks to find out about what adolescents are eating, their physical activity levels and to identify the factors that may contribute to this problem. It is hoped that knowledge gained from this study will help us devise more appropriate ways to help adolescents eat healthily and have healthy body weight.

If you agree to participate in this study, we will book an appointment with you and meet you at a community location of your choice. On the day of the study we will ask you some questions about your adolescent and your household. We will also ask questions regarding the food environment in your home. Lastly, we will take your weight and height measurements and compare it with that of your adolescent. Your participation in this study will just be for one day (Less than one and a half hours).

Possible Risks and Discomforts: There are no foreseeable risks associated with participation in this study. Snacks will also be given to make up for time used in participating in the study, periodic breaks will also be given.

Possible Benefits: Your participation in this study together with your ward will enable us gather enough information to better understand the factors that contribute to unhealthy lifestyles among adolescents and how we can develop better approaches to prevent it and its related diseases.

Confidentiality: All information collected from you and your child will be kept in strict confidence and be used for research purposes only. Subjects will not be identified by name during data entry> Only study investigators will have access to your information. However, staff of the Institutional Review Board of the University of Ghana may request to look at your research records. Your identity will not be disclosed in any publication.

Compensation: You will receive a copy and interpretation of your body measurements at the end of the study. There will be no other compensation for participation.

Additional Cost: There is no cost to you for participating in this study.

Voluntary Participation and Right to Leave the Research: Participation in this study is completely voluntary. You may withdraw from or leave the study at any point in time without any penalty

Contacts for Additional Information

In case you have further questions regarding this study, please direct them to Norbert Amuna on telephone number 0545069977. You may also call Prof. Richmond Aryeetey on 0261128506 when necessary.

Your rights as a Participant

This research has been reviewed and approved by the Institutional Review Board of Noguchi Memorial Institute for Medical Research (NMIMR-IRB). If you have any questions about your rights as a research participant you can contact the IRB Office between the hours of 8am-5pm through the landline 0302916438 or email addresses: nirb@noguchi.ug.edu.gh





VOLUNTEER AGREEMENT

The above document describing the benefits, risks and procedures for the research title (**Drivers of healthy lifestyle behaviour among adolescents in the Volta and Oti Regions of Ghana**) has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree to participate as a volunteer.

Date

Name and signature or mark of volunteer

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

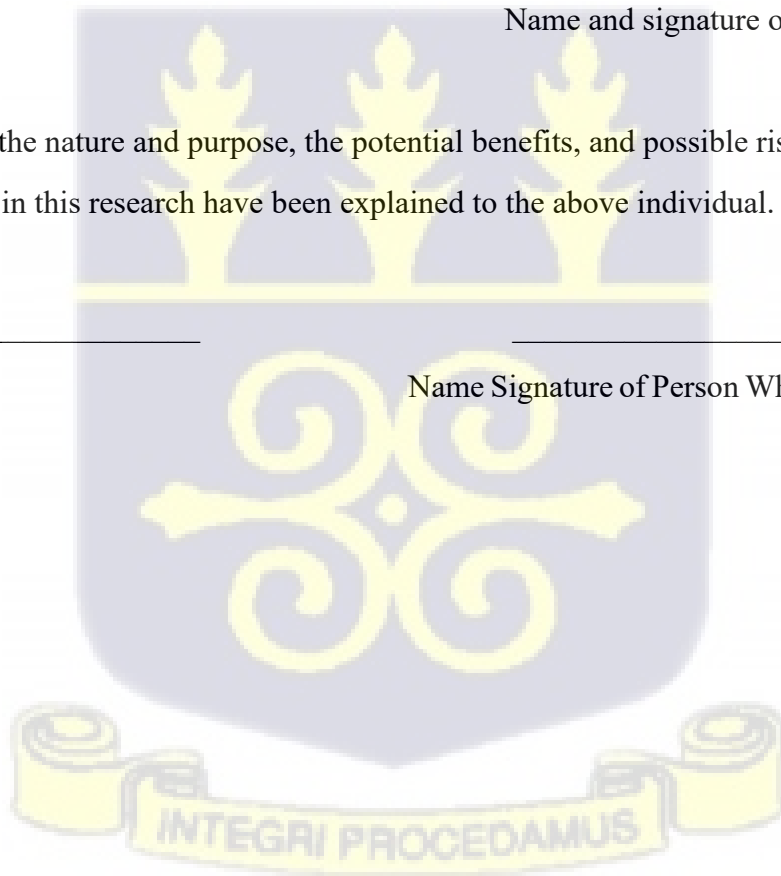
Date

Name and signature of witness

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

Date

Name Signature of Person Who Obtained Consent



Appendix 2: Child Assent Form

TITLE: Drivers of healthy lifestyle behaviour among adolescents in the Volta and Oti Regions of Ghana.

Introduction

My name is Norbert Ndaah Amuna and I am from the Department for Population, Family and Reproductive Health at the University of Ghana, School of Public Health. I am conducting a research study entitled **Drivers of healthy lifestyle behaviour among adolescents in the Volta and Oti Regions of Ghana.**

I am asking you to take part in this research study because I am trying to learn more about the things that contribute to unhealthy lifestyles among adolescents (10-19 year olds). Unhealthy lifestyles among adolescents is a problem in most parts of the world including Ghana. We want to find ways to prevent it because it can lead to some future health problems, especially in adulthood. Your participation in this study will last for only one day.

General Information

This consent form is a request for your participation in a research study by Norbert Amuna, a PhD candidate at the School of Public Health, University of Ghana. If you agree to participate in the study, you will be asked to complete a questionnaire or participate in an interview about adolescent unhealthy lifestyles. You will be asked to give some information about you and your household, your eating habits, the foods and drinks you have taken over the past 7 days, your physical activity and how often you do certain things like watching television or playing video games. We will measure your height and let you stand on a weighing scale to measure your weight. The body measurements and answering of questions will take place in your school or community.

Possible Benefits

Your participation in this study will give us more information to help us understand some of the things that contribute to unhealthy lifestyles among adolescents and how best we can prevent this. The results of your measurements will be given to you to take home and share with your parents. You will also be given an exercise book and a pen for participating in this study.

Possible Risks and Discomforts

There are no risks to you for participating in this study. You will also not miss any class, class test or examination or work when participating in this study.

Voluntary Participation and Right to Leave the Research

You can stop participating at any time if you feel uncomfortable. No one will be angry with you if you do not want to participate.

Confidentiality

Your information will be kept confidential. No one will be able to know how you responded to the questions and your information will be anonymous.

Contacts for Additional Information

You may ask me any questions about this study. You can call me at any time on 0545069977 or talk to me the next time you see me.

Please talk about this study with your parents before you decide whether or not to participate. I will also ask permission from your parents before you are enrolled into the study. Even if your parents say yes, you can still decide not to participate.



VOLUNTARY AGREEMENT

By making a mark or thumb printing below, it means that you understand and know the issues concerning this research study. If you do not want to participate in this study, please do not sign this assent form. You and your parents will be given a copy of this form after you have signed it.

This assent form which describes the benefits, risks and procedures for the research titled, “Drivers of healthy lifestyle behaviour among adolescents in the Volta and Oti Regions of Ghana” has been read and or explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree to participate.

Child’s Name: Researcher’s
Name:.....

Child’s Mark/Thumbprint.....Researcher’s
Signature:.....

Date: Date:



Appendix 3: Parental Consent Form – For Child Participation

Title: Drivers of healthy lifestyle behaviour among adolescents in the Volta and Oti Regions of Ghana

Principal Investigator: Norbert Ndaah Amuna

Address: Department of Population, Family and Reproductive Health, University of Ghana, School of Public Health. P. O. Box LG 13. Legon, Accra.

General Information about Research

Your child has been selected to participate in an adolescent dietary and physical activity study. Unhealthy lifestyle behaviours, including poor diets, poor hygiene and physical inactivity behaviours constitute a considerable global public health burden and one of the greatest challenges of the 21st Century. Adolescent poor diet quality, including consumption of energy-dense foods as well as inadequate physical activity can contribute to an increased risk of obesity. It also sets the stage for the onset of chronic diseases like diabetes, hypertension and other heart diseases. We currently do not know the extent of the problem here in the Volta and Oti regions. We also do not have full understanding of the factors that contribute to unhealthy diets and physical inactivity among adolescents in the Volta and Oti regions. This is a community-based study involving adolescents aged 10 – 19 years and their parents. This study seeks to find out about adolescent lifestyles, what adolescents are eating, their hygiene, their physical activity levels and to identify the factors that may contribute to this problem. It is hoped that knowledge gained from this study will help us devise more appropriate ways to help adolescents eat healthily and have healthy body weight.

This consent form is a request for your permission to allow your child to participation in the study. If you agree for your child to participate, we will take your child's body weight and height measurements. We will also collect information on his/her eating habits and physical activity. Both body measurements and completion of questionnaires will take place in your community. Your child will be involved in this study for just one day.

Possible Risks and Discomforts: There are no foreseeable risks associated with this study as procedures to be carried out are routine. Snacks will also be given to make up for time used in participating in the study, periodic breaks will also be given.

Possible Benefits: There will be no direct benefit of this study to your child. It is however, hoped participation will help generate information that will help researchers identify the factors that contribute to unhealthy lifestyles and develop ways to encourage healthy eating and physical activity among adolescents.

Confidentiality: All information collected from your child will be kept in strict confidence and be used for research purposes only. Subjects will not be identified by name during data entry. Only study investigators will have access to your information. However, staff of the Institutional Review Board of the University of Ghana may request to look at his/ her research records. Your child's identity will not be disclosed in any publication.

Compensation: Your child will be given results of his/ her body measurements and interpretation. Your child would also be given nutritional and physical activity advice. In addition, your child will receive an exercise book and a pen for participating in the study.

Additional Cost: You will bear no cost for your child's participation in this study.

Voluntary Participation and Right to Leave the Research: Participation in this study is completely voluntary. Your child is free to withdraw from the study at any time. You may also

withdraw your child's participation in this study at any time without any consequence to you or your child.

Contacts for Additional Information

In case you have further questions regarding this study, please direct them to Norbert Amuna on telephone number 0545069977. You may also call Prof. Richmond Aryeetey on 0261128506 when necessary.

Your rights as a Participant

This research has been reviewed and approved by the Institutional Review Board of Noguchi Memorial Institute for Medical Research (NMIMR-IRB). If you have any questions about your rights as a research participant you can contact the IRB Office between the hours of 8am-5pm through the landline 0302916438 or email addresses: nirb@noguchi.ug.edu.gh



VOLUNTEER AGREEMENT

The above document describing the benefits, risks and procedures for the research title (**Drivers of healthy lifestyle behaviour among adolescents in the Volta and Oti Regions of Ghana**) has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree to participate as a volunteer.

Date

Name and signature or mark of volunteer

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

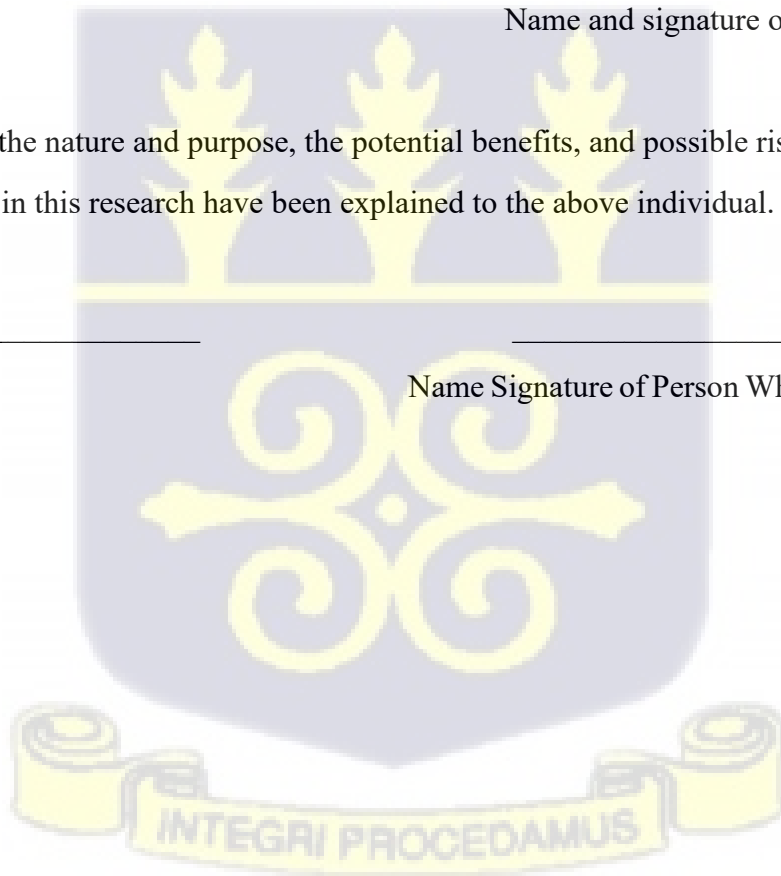
Date

Name and signature of witness

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

Date

Name Signature of Person Who Obtained Consent



Appendix 4: Adolescent Consent Form – For Adolescents 18 Years and Above

Title: Drivers of healthy lifestyle behaviour among adolescents in the Volta and Oti Regions of Ghana

Principal Investigator: Norbert Ndaah Amuna

Address: Department of Population, Family and Reproductive Health, University of Ghana, School of Public Health. P. O. Box LG 13. Legon, Accra.

General Information about Research

Unhealthy lifestyle behaviours, including poor diets, poor hygiene and physical inactivity behaviours constitute a considerable global public health burden and one of the greatest challenges of the 21st Century. Adolescent poor diet quality, including consumption of energy-dense foods as well as inadequate physical activity can contribute to an increased risk of obesity. It also sets the stage for the onset of chronic diseases like diabetes, hypertension and other heart diseases. We currently do not know the extent of the problem here in the Volta and Oti regions. We also do not have full understanding of the factors that contribute to unhealthy diets and physical inactivity among adolescents in the Volta and Oti regions. This is a community-based study involving adolescents aged 10 – 19 years and their parents. This study seeks to find out about what adolescents are eating, their physical activity levels and to identify the factors that may contribute to this problem. It is hoped that knowledge gained from this study will help us devise more appropriate ways to help adolescents eat healthily and have healthy body weight.

This consent form is a request for your participation in a research study by Norbert Amuna, a PhD candidate at the School of Public Health, University of Ghana. If you agree to participate in the study, you will be asked to complete a questionnaire or participate in an interview about adolescent unhealthy lifestyles. You will be asked some questions about your dietary behaviour and physical activity. You will also be asked questions regarding the food environment in your home. Lastly, we will take your weight and height measurements. Your participation in this study will just be for one day (Less than one and a half hours).

Possible Risks and Discomforts: There are no foreseeable risks associated with participation in this study. Snacks will also be given to make up for time used in participating in the study, periodic breaks will also be given.

Possible Benefits: Your participation in this study will enable us gather enough information to better understand the factors that contribute to unhealthy lifestyles among adolescents and how we can develop better approaches to prevent it and its related diseases.

Confidentiality: All information collected from you will be kept in strict confidence and be used for research purposes only. You will not be identified by name during data entry. Only study investigators will have access to your information. However, staff of the Institutional Review Board of the University of Ghana may request to look at your research records. Your identity will not be disclosed in any publication.

Compensation: You will receive a copy and interpretation of your body measurements at the end of the study. There will be no other compensation for participation.

Additional Cost: There is no cost to you for participating in this study.

Voluntary Participation and Right to Leave the Research: Participation in this study is completely voluntary. You may withdraw from or leave the study at any point in time without any penalty

Contacts for Additional Information

In case you have further questions regarding this study, please direct them to Norbert Amuna on telephone number 0545069977. You may also call Prof. Richmond Aryeetey on 0261128506 when necessary.

Your rights as a Participant

This research has been reviewed and approved by the Institutional Review Board of Noguchi Memorial Institute for Medical Research (NMIMR-IRB). If you have any questions about your rights as a research participant you can contact the IRB Office between the hours of 8am-5pm through the landline 0302916438 or email addresses: nirb@noguchi.ug.edu.gh



VOLUNTEER AGREEMENT

The above document describing the benefits, risks and procedures for the research title (**Drivers of healthy lifestyle behaviour among adolescents in the Volta and Oti Regions of Ghana**) has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree to participate as a volunteer.

Date

Name and signature or mark of volunteer

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

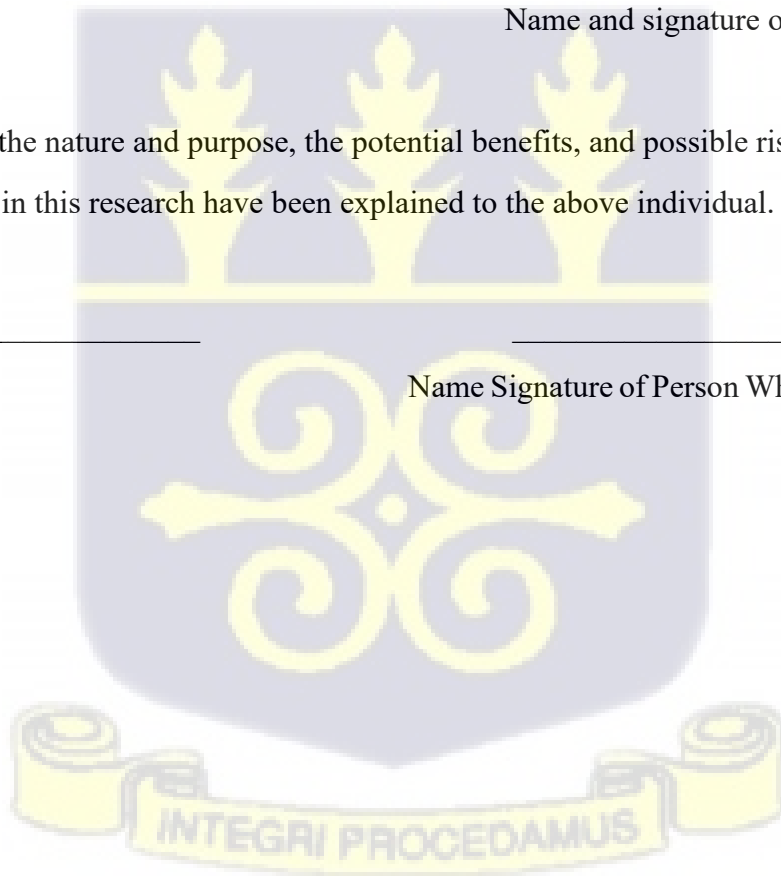
Date

Name and signature of witness

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

Date

Name Signature of Person Who Obtained Consent



Appendix 5: Adolescent Interview Guide

The aim of research (5 Minutes)

1. Greetings and introduction
2. The aim of research: The aim of the research is to explore the eating habits of adolescents in different cultures: what kind of differences can be explored in the eating habits of different ethnic groups. What kind of factors influence food choice, especially cultural characteristics, such as values, family, tradition, religion, sustainability).
3. General rule: There are no good or bad answers.
4. Anonymity, recording
5. Introduction of the main topics of the interview

I. Individual factors (10 Minutes)

- Could you please introduce yourself with a few words?
- What is your name? How old are you? What is your profession? Where did you go to school?
- Where were you born? In which region? What is your ethnicity?
- Where do you live at present? How long have you been living in your current place?

Food consumption and favourite foods

- Could you talk a little bit about your food?
- Generally, what type of food do you eat? Is there any food that you don't eat or you are not allowed to eat?
- What foods do you like? Why? What foods do you dislike? Why? Any cultural and religious taboos about food? What are these foods?
- Tell me about your food intake, fruit intake, vegetable intake, energy dense food intake, sugar-sweetened beverages intake, oily foods, meat,
- What are your favourites dishes? Are these healthy or not?
- Do you follow any kind of special diet? If yes, which one and what is your reason?
- How often do you eat in a day?

Place of eating

- Where do you usually eat during day time?

Who?

- With whom do you usually eat together?

Beliefs about food

- Your beliefs about food. What is healthy food? What is unhealthy food?
- Your beliefs about food, what is a healthy diet, the effects of what you eat on your health.
- Tell me about your beliefs about food, healthy foods, spending money on food, being wasteful.

Barriers

- Let's us talk about your biggest barrier to healthy eating
- How do other people in your life impact how many fruits and vegetables you eat?
- Think about when you are at home; is there anything that prevents you from eating fruits and vegetables?

Socio-economic barriers

- What are the barriers to your intake of fruits and vegetables?
- Are you able to pay for the fruits and vegetables that are available?

Facilitators

- What helps you eat healthy?

Knowledge

- Let's talk about your knowledge or awareness of nutrition
- Why do you think people need to eat fruits and vegetables? What are the benefits of consuming fruits and vegetables?
- What do you believe is the main reason why some adolescents do not consume enough fruits and vegetables?
- Tell me about your understanding of dietary restrictions, and ability to identify healthy foods
- Tell me about eating habits and what's in food and things like that.
- How many fruits and vegetables do you eat a day?

Availability

- Are there always fruits and vegetables at home?

Preference

- Fruits and vegetables, what do you prefer? Why?

Skill

- Do you take time to prepare your meal so you can eat healthy? How easy is it for you to choose a healthy snack?
- How do you prepare fruits and vegetables before consumption? Is that difficult?

II. Social Environmental

1. Parental Influence

- Could you talk a little bit about your family?
- What kind of food do people usually eat in your culture? What do they prefer?

Parental influence on the home environment (10 Minutes)

- At home do your parents monitor what you eat?
- Do your parents influence what you eat? How you eat? Do your parents encourage healthy eating behaviours at home? How? Do they eat fruits and vegetables? Do they eat while watching TV?
- Are there fruits and vegetables at home?
- Are there any family negative attitudes and beliefs that affect your diet?
- What does a typical family lunch look like in your home? Have you got any special habits?
- Are there any differences between the food that you eat weekdays and in the weekend?
- Who does food shopping in your family? Who does the cooking in your family?
- Do you cook? How often do you cook?
- How do you usually prepare the food in your home and in your community?
- How does the eating habits change on festive occasions in your culture?
- What role does food play in your culture?
- Besides traditional food, what kind of special food do you eat?

Modelling

- How common is it to find your father/mother or other family members eating junk foods?
- How common is it to find your father/mother or other family members eating fruits and vegetables?

2. Peer Support (5 Minutes)

- Who are your friends? How often do you meet them? What do you usually do together in your free time?
- What is your hobby? What do you like doing in your spare time?
- Interpersonal support for healthy behaviour change.
- Do your friends share information with you about diets?
- What do they usually eat?
- Do you eat what they eat?
- Do you feel pressurized to eat what they eat? Are these healthy foods?
-

III. THE FACTORS OF FOOD CHOICE (10 Minutes)

- What factors do you take into consideration when choosing food? (E.g. Traditional, climate friendly, cost, friends like it, family likes it)
- What do you usually look at first on the food product when purchasing?
- How important is quality for you? And what about the risks?
- What do you usually read on the label of the product?
- Are you afraid of any risks in food consumption?
- Who buys the food in your family? What kind of shops do you prefer when it comes to purchasing food?
- How much do you insist on traditional food?
- How much are you willing to try new or unknown food? Are you ready to cook such kind of food?
- **Modelling**
- How common is it to find your friends and peers eating junk foods?
- How common is it to find your friends and peers eating fruits and vegetables?
-

IV. CULTURE AND FOOD CONSUMPTION (10 Minutes)

- What does the definition of culture mean to you? Could you please describe your thoughts?
- What are the main values in your life?
- How important are these values in your food consumption?
- From the statements below, please choose the one that you most agree with:
 - I pay attention to healthy nutrition and balanced diet
 - For me, it is more important that the food is tasty even if it is not so healthy
 - Price is the most important factor in food choice
 - The lunch that I consume together with my family is the most important for me
 - In my opinion, healthy diet can contribute to the prevention of diseases
- What type of food do you know that originally belongs to other nations? How often do you prepare or buy such kind of food?
- How often do you meet people of different origin, from different ethnicities or cultures?
- Do you travel to other regions? How often? When did you last travel? What was the reason?
- Which was the longest time that you spent in another community or region? Why?
- What kind of differences did you meet between the habits of people with different cultures?
- What cultural differences did you meet between the habits of people with different cultures?
- What cultural differences did you notice between the eating habits of other people of different ethnicities?
- What can be the reason for these differences?

- Was it hard for you to accommodate yourself to these different habits when you were away from your community? Could you describe your feelings?

III. Physical Environmental

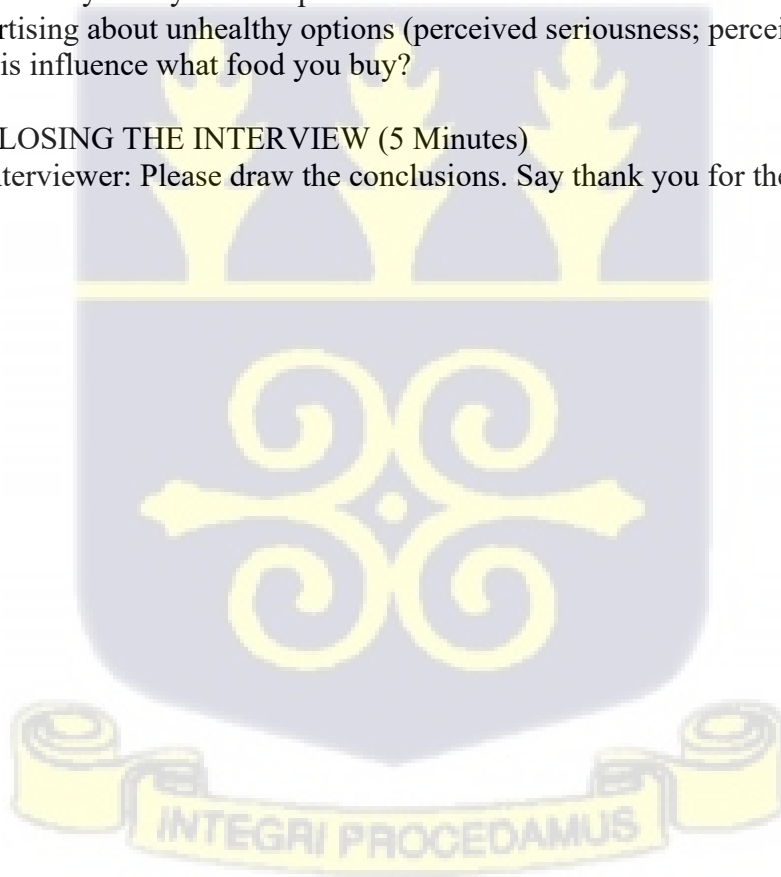
- What aspects of your community environment foster healthy eating?
- Your living situation: Available foods: Are there healthy options? limited healthy options or not?
- Availability and accessibility of fruits and vegetables
- Unhealthy options
- Socioeconomic status
- How many fruits and vegetables do you eat a day?
- How do other people in your life impact how many fruits and vegetables you eat?
- Think about when you are at home; is there anything that prevents you from eating fruits and vegetables?

Macrosystem (Social media, government policy)

- Do you see or watch promotions about vegan or vegetarian diets or healthy foods?
- **Cost**
- Is fresh and healthy food accessible in your community?
- If you had a little more money would it be easier for you to figure out what food to eat? Would you buy more expensive healthier food?
- Advertising about unhealthy options (perceived seriousness; perceived susceptibility). Do this influence what food you buy?

IV. CLOSING THE INTERVIEW (5 Minutes)

Interviewer: Please draw the conclusions. Say thank you for the participation



Appendix 6: Interview Guide for Caregivers

(40-60 MINUTES)

Parental influence on the home environment

- At home do you monitor what your adolescent eats?
- Do you try to influence what he/she eats? How they eat? Do you encourage healthy eating behaviours at home? How? Do you eat fruits and vegetables? Do you eat while watching TV?
- Are there fruits at home?
- Are there vegetables at home?
- Are there any family negative attitudes and beliefs that affect your adolescent's diet?
- What does a typical family lunch look like in your home? Have you got any special habits?
- Are there any differences between the food that you eat weekdays and in the weekend?
- Who does food shopping in your family? Who does the cooking in your family?
- Do you cook? How often do you cook?
- Does your adolescent eat alone or eat together with the family?
- How do you usually prepare the food in your home and in your community?
- Does the eating habit change on festive occasions in your culture?
- What role does food play in your culture?
- Besides traditional food, what kind of special food do you eat?
- **Modelling**
- How common is it to find members of your family eating junk foods?

How common is it to find members of your family eating fruits and vegetables?

What do you think are the main food issues for adolescents and for families in the neighborhood?

(probe: if adolescents ever talk about the food they eat at school or home)

How do fruits and vegetables fit into the picture? (Probe: what is your perception of adolescent's attitudes toward fruits and vegetables)?

Do adolescents tend to eat fruit/veg or do they mostly eat other snacks? Are there any popular fruit/veg adolescents like? What are their favourite snacks?

What cultural differences, if any, do you see with adolescents in terms of adding fruits and vegetables to their meals?

Do you think the neighborhood provides access to affordable and quality fruits and vegetables? (probe: if they feel the locally available fruits and veg are culturally acceptable, do they perceive this to be an issue?).

Are there any health promotion activities in the community in the past, to promote healthy eating? if so what were these and what were your experiences?

Do you have anything else to add?

Attitudes How do you think your adolescent feels about eating fruits and vegetables? Why do you think they feel that way?

Challenges What are some things that make it difficult for you to offer your adolescents fruits and vegetables?

Knowledge What types of things would you like to learn about fruits and vegetables?

Interview questions

Attitudes What are some nutrition-related perceptions that you encounter?

Challenges What challenges do you think exist in addressing the dietary behaviours and health of adolescents in this community?

Thank you again for agreeing to be interviewed

SECTION C – SIGNATURES

I. As the **Student Investigator** on this project, my signature confirms that:

1. I will ensure that all procedures performed under the study will be conducted in accordance with all relevant policies and regulations that govern research involving human participants.
2. I understand that if there is any change from the project as originally approved I must submit an amendment to the NMIMR- IRB for review and approval prior to its implementation. Where I fail to do so, the amended aspect of the study is invalid.
3. I understand that I will report all serious adverse events associated with the study within seven days verbally and fourteen days in writing.
4. I understand that I will submit progress reports each year for review and renewal. Where I fail to do so, the NMIMR-IRB is mandated to terminate the study upon expiry.
5. I agree that I will submit a final report to the NMIMR-IRB at the end of the study.

Name of Student: Norbert Ndaah Amuna

Signature of Student :



Date: 10/02/2021 :

II. As the **Student Supervisor** on this project, my signature confirms that I have read the students work which has been reviewed and approved by the departmental review committee/ scientific and technical committee:

Name of Supervisor: Professor Richmond Aryeetey

Signature of Supervisor:



Date: 10/02/2021



Appendix 7: Adolescent Questionnaire

Date of interview (dd/mm/yy): ____/____/____

CODE

NUMBER:

A. BACKGROUND INFORMATION

1. Adolescent ID: ADID.....
2. Region: [1] Volta [2] Oti
3. District/Municipality: DIST
4. Residence: [1] Urban [2] Rural
5. Sex of respondent: [1] Male [2] Female
6. Age of respondent (completed years): AGE
7. Date of birth of respondent (dd/mm/yy): DBTH
8. Religion: [1] Islam [2] Christian [3] Traditional African [4] Other (specify).....
9. How do you rate your religiosity?
[1] Not at all religious [2] Weak religious [3] Strongly religious [4] Very strongly religious
10. Parental status: [0] None [1] Single parent [2] Dual parents
11. Sibling status:
12. Brother status:
13. Sister status:
14. Do you smoke? [1] Never smoked [2] Ever smoked [3] Current smoker
15. Do you drink alcoholic beverages? [1] I don't [2] 1-2 glasses/day [3] 3-4 glasses/day [4] >5 glasses
16. Have you ever attended school or preschool? [1] Yes [0] No
17. If yes, School Type: [1] Public [2] Private
18. Did you attend school at any time during the (2020- 2021) school year? [1] Yes [0] No
19. What is the highest level of school or preschool you have ever attended?
[1] Pre- primary
[2] Primary
[3] Junior secondary (JSS/JHS) school
[4] Secondary (SSS/SHS)
[5] Higher (University/Polytechnic/Nursing or teacher training college)
20. Marital status
[1] Married or living together
[2] Divorced/separated
[3] Widowed
[4] Never married and never lived together
21. Who is your main caregiver in your household?
[1] Father [2] Mother [3] Grandfather [4] Grandmother [5] Brother
[6] Sister [7] Aunty [8] Uncle [9] Others (please specify)
.....
22. What is your relationship to the main caregiver/head of the household?
[1] Wife or husband
[2] Brother or sister
[3] Son or daughter
[4] Stepchild
[5] Adopted/foster child
[6] Niece/nephew/cousin

- [7] Grandchild
 [8] Son-in-law or daughter in-law
 [9] Other relative (Please specify)
 [10] Don't know
 23. Is your natural mother alive? [1] Yes [0] No
 24. If yes, do you usually live with your natural mother in this household?
 25. Is your natural father alive? [1] Yes [0] No
 26. If yes, do you usually live with your natural father in this household? [1] Yes [0] No
 27. Mother's/Guardian's occupation
 [1] Artisan (Carpenter, hairdresser, seamstress etc.)
 [2] Professionals (Teacher, lawyer, accountant)
 [3] Office worker (Secretary)
 [4] Trading
 [5] Farmer
 [6] Not employed
 28. Education level of mother/caregiver/Guardian
 [1] None
 [2] Primary/Elementary
 [3] JHS/Middle school
 [4] SHS/Secondary
 [5] Post-secondary
 [6] Tertiary
 [7] Don't know
 [8] Other (specify)
 29. Country of origin: [1] Ghana [2] Togo [3] Others (please specify)
 30. Region of origin
 [1] Volta [2] Oti [3] Greater Accra [4] Central [5] Western [6] Eastern
 [7] Ashanti [8] Bono [9] Bono East [10] Ahafo [11] Savanna [12] Northern
 [13] Northeast [14] Upper East [15] Upper West [16] Western North
 31. Ethnicity [1] Ewe [2] Akan [3] Ga [4] Dagomba [5] Kokomba
 [6] Kotokoli [7] Lolobi [8] Likpe [9] Akpafu [10] Buem [11] Santrokofi
 [12] Nkonya [13] Nchumuru [14] Krachi [15] Basares
 [16] Ntrubos [17] Adeles [18] Atwodes [19] Challas [20] Others
 32. How long have you been living in this place? Years
 33. Occupation of father/Guardian
 [1] Artisan (Carpenter, hairdresser, seamstress etc.)
 [2] Professionals (Teacher, lawyer, accountant)
 [3] Office worker (Secretary)
 [4] Trading
 [5] Farmer
 [6] Not employed
 34. Residential status
 [1] Own house
 [2] Family house
 [3] Rented house

- [4] Company/mission house
- [5] Government house
- [6] Caretakers

35. How many persons are in your house hold?

36. How do you usually get to school/town/work?

- [1] By Foot
- [2] By Bicycle
- [3] By Bus/ Car
- [4] By Motorbike
- [5] Other (Please specify)

37. How long does it take you to get to school/town/work?

- [1] 0 to 15 minutes
- [2] 16 to 30 minutes
- [3] 31 to 45 minutes
- [4] 46 to 60 minutes (1 hour)
- [5] More than 1 hour
- [6] Don't know

B. SOCIODEMOGRAPHIC INFORMATION

38. What is the main source of drinking water for members of your household?

PIPED WATER

- [1] Piped into dwelling
- [2] Piped to yard/plot
- [3] Public tap/standpipe
- [4] Tube well or borehole

Dug well

- [5] Protected well
- [6] Unprotected well

Water from spring

- [7] Protected spring
- [8] Unprotected spring
- [9] Rainwater
- [10] Tanker truck
- [11] Cart with small tank
- [12] Surface water (river/dam/lake/pond/stream/canal/irrigation channel)
- [13] Bottled water
- [14] Sachet water

39. What's your opinion about the quality of drinking water you use? [1] Good [2] Bad

40. What type of toilet facility do members of your household usually use?

FLUSH OR POUR FLUSH TOILET

- [1] Flush to piped sewer system
- [2] Flush to manhole/septic tank
- [3] Flush to pit latrine
- [4] Flush to somewhere else
- [5] Flush, don't know where

PIT LATRINE

- [6] Ventilated improved pit latrine

- [7] Pit latrine with slab
- [8] Pit latrine without slab/open pit
- [9] Composting toilet
- [10] Bucket toilet
- [11] Hanging toilet/hanging latrine
- [12] No facility/bush/field
- [13] Other (specify).....

41. Do you share this toilet facility with other households? [1] Don't share [2]
Share

42. Household assets: Does your family/household have:

Electricity	[1] Yes	[0] No
Washing machine?	[1] Yes	[0] No
Computer/Laptop computer/Tablet computer?	[1] Yes	[0] No
A refrigerator/A freezer?	[1] Yes	[0] No
Electric generator/Invertor(s)?	[1] Yes	[0] No
Sewing machine?	[1] Yes	[0] No
A wall clock?	[1] Yes	[0] No
A radio?	[1] Yes	[0] No
A black/white television?	[1] Yes	[0] No
A color television?	[1] Yes	[0] No
A mobile telephone	[1] Yes	[0] No
Bed?	[1] Yes	[0] No
Table?	[1] Yes	[0] No
Chair?	[1] Yes	[0] No
Cabinet/cupboard?	[1] Yes	[0] No
Access to the Internet in any device?	[1] Yes	[0] No
Video deck/VCD/DVD player	[1] Yes	[0] No
Gas/electric cooker	[1] Yes	[0] No
Air conditioner	[1] Yes	[0] No
Satellite dish/ DSTV/ Multi TV	[1] Yes	[0] No
A wrist watch?	[1] Yes	[0] No
A bicycle?	[1] Yes	[0] No
A motorcycle or motor scooter?	[1] Yes	[0] No
An animal-drawn cart?	[1] Yes	[0] No
A car, bus or truck?	[1] Yes	[0] No
A boat without a motor?	[1] Yes	[0] No
A boat with a motor	[1] Yes	[0] No

43. What type of fuel does your family mainly use for cooking?

- [1] Electricity
- [2] LPG
- [3] Natural gas
- [4] Biogas
- [5] Kerosene
- [6] Coal, lignite
- [7] Charcoal
- [8] Wood
- [9] Straw/shrubs/grass
- [10] Agricultural crop residue
- [11] No food cooked in household

44. Main material of the floor (Record observation)

- [1] Natural floor earth/sand
- [2] Natural floor dung
- [3] Rudimentary floor wood planks
- [4] Rudimentary floor Palm/bamboo
- [5] Finished floor parquet or polished wood
- [6] Finished floor vinyl or asphalt strips
- [7] Finished floor ceramic/marble/porcelain/tiles/terrazzo floor
- [8] Finished floor cement floor
- [9] Finished floor woolen carpet/synthetic carpet
- [10] Finished floor linoleum/rubber carpet

45. Main material of the roof (Record observation)

- [1] No roof
- [2] Natural: Thatch/palm leaf
- [3] Natural: Mud/sod
- [4] Rudimentary: Rustic mat
- [5] Rudimentary: Palm/bamboo
- [6] Rudimentary: Wood planks
- [7] Rudimentary: Cardboard
- [8] Main roof material: Finished: Zinc/aluminium
- [9] Main roof material: Finished: Wood
- [10] Main roof material: Finished: Calamine/cement fiber
- [11] Main roof material: Finished: Ceramic/brick tiles
- [12] Main roof material: Finished: Cement
- [13] Main roof material: Finished: Roofing shingles
- [14] Finished: Asbestos/slate roofing sheets

46. Main material of the exterior walls (Record observation)

- [1] Natural: Cane/palm/trunks
- [2] Natural: Mud/landcrete
- [3] Rudimentary: Bamboo with mud
- [4] Rudimentary: Stone with mud
- [5] Rudimentary: Uncovered adobe
- [6] Rudimentary: Plywood
- [7] Rudimentary: Cardboard
- [8] Rudimentary: Reused wood
- [9] Finished: Cement walls
- [10] Finished: Stone with lime/cement
- [11] Finished: Bricks
- [12] Finished: Cement blocks
- [13] Finished: Covered adobe
- [14] Finished: Wood planks/shingles
- [15] Other (specify).....

47. Does any member of this household own any agricultural land? [1] Yes [0]
No

48. How many hectares or acres or plots of agricultural land do members of this household own?

(IF 99.5 OR MORE ACRES, RECORD IN HECTARES. 100 ACRES= 1 HECTARE)

- [1] Hectares [.....][.....] . [.....]
 [2] Acres [.....][.....] . [.....]
 [3] Plots [.....][.....] . [.....]
 [4] 95 OR MORE HECTARES
 [5] DON'T KNOW

49. Does this household own any livestock, herds, other farm animals, or poultry? [1]
 Yes [0] No

50. If yes, how many of the following animals does this household own?

- [1] None, enter '00'.
 [2] Cattle/cows/bulls
 [4] Horses/donkeys/mules
 [5] Goats
 [6] Pigs
 [7] Rabbits
 [8] Grasscutter
 [9] Sheep
 [10] Chickens
 [11] Other poultry
 [12] Other (specify).....
 If 95 or more, enter '95'.

51. Does any member of this household have a bank account? [1] Yes [0] no

52. How many rooms in this household are used for sleeping?

53. Number of members per sleeping room

C. ADOLESCENT NUTRITION KNOWLEDGE

Now I would like to ask you about your nutrition knowledge

54. Do health experts recommend that people should be eating more, the same amount, or less of the following foods? (tick one box per food)

Fruit	[1] More	[2] Same	[3] Less	[4] Not
Sure				
Food and drinks with added sugar	[1] More	[2] Same	[3] Less	[4] Not
Sure				
Vegetables	[1] More	[2] Same	[3] Less	[4] Not
Sure				
Fatty foods	[1] More	[2] Same	[3] Less	[4] Not
Sure				
Processed red meat	[1] More	[2] Same	[3] Less	[4] Not
Sure				
Wholegrains	[1] More	[2] Same	[3] Less	[4] Not
Sure				
Salty foods	[1] More	[2] Same	[3] Less	[4] Not
Sure				
Water	[1] More	[2] Same	[3] Less	[4] Not
Sure				

55. How many servings of fruit and vegetables per day do experts advise people to eat as a minimum? (One serving could be, for example, an apple or a handful of chopped carrots) (tick one)

[1] 2 [2] 3 [3] 4 [4] 5 or more [5] Not sure

56. Which of these types of fats do experts recommend that people should eat less of? (tick one box per food)

Unsaturated fats	[1] Eat less	[2] Not eat less	[3] Not sure
Trans fats	[1] Eat less	[2] Not eat less	[3] Not sure
Saturated fats	[1] Eat less	[2] Not eat less	[3] Not sure

57. Which type of dairy foods do experts recommend for people to drink? (tick one)

[1] Full fat (e.g. full fat milk)
 [2] Reduced fat (e.g. skimmed and semi-skimmed milk)
 [3] Mixture of full fat and reduced fat
 [4] Neither, dairy foods should be avoided
 [5] Not sure

58. How many times per week do experts recommend that people eat breakfast? (tick one)

[1] 3 times per week
 [2] 4 times per week
 [3] Every day
 [4] Not sure

59. If a person has two glasses of fruit juice in a day, how many of their daily fruit and vegetable servings would this count as? (tick one)

[1] None
 [2] One serving
 [3] Two servings
 [4] Three servings
 [5] Not sure

60. Which one of the following nutrients has the most calories for the same weight of food? (tick one)

[1] Sugar
 [2] Starchy
 [3] Fibre/roughage
 [4] Fat
 [5] Not sure

61. Compared to minimally processed foods, processed foods are: (tick one)

[1] Higher in calories
 [2] Higher in fibre
 [3] Lower in salt
 [4] Not sure

62. One of the unhealthiest ways of cooking methods is... (tick one)

[1] Grilling
 [2] Steaming
 [3] Baking
 [4] Frying
 [5] Not sure

63. Do you think these foods are typically high or low in fibre? (tick one box per food)

Oats	[1] High in fibre	[2] Low in fibre	[3] Not Sure

Oranges	[1] High in fibre	[2] Low in fibre	[3] Not Sure
White rice	[1] High in fibre	[2] Low in fibre	[3] Not Sure
Eggs	[1] High in fibre	[2] Low in fibre	[3] Not Sure
Potatoes with skin	[1] High in fibre	[2] Low in fibre	[3] Not Sure
Spaghetti/Pasta	[1] High in fibre	[2] Low in fibre	[3] Not Sure

64. How many minutes per day of moderate-to-vigorous intensity physical activity do experts recommend for adolescents? (tick one)

- [1] At least an average of 30 minutes per day
- [2] At least an average of 50 minutes per day
- [3] At least an average of 60 minutes per day
- [4] at least an average of 90 minutes per day
- [5] At least an average of 120 minutes per day

65. Healthy and Unhealthy Dietary Habits and Food

In your view, what is a healthy diet?

- [1] A diet rich in different foods
- [2] Foods rich in meat, fish, eggs, cheese, legumes and other proteins
- [3] A diet without any fats
- [4] Eating fish very often

66. In your view, which is the healthiest food?

- [1] Washed vegetables ready to eat
- [2] A canned food
- [3] A food very rich in dressing
- [4] A fried food

67. In your view, which is the healthiest cooking method?

- [1] Cooking on a grill/in boiled water
- [2] Frying/braising
- [3] Cooking in the oven without fats
- [4] cooking in a pan with oil or fat.

D. ASSESSMENT OF DIET DIVERSITY AND NUTRIENT ADEQUACY OF PRISONERS' DIETS USING 3-DAY 24 HOUR RECALLS.

24 HOUR FOOD RECALL - WEEK DAY

Now I will ask you some questions about your food intakes within the last 24 hours.

Now I would like to ask you about the foods you ate during the past week. (Read the list of foods below, if you ate any of the food during the past week. If you ate any of them it is yes, if you did not eat any it is no)			
Serial No	Code	Food Item	Week
1	DD1	bread, rice noodles, biscuits or any other foods made from millet, sorghum, maize, rice or wheat? E.g. banku, kenkey, Porridge	[1] Yes [2] No
2	DD2	Any potatoes, yams, cassava or any other foods made from roots or tubers? Fufu, Yam	[1] Yes [2] No
3	DD3	Any vegetables eg carrots, potato leaves, green pepper. Green leaves, ayoyo.	[1] Yes [2] No
4	DD4	Any fruits? eg banana, pawpaw, orange, water melon	[1] Yes [2] No

5	DD5	Any beef, pork, lamb, goat, rabbit, wild game, chicken, duck, other birds, liver, kidney, heart, or other organ meats?	[1] Yes [2] No
6	DD6	Any eggs?	[1] Yes [2] No
7	DD7	Any fresh or dried fish or shellfish?	[1] Yes [2] No
8	DD8	Any foods made from beans, peas, lentils, or nuts?	[1] Yes [2] No
9	DD9	Any foods made with oil, fat, or butter?	[1] Yes [2] No
10	DD10	Any sugar or honey?	[1] Yes [2] No
11	DD11	Any soda, coke, malt drink, fanta, Sobolo	[1] Yes [2] No

Please estimate your average food use as best you can, and please answer every question - do not leave ANY lines blank. PLEASE PUT A TICK (✓) ON EVERY LINE

FOODS AND AMOUNTS	AVERAGE USE LAST YEAR								
MEAT AND FISH (medium serving)	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Beef: roast, steak, mince, stew or casserole									
Beefburgers									
Pork: roast, chops, stew or slices									
Lamb: roast, chops or stew									
Chicken or other poultry eg. turkey									
Bacon									
Ham									
Corned beef, Spam, luncheon meats									
Sausages									
Savoury pies, eg. meat pie, pork pie, pasties, steak & kidney pie, sausage rolls									
Liver, liver paté, liver sausage									
Fried fish in batter, as in fish and chips									
Fish fingers, fish cakes									
Other white fish, fresh or frozen, eg. cod, haddock, plaice, sole, halibut									
Oily fish, fresh or canned, eg. mackerel, kippers, tuna, salmon, sardines, herring									
Shellfish, eg. crab, prawns, mussels									
Fish roe, taramasalata									
	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

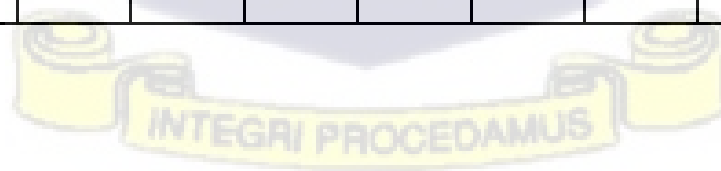
E. Food Frequency Questionnaire (FFQ) to Assess Adolescent Food Consumption in the Past 1 Month (Weekly average)

I will want to know the number of times (frequency) you consumed the following foods in the past 1 month preceding this interview (Interviewer should state period). For each of the food you consumed, I will also like to know the estimated quantity (amount) you consume on each occasion.

Note: If never, then skip to the next food without indicating amount consumed on each occasion

MAIN MEALS: CEREALS & GRAINS	Never	Once per month	2 -3 times per month	1 per week	2 per week	3 per week	4 per week	5 per week	6 per week	Every day	Estimated usual Quantity (amount) consumed on each occasion		Where you get it from [1] Home [2] School vender [3] Street food [4] Corner shop [5] Chop bar/ restaurant [6] Supermarket
											Amount	Amount	
Wheat	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Oats	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Banku	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Kenkey	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Akple	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Tuo zaafi (TZ)	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
White rice	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Brown rice	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Mixed dish (waakye)	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Koko	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Tombrown	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			

BREAD, BISCUITS, PASTRIES											Estimated usual Quantity (amount) consumed on each occasion		Where you get it from [1] Home [2] School vender [3] Street food [4] Corner shop [5] Chop bar/ restaurant ermarket
											Amount	Amount	
Whole wheat or whole grain bread	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
White bread (Sugar bread, butter bread)	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Biscuit, cookies	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Pastries, cakes	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Pizza	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Other pastries (pies, baked chips, bans etc.)	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Macaroni/ Spaghetti/indo mie	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			

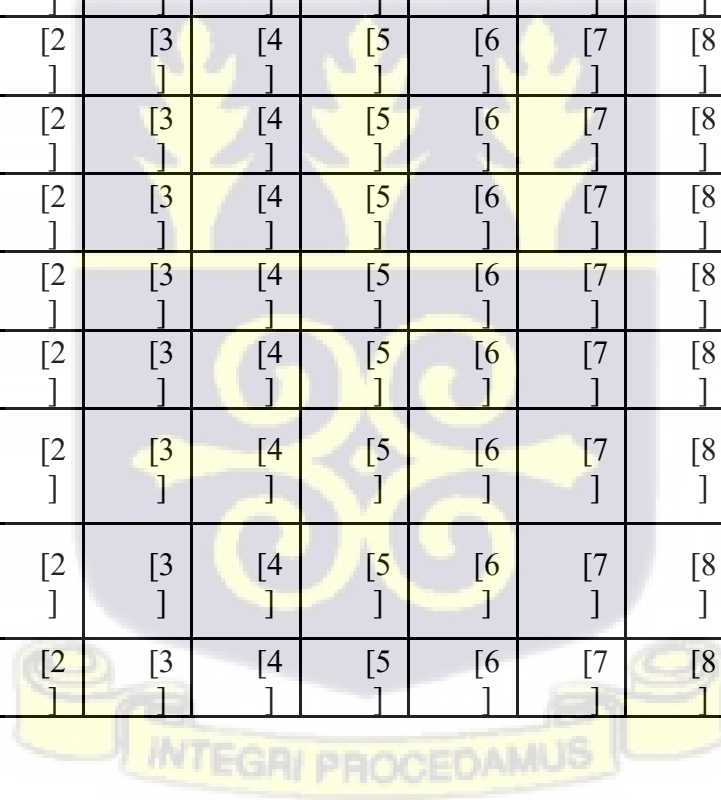


MAIN MEALS: ROOTS AND TUBERS

MAINMEALS; ROOTS AND TUBERS	Never	Once per month	2 -3 times per month	1 day per week	2 days per week	3 days per week	4 days per week	5 days per week	6 days per week	Every day	Estimated usual Quantity (amount) consumed on each occasion		Where you get it from [1] Home [2] School vender [3] Street food [4] Corner shop [5] Chop bar/ restaurant [6] Supermarket
											Amount	Amount	
Cassava	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Yam	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Plantain	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Fufu	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Cocoyam	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Sweet potatoes	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Beet roots	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Gari	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Kokonte	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			

BEANS, LEGUMES, LENTILS, NUTS	Never	Once per month	2 -3 times per month	1 day per week	2 days per week	3 days per week	4 days per week	5 days per week	6 days per week	Every day	Estimated usual Quantity (amount) consumed on each occasion		Where you get it from [1] Home [2] School vender [3] Street food
											Amount	Amount	

Pork	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Smoked fish, grilled fish	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Salted fish	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Fried fish	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Fish canned in oil	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Fish canned in tomato sauce	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Eggs scrambled	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Eggs Fried	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Eggs cooked	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Sausage, Bacon, Ham, peperoni	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Corned beef, luncheon	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Poultry (chicken, turkey, guinea fowl, birds, duck) roast	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Poultry (chicken, turkey, guinea fowl, birds) fried	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Game (grasscutter, rats, rabbits)	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			



Snails	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Crabs/shrimps/lobsters	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Organ meat	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Milk, cheese, wagashi, Burkina, yoghurt, fan milk	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			

Fruits

Fruits	Never	Once per month	2 -3 times per month	1 day per week	2 days per week	3 days per week	4 days per week	5 days per week	6 days per week	Every day	Estimated usual Quantity (amount) consumed on each occasion Amount		Where you get it from [1] Home [2] School vender [3] Street food [4] Corner shop [5] Chop bar/restaurant [6] Supermarket
Bananas	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Pineapple	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Mangoes	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Apples	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Grapes	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Pears	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Watermelon	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			

Citrus (Orange, tangerine, star fruits)	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Coconut	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Pawpaw	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			

Vegetable list	Never	Once per month	2 -3 times per month	1 day per week	2 days per week	3 days per week	4 days per week	5 days per week	6 days per week	Every day	Estimated usual Quantity (amount) consumed on each occasion		Where you get it from [1] Home [2] School vender [3] Street food [4] Corner shop [5] Chop bar/ restaurant [6] Supermarket
											Amount	Unit of amount	
Okra fruit	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Pumpkin fruit	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Green leafy vegetables (gboma, ayoyo, ademe, bitter leaves, cassava leaves, lettuce, bean leaves, kenaf, alefu, kontomire, etc)	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			

Tomatoes	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Fresh pepper	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Dried pepper	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Onions	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Cabbage	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Cucumber	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Carrot	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Sweet pepper	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Green/Red/Yellow peppers	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Mushrooms	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			

SNACK FOODS/DESSERTS	Never	Once per month	2 -3 times per month	1 day per week	2 days per week	3 days per week	4 days per week	5 days per week	6 days per week	Every day	Estimated usual Quantity (amount) consumed on each occasion		Where you get it from [1] Home [2] School vender [3] Street food [4] Corner shop [5] Chop bar/ restaurant [6] Supermarket
											Amount	Amount	
Potato chips	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Pop corn	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Plantain chips	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Groundnuts	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			

Crackers	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Cakes	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Doughnuts	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Spring rolls	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Cookies/biscuits	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Candy/Toffee/	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Ice cream, yoghurt	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Chocolate bars	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Roasted corn	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Fresh cooked corn	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Pop corn	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Pies	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			

SUGAR-SWEETENED BEVERAGES	Never	Once per month	2 -3 times per month	1 day per week	2 days per week	3 days per week	4 days per week	5 days per week	6 days per week	Every day	Estimated usual Quantity (amount) consumed on each occasion (cans, glasses, vol)		Where you get it from [1] Home [2] School vender [3] Street food [4] Corner shop [5] Chop bar/ restaurant [6] Supermarket
											Amount	Amount	
Sports drinks with vitamins	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			

Regular energy drinks	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Sugar-free or low calorie drinks	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Smoothies	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Milkshakes	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Fruit juices (Pure Heaven, Ceres, Nourisher)	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Minerals (eg. Malt, Fanta, Sprite, Coca Cola)	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Local drinks (Sobolo, leeha, asana, shitor da, etc.)	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Black tea	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Coffee	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Chocolate drink	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Water (Tap/ bottled/ satchet)	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Wine	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Liquor	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Beer	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
OTHER FOODS, SPREADS AND TOPPINGS	Never	Once per month	2 -3 times per month	1 day per week	2 days per week	3 days per week	4 days per week	5 days per week	6 days per week	Every day	Estimated usual Quantity (amount) consumed on each occasion (Teaspoons)	Where you get it from [1] Home [2] School vender	

											Amount	Amount	[3] Street food [4] Corner shop [5] Chop bar/ restaurant [6] Supermarket
Ketchup	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Mayonnaise	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Salad cream	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Margarine	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Butter	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Jam/marmalade	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Chocolate spread	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			
Groundnut paste	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]			



F. FOOD SECURITY ASSESSMENT

I will want to know about your food security situation. I want to know whether you have enough to meet your needs.

Serial No	Code	Question	Responses	Resp
200	HH	Think about the past 12 months. Were there any months when you didn't have enough food to meet your needs?	[1] Yes [2] No	☐
201	HH0	If yes, which months did this happen?	[1] Jan [2] Feb [3] Mar [4] Apr [5] May [6] Jun [7] Jul [8] Aug [9] Sep [10] Oct [11] Nov [12] Dec	☐
202	HH1	Which of these statements best describes the food you had access to in the last 12 months?	1. I always had enough of the kinds food I want to eat, and my parents/guardians could afford to buy me the food I wanted. 2. I always had enough food to eat, but not always the kinds of food I want 3. Sometimes I didn't have enough food to eat 4. I often went without eating because there was not enough food. [5] DK or Refused	☐
203	HH2	In the past four weeks, did you worry about where your next meal will come from?	[1] Yes [2] No (skip to HH3)	☐
204	HH2a	IF YES , How often did this happen?	[1] Rarely (once or twice in the past four weeks) [2] Sometimes (three to ten times in the past four weeks) [3] Often (more than ten times in the past four weeks)	☐
205	HH3	In the past four weeks, were there times when you were not able to eat/afford the kinds of foods you preferred because your family didn't have enough resources or money?	0 = No (skip to HH4) 1=Yes	☐
206	HH3a	IF YES , how often did this happen?	[1] Rarely (once or twice in the past four weeks)	☐

			[2] Sometimes (three to ten times in the past four weeks) [3] Often (more than ten times in the past four weeks)	
207	HH4	In the past four weeks, did you have to eat the same foods over and over again because there wasn't enough money or food at home? For example, eating mostly kenkey or bread every day.	[1] Yes [2] No (skip to AD1)	☐
208	HH4a	IF YES , How often did this happen?	[1] Rarely (once or twice in the past four weeks) [2] Sometimes (three to ten times in the past four weeks) [3] Often (more than ten times in the past four weeks)	☐

Adolescent Stage 2

Adolescent Stage 2: Questions AD1-AD4 (asked of households passing the screener for Stage 2 adolescent. If affirmative response (i.e., "often true" or "sometimes true") to one or more of Questions HH2-HH4, OR, response [3] or [4] to question HH1 (if administered), then continue to <i>Adolescent Stage 2</i>				
	No	Question	Response option	Code
300	AD1	In the past four weeks, did you have to eat foods that you really did not want to eat because there wasn't enough money or resources for other types of food? E.g. undesirable or socially unacceptable food?	1 = Yes 2 = No (skip to AD2)	☐
301	AD1a	IF YES , How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	☐
302	AD2	In the past four weeks, did you ever have to cut the size of your meals/ eat a smaller meal/skip meals (like breakfast, lunch, or dinner) because there wasn't enough food or money at home?	1 = Yes 2 = No (skip to AD3)	☐
303	AD2a	IF YES , How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks)	☐

			3 = Often (more than ten times in the past four weeks)	
304	AD3	In the past four weeks, did you ever have to eat fewer meals in a day because there was not enough food?	1 = Yes 2 = No (skip to AD4)	☐
305	AD3a	IF YES , How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	☐
306	AD4	In the past four weeks, was there ever a time when there was no food at all in your house, and you went hungry because your family couldn't afford to buy any?	1 = Yes 2 = No (skip to AD5)	☐
307	AD4a	IF YES , How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	☐

Adolescent stage 3

Serial No	Code	Question	Response Option	Code
Stage 3: Questions AD5-AD5a (asked of households passing screener for Stage 3 adolescent-referenced questions).				
400	AD5	In the past four weeks, did you ever go a whole day and night without eating anything because there was no food or money for food at home?	[1] Yes [2] No [3] DK	☐
401	AD5a	IF YES, how often did this happen?	[1] Rarely (once or twice in the past four weeks) [2] Sometimes (three to ten times in the past four weeks) [3] Often (more than ten times in the past four weeks)	☐

G. DIETARY BEHAVIOURS QUESTIONNAIRE

How much do you agree or disagree with the following statements?

501. I don't eat vegetable salads prepared away from home.

[1] Strongly agree [2] Agree [3] Disagree [4] Strongly disagree

502. Members of my household don't add vegetables to stews and soups.

[1] Strongly agree [2] Agree [3] Disagree [4] Strongly disagree

503. My family always keeps fruits at home

[1] Strongly agree [2] Agree [3] Disagree [4] Strongly disagree

504. I always keep fruits at home

[1] Strongly agree [2] Agree [3] Disagree [4] Strongly disagree

505. I think fruits are expensive.

[1] Strongly agree [2] Agree [3] Disagree [4] Strongly disagree

506. I think vegetables are expensive

[1] Strongly agree [2] Agree [3] Disagree [4] Strongly disagree

507. Fruits are not available in my community

[1] Strongly agree [2] Agree [3] Disagree [4] Strongly disagree

508. Vegetables are not available in my community

[1] Strongly agree [2] Agree [3] Disagree [4] Strongly disagree

509. When you eat bread, how often do you eat bran bread/brown bread/wholegrain bread?

[1] Almost always [2] Often [3] Sometimes [4] Seldom [5] Never [6] I don't eat bread

H. FOOD PREFERENCES

Please indicate your preference

510. Which of these do you prefer to eat?

[1] Eat home-cooked food
[2] Eat away from home in a restaurant or chop-bar
[3] Eat take-away food at home

511. Beverage

[1] Natural Fruit choice
[2] Soft drink/carbonated drink

512. Egg

[1] Fried egg
[2] Boiled egg

513. Vegetable salad preparation

[1] Vegetable salad with mayonnaise/salad cream
[2] Vegetable salad without salad cream/mayonnaise

514. Preparation of chicken/meat

[1] Fried chicken/meat
[2] Roasted chicken/meat

515. Type of Biscuit

- [1] Creamy sandwiched biscuits/wafer
- [2] Non-creamy sandwiched biscuits

516. Type of Bread

- [1] Sugar bread
- [2] Brown/wheat bread

517. Type of cooked yam

- [1] Fried yam
- [2] Boiled yam

518. Type of Cooked Rice

- [1] Boiled rice with stew
- [2] Fried rice

519. Spread on bread

- [1] Groundnut paste on bread
- [2] Butter on bread

520. Type of cooked plantain

- [1] Fried plantain
- [2] Roasted plantain

521. Type of cooked corn

- [1] Popcorn (sugar or salt)
- [2] Boiled corn

522. Breakfast beverage

- [1] Coffee beverage
- [2] Milo/cocoa beverage

523. Type of snack

- [1] Fruit snack
- [2] Pastry snack

I. FOOD PURCHASE AND PREPARATION

524. How much responsibility do you have for food shopping?

- [1] Little or none
- [2] About half
- [3] Most or all

525. Who purchases the foods you eat in your family?

- [1] Yourself
- [2] Mother
- [3] Father
- [4] Maternal grandmother or grandfather
- [5] Paternal grandmother or grandfather
- [6] Most elderly member or members of the household
- [7] Older sibling
- [8] Other (please specify).....

526. When purchasing food what are the key factors that influence the foods you choose?

- [1] Food pricing and affordability
- [2] Quality and freshness
- [3] Monetary resources

527. Who typically makes the household food decisions (i.e. purchase and source household food)?

[1] Mother [2] Father [3] Sister [4] Brother [5] Aunt [6] Uncle [7]
Grandmother [8] Everybody in the family [9] Others (please state)

528. Are you involved in deciding what food is to be served [1] Yes [0] No

529. How much responsibility do you have for planning meals?

[1] Little or none [2] About half [3] Most or all

530. How much responsibility do you have for preparing meals?

[1] Little or none [2] About half [3] Most or all

531. Who prepares and cooks the meals in your family?

[1] Yourself [2] Mother [3] Father [4] Maternal grandmother or grandfather [5]
Paternal grandmother or grandfather [6] Most elderly member or members of the household
[7] Older sibling [8] Other (please specify).....

J. PERSONAL EATING HABITS

532. In a typical week, where are most of your

Breakfast prepared? [1] At home [2] Out [3] Don't eat meal

Lunches prepared? [1] At home [2] Out [3] Don't eat meal

Dinners prepared? [1] At home [2] Out [3] Don't eat meal

533. How many times per day do you usually eat?

[1] Once [2] Twice [3] Thrice [4] Four times [5] Five times or more

534. Which of the following meals do you usually skip?

[1] None [2] Breakfast [3] Lunch [4] Supper [5] Snacks

535. Why do you skip the above meal?

[1] Not hungry [2] Lack of time [3] Don't like the foods they serve (taste)
[4] Don't have to buy [5] Food is inadequate [6] NA [7] Other (specify)
.....

536. Where do you usually get your lunch in afternoon?

[1] Home [2] Roadside vendors/sellers [3] Food hawkers [4] Restaurant/chop-bar

[5] Vendors/sellers outside school [6] School feeding program [7] Other (please
specify).....

537. Do you avoid or dislike any food? [1] Yes [0] No

If yes, what are these foods?

538. Why do you dislike or avoid these foods?

[1] Taste/Appearance [2] Health (allergy) [3] Cultural/Religious taboo [4] Family doesn't
eat it [5] Others (please specify)

539. In the last 7 days on how many days did you go without taking breakfast?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6]
6 Days [7] Daily

FAST FOODS AND TAKEAWAY FOODS

540. In the last 7 days on how many days did you eat out?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

541. In the last 7 days on how many days did you eat fast food?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

542. In the last 7 days on how many days did you eat a take-away food?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

543. In the last 7 days, how many days was your evening meal purchased from a fast-food restaurant and eaten at home?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily

544. In the last 7 days, how many days was your evening meal bought from the street side and eaten at home?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily

545. In the last 7 days, how many days was your evening meal delivered to your home like pizza or fried rice?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily

546. In the last 7 days, how many days was your evening meal made from a heat-and-serve or box meal like Spaghetti?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily

547. In the last 7 days, how many days was your evening meal a microwaved meal or reheated refrigerated or frozen food eaten at home?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily

548. In the last 7 days, how many days was your evening meal cooked from scratch at home and eaten at home.

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily

549. In the last 7 days on how many days did you eat alone?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily

FRIED FOODS AND FATTY FOODS

550. How often do you eat food that is fried at home? (Fried chicken, fried fish, fried plantain, fried yam, fried chips, bofloat, fried rice)

[1] Less than once a week [2] 1-3 times a week [3] 4-6 times per week [4] Daily

551. How often do you eat food that is fried away from home? (Fried chicken, fried fish, fried plantain, fried yam, fried chips, bofloat, fried rice)

[1] Less than once a week [2] 1-3 times a week [3] 4-6 times per week [4] Daily

552. How often do you add butter, margarine or lard as a spread on your bread?

[1] Less than once a week [2] 1-3 times a week [3] 4-6 times per week [4] Daily

553. In the last 7 days on how many days did you eat fried food including fried potato, fried plantain/kelewele/tatale, fried yam?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

554. In the last 7 days on how many days did you eat fried food including/chips/Bofrot /Doughnuts

Akara / Koose/crisps?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

555. In the last 7 days on how many days did you eat fried chicken/meat/fish?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

556. In the last 7 days on how many days did you eat fried rice?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

557. In the last 7 days on how many days did you eat gari/beans and oil/palmoil/red-red?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

558. In the last 7 days on how many days did you eat fatty meat products?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

FRUITS AND VEGETABLES

559. In the last 7 days on how many days did you eat five portions of fruits and vegetables?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily

560. In the last 7 days on how many days did you eat fruit?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

561. In the last 7 days on how many days did you eat greens, vegetables (okro, gboma, ayoyo/ademe etc) in stews and soups?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

562. In the last 7 days on how many days did you eat raw (uncooked) vegetables (carrots, cucumber, peppers, cabbage, lettuce)?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

563. In the last 7 days on how many days did you eat red meat?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

SNACKS

564. In the last 7 days on how many days did you eat salty snacks, salted nuts?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

565. In the last 7 days on how many days did you eat pastries, sweet and savoury biscuits/cakes/confectionary?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

566. In the last 7 days on how many days did you eat sweets, lollies, chocolate and confectionary?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

567. In the last 7 days on how many days did you eat ice-cream/ice-lollies?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

568. How often do you eat sweets?

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

569. Do you have the opportunity for unrestricted snacking at home? [1] Yes [0] No

SUGAR-SWEETENED DRINKS

570. How often do you have soft drinks available in the home?

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

571. During the last 7 days, on how many days did you drink energy drinks like Rush?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

572. During the last 7 days, on how many days did you drink sweetened beverages, soft drinks, Malt, Coke, Pepsi, Fanta, Sobolo, or any other sweetened drinks?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

573. If you drank soft drinks/minerals, how many drinks/day did you take on the average?

[1] 1/2 bottle [2] 1 bottle [3] 2 bottles [4] 3 bottles [5] 4 bottles [6] 5 bottles [7] 6 bottles or more

574. How often does your mother/caregiver drink sugar-sweetened beverages?

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

575. How often does your mother/caregiver eat fruits or vegetables?

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

576. Does your mother/caregiver think you should cut down on the amount of sweetened drinks you take? [1] Yes [0] No

HUNDRED PER CENT FRUIT JUICES

577. During the last 7 days, on how many days did you drink 100% fruit juice (no sugar added)? Examples: Ekumfi juice, Tropicana, Don Simon, Ceres, or any other fruit drinks that are 100% juice?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

578. During the last 7 days, on how many days did you drink beers/wines/spirits?

[0] Never [1] 1 Day [2] 2 Days [3] 3 Days [4] 4 Days [5] 5 Days [6] 6 Days [7] Daily [8] 2 or more times per day

MEAL TIMES

579. Eats dinner in front of the TV

[1] Yes [0] No

580. As a family how do you typically eat your food?

- [1] Use cutlery (spoon, fork)
- [2] Use chopsticks
- [3] Use hands

581. Eating posture: Typically, which of these fits your eating environment?

- [1] The food is eaten at the table
- [2] The food is on my laps
- [3] The food is eaten while sitting on the floor
- [4] The food is eaten while sitting on a stool

582. TV Viewing: Typically, which of these fits your eating environment?

- [1] The food is always eaten with the television on
- [2] The food is never eaten with the television on.

Social rules about eating: In my family:

583. Children eat at table with adults [1] Yes [0] No

584. Women and men eating at same table [1] Yes [0] no

585. Which of these fit your family mealtime routine?

- [1] No routine of meals and planned snacks and allow grazing on food throughout the day.
- [2] A planned daily routine of 3 meals and 2–3 snacks and no grazing on food throughout the day.

SOCIAL FACILITATION OF EATING

586. Who do you usually eat with?

- [1] Alone
- [2] With family
- [3] With friends/peers

587. I turn to eat more when

- [1] I eat alone
- [2] I eat with people

588. I spend longer time eating when

[1] I eat alone

[2] I eat with people

589. Does your religion or culture bar you from any specific foods?

[1] Yes [0] No

590. What are these foods? (please list)

K. FOOD-SUSTAINABILITY RELATED TERMS

		Have you ever heard of the following food sustainability terms?	
601		Ecological footprint	[1] Yes [0] No
602		Carbon footprint	[1] Yes [0] No
603		Food sustainability	[1] Yes [0] No
604		Environmental impact	[1] Yes [0] No
605		Biodiversity	[1] Yes [0] No
606		Local food	[1] Yes [0] No
607		Greenhouse gas emissions	[1] Yes [0] No
608		Green water-blue water-grey water	[1] Yes [0] No
609		Climate adaptation	[1] Yes [0] No
610		Mitigation	[1] Yes [0] No
611		Resilience	[1] Yes [0] No

Knowledge of terms related with food-sustainability

		Do you know the meaning of the following food sustainability terms?	PROBE FOR MEANING
612		Ecological footprint	[1] Yes [0] No
613		Carbon footprint	[1] Yes [0] No
614		Food sustainability	[1] Yes [0] No
615		Environmental impact	[1] Yes [0] No
616		Biodiversity	[1] Yes [0] No
617		Local food	[1] Yes [0] No
618		Greenhouse gas emissions	[1] Yes [0] No
619		Green water-blue water-grey water	[1] Yes [0] No
620		Climate adaptation	[1] Yes [0] No
621		Mitigation	[1] Yes [0] No
622		Resilience	[1] Yes [0] No

Adolescents' perceived environmental benefit of sustainable diet behaviours

633		Avoiding excess packaging	[1] Very small benefit [2] Small benefit [3] Unsure [4] Large benefit [5] Very large benefit
634		Buying locally grown produce	[1] Very small benefit [2] Small benefit [3] Unsure [4] Large benefit [5] Very large benefit
635		Consuming seasonal fruits and vegetables	[1] Very small benefit

			[2] Small benefit [3] Unsure [4] Large benefit [5] Very large benefit
636		Limiting red and processed meat	[1] Very small benefit [2] Small benefit [3] Unsure [4] Large benefit [5] Very large benefit
637		Prioritising plant proteins	[1] Very small benefit [2] Small benefit [3] Unsure [4] Large benefit [5] Very large benefit
638		Reducing consumption of air freighted foods	[1] Very small benefit [2] Small benefit [3] Unsure [4] Large benefit [5] Very large benefit
639		Choosing sustainable fish	[1] Very small benefit [2] Small benefit [3] Unsure [4] Large benefit [5] Very large benefit
640		Reducing food waste	[1] Very small benefit [2] Small benefit [3] Unsure [4] Large benefit [5] Very large benefit
641		Choosing organic produce	[1] Very small benefit [2] Small benefit [3] Unsure [4] Large benefit [5] Very large benefit

Readiness of adolescents to adopt an environmentally sustainable diet

		How ready are you	
642		To avoid products with excess packaging?	[1] I am not interested in doing this at the moment (pre-contemplation) [2] I am thinking about this but I need more information (contemplation) [3] I would like to do this but there are things stopping me (planning) [4] I have started to do this some of the time (action) [5] I am doing this confidently most of the time (maintenance)

			[6] I am not currently doing this but have done in the past (relapse)
643		To buy locally grown produce?	[1] I am not interested in doing this at the moment (pre-contemplation) [2] I am thinking about this but I need more information (contemplation) [3] I would like to do this but there are things stopping me (planning) [4] I have started to do this some of the time (action) [5] I am doing this confidently most of the time (maintenance) [6] I am not currently doing this but have done in the past (relapse)
644		To consume seasonal fruits and vegetables?	[1] I am not interested in doing this at the moment (pre-contemplation) [2] I am thinking about this but I need more information (contemplation) [3] I would like to do this but there are things stopping me (planning) [4] I have started to do this some of the time (action) [5] I am doing this confidently most of the time (maintenance) [6] I am not currently doing this but have done in the past (relapse)
645		To limit red and processed meat (e.g. sausages, bacon?)	[1] I am not interested in doing this at the moment (pre-contemplation) [2] I am thinking about this but I need more information (contemplation) [3] I would like to do this but there are things stopping me (planning) [4] I have started to do this some of the time (action) [5] I am doing this confidently most of the time (maintenance) [6] I am not currently doing this but have done in the past (relapse)
646		To prioritise plant proteins?	[1] I am not interested in doing

			this at the moment (pre-contemplation) [2] I am thinking about this but I need more information (contemplation) [3] I would like to do this but there are things stopping me (planning) [4] I have started to do this some of the time (action) [5] I am doing this confidently most of the time (maintenance) [6] I am not currently doing this but have done in the past (relapse)
647		To reduce consumption of air freighted foods	[1] I am not interested in doing this at the moment (pre-contemplation) [2] I am thinking about this but I need more information (contemplation) [3] I would like to do this but there are things stopping me (planning) [4] I have started to do this some of the time (action) [5] I am doing this confidently most of the time (maintenance) [6] I am not currently doing this but have done in the past (relapse)
648		To choose sustainable fish?	[1] I am not interested in doing this at the moment (pre-contemplation) [2] I am thinking about this but I need more information (contemplation) [3] I would like to do this but there are things stopping me (planning) [4] I have started to do this some of the time (action) [5] I am doing this confidently most of the time (maintenance) [6] I am not currently doing this but have done in the past (relapse)
649		To reduce food waste?	[1] I am not interested in doing this at the moment (pre-contemplation)

			[2] I am thinking about this but I need more information (contemplation) [3] I would like to do this but there are things stopping me (planning) [4] I have started to do this some of the time (action) [5] I am doing this confidently most of the time (maintenance) [6] I am not currently doing this but have done in the past (relapse)
650		To choose organic produce?	[1] I am not interested in doing this at the moment (pre-contemplation) [2] I am thinking about this but I need more information (contemplation) [3] I would like to do this but there are things stopping me (planning) [4] I have started to do this some of the time (action) [5] I am doing this confidently most of the time (maintenance) [6] I am not currently doing this but have done in the past (relapse)

L. PARENTING STYLE

Please rate how often your mother or caregiver engages in the different parenting practices listed below on a scale of 1-5, where: [1] = Never, [2] = Rarely, [3] = Sometimes, [4] = Often and [5] = Always.

SUBFACTOR 1 (Warmth & Involvement)

Sample items:

700. I can count on my parents to help me out when I have any problems

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

701. When my parent wants me to do something, she (he) explains why

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

702. I find it very easy to talk to my parent openly. She (he) is very involved in my life.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

703. My parent keeps pushing me to do my best in whatever I do.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

704. My parents make time to talk to me.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

705. If I do well my parents give praise and show admiration.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

706. Me and my parents regularly do something fun together.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

707. My parent listens to my opinion or perspective when I've got a problem.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

708. My parent puts time and energy into helping me.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

709. My parent seems to think of me often.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

710. My parent spends a lot of time with me.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

711. My parent helps me to choose my own direction.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

712. My parent praises me when I am good.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

713. My parent appreciates what I try or accomplish.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

714. My parent encourages me to talk about my troubles.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

715. My parent is responsive to my feelings or needs.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

716. When I have a bad result my parents encourage me to do better.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

717. My parent shows sympathy when I am hurt or frustrated.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

718. My parent gives me comfort and understanding when I am upset.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

SUBFACTOR2: Strictness, demandingness, control

Please rate how often your mother or caregiver engages in the different parenting practices listed below on a scale of 1-5, where: [1] = Never, [2] = Rarely, [3] = Sometimes, [4] = Often and [5] = Always.

719. When I come home or leave the house, I have to tell my parents.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

720. My parents really know what I do in my leisure time.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

721. My parents really know where I go in the evenings.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

722. My parents tell me exactly what time to be home when I go out.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

723. My parents give me certain jobs to do and will not let me do anything else until they are done.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

724. My parents believe in having a lot of rules and sticking to them.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

725. My parents make sure I know exactly what I can and cannot do.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

726. Most of the time my parents know exactly where I am when I go out.

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

727. In a typical week, on a school night (Sunday-Thursday), I am usually not allowed to stay out after 7pm?

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

728. In a typical week, on a Friday-evening or Saturday-evening, I am usually not allowed to stay out after 8pm?

[1] Never [2] Rarely [3] Sometimes [4] Often [5] Always

M. PARENTAL HEALTHY FOOD ROLE MODELLING (ROLE MODELLING AT SNACK TIME, PARENTAL ROLE MODELLING)

729. When I am with my parent(s) or caregiver they drink 100% fruit juice.

[1] Never [2] Hardly ever [3] Sometimes [4] Usually/Always

730. When I am with my parent(s) or caregiver they do not add salad dressing or mayonnaise to their salads.

[1] Never [2] Hardly ever [3] Sometimes [4] Usually/Always

731. When I am with my parent(s) or caregiver they eat fruit as a snack.

[1] Never [2] Hardly ever [3] Sometimes [4] Usually/Always

732. When I am with my parent(s) or caregiver they eat vegetables or salad as a snack.

[1] Never [2] Hardly ever [3] Sometimes [4] Usually/Always

Role modelling at dinner

733. When I am with my parent(s) or caregiver they eat fruit at dinner.

[1] Never [2] Hardly ever [3] Sometimes [4] Usually/Always

734. When I am with my parent(s) or caregiver they eat vegetables at dinner.

[1] Never [2] Hardly ever [3] Sometimes [4] Usually/Always

735. When I am with my parent(s) or caregiver they eat green salad at dinner.

[1] Never [2] Hardly ever [3] Sometimes [4] Usually/Always

736. When I am with my parent(s) or caregiver they make half of the food on their plate at dinner fruits and vegetables.

[1] Never [2] Hardly ever [3] Sometimes [4] Usually/Always

N. BARRIERS TO CHANGE [PROBE ALL “YES” ANSWERS]

737. Do you know which foods must be restricted to reduce dietary intake of fats and cholesterol?

[1] Yes [0] No

738. Do you know which foods must be restricted to reduce dietary intake of sugar?

[1] Yes [0] No

739. Do you know which foods must be eaten to increase dietary intake of fibre?

740. [1] Yes [0] No

741. Do you know which benefits you could gain by eating a healthy diet?

[1] Yes [0] No

742. Do you know how to improve your diet?

[1] Yes [0] No

743. Do you know how much you must eat to satisfy your energy requirement?

[1] Yes [0] No

744. Do you know how important it is not to be influenced by your friends in choosing your food?

[1] Yes [0] No

745. Do you think that your family would support your efforts in improving your food habits?

[1] Yes [0] No

O. BARRIERS EXPERIENCED TO HEALTHY EATING

746		Lack of will power	[1] [2] [3] [4]
747		Don't want to give up foods that I like	[1] [2] [3] [4]
748		Busy lifestyle/preparation of healthy food too inconvenient	[1] [2] [3] [4]
749		Price of healthy foods too expensive	[1] [2] [3] [4]
750		Taste preferences for unhealthy food	[1] [2] [3] [4]
751		Don't want to change eating habits	[1] [2] [3] [4]
752		Lack of cooking skills	[1] [2] [3] [4]
753		Experts keep changing minds on what is healthy	[1] [2] [3] [4]
754		Lack of knowledge about healthy eating	[1] [2] [3] [4]
755		High fat foods tasted better	[1] [2] [3] [4]
756		I always feel like eating whatever I want	[1] [2] [3] [4]
757		I eat a lot of meals away from home	[1] [2] [3] [4]
758		Holidays and special occasions are my problem	[1] [2] [3] [4]

759		It is easier to always snack	[1] [4]	[2]	[3]
760		It takes too much planning to prepare and eat a healthier diet	[1] [4]	[2]	[3]
761		There are no healthy food options at my school	[1] [4]	[2]	[3]
762		There were no healthier foods sold in my community	[1] [4]	[2]	[3]
763		High fat foods are a traditional part of my culture	[1] [4]	[2]	[3]
764		Healthier foods are too expensive	[1] [4]	[2]	[3]
765		I can't keep track of what I need to eat	[1] [4]	[2]	[3]
766		Fruits and vegetables don't fill me up	[1] [4]	[2]	[3]
767		Fruits and vegetables are too expensive	[1] [4]	[2]	[3]
768		Fruits and vegetables do not taste as nice as high fat foods	[1] [4]	[2]	[3]
769		I don't like the taste of healthier foods	[1] [4]	[2]	[3]
770		Fruits and vegetables took too long to prepare	[1] [4]	[2]	[3]
771		I do not know how to cook vegetables	[1] [4]	[2]	[3]
772		I do not know where to find low fat foods	[1] [4]	[2]	[3]
773		My family does not support me for eating more healthfully	[1] [4]	[2]	[3]
774		I do not know how to cook healthier meals	[1] [4]	[2]	[3]
775		Lack of self-control	[1] [4]	[2]	[3]
776		Convenience	[1] [4]	[2]	[3]
777		Lack of access to healthy foods	[1] [4]	[2]	[3]
778		Negative attitude towards healthy foods	[1] [4]	[2]	[3]
779		Lack of knowledge and support	[1] [4]	[2]	[3]

800. The next 4 questions ask about cleaning your teeth and washing your hands.

13. During the past 30 days, how many times per day did you usually clean or brush your teeth?

[1] I did not clean or brush my teeth during the past 30 days

[2] Less than 1 time per day

[3] 1 time per day

[4] 2 times per day

[5] 3 times per day

[6] 4 or more times per day

801. Occasion of tooth brushing

- [1] in the morning
- [2] in the evening
- [3] after meals
- [4] after dessert/sweets

802. Use of toothpaste

- [1] non-fluoridated
- [2] fluoridated

803. Where does dental plaque start in the mouth

- [1] on the tongue
- [2] on the gums
- [3] on the teeth
- [4] all the above mentioned
- [5] never heard about plaque
- [6] don't know

804. Reasons of brushing teeth

- [1] clean, bright teeth
- [2] prevention of caries
- [3] prevention of bleeding gums
- [4] prevention of oral ulcer
- [5] to get rid of foul breath
- [6] to set good example to others

805. Reasons of not brushing teeth

- [1] bother me too much
- [2] no time for brushing
- [3] useless, good teeth are hereditary
- [4] gums are bleeding when brushing
- [5] no money for brush and toothpaste
- [6] nobody brushes teeth in my family
- [7] don't know of any benefits from brushing
- [8] always forget to brush my teeth
- [9] don't like the smell of toothpaste

806. Number of times having seen a dentist

- [1] never
- [2] 1–2 times
- [3] 3 or more times

807. Time since last visit to the dentist

- [1] less than 1 year
- [2] 1–2 years ago
- [3] 3 or more years ago
- [4] never seen a dentist

808. Preventive services received during

- [1] the recent two years
- [2] check-up of teeth

- [3] topical application of fluoride
- [4] fissure sealing
- [5] scaling of teeth

809. During the past 30 days, how often did you wash your hands before eating?

- [1] Never
- [2] Rarely
- [3] Sometimes
- [4] Most of the time
- [5] Always

810. During the past 30 days, how often did you wash your hands after using the toilet or latrine?

- [1] Never
- [2] Rarely
- [3] Sometimes
- [4] Most of the time
- [5] Always

811. During the past 30 days, how often did you use soap when washing your hands?

- [1] Never
- [2] Rarely
- [3] Sometimes
- [4] Most of the time
- [5] Always

The next 11 questions ask about drinking alcohol. This includes drinking beer, akpeteshie, plam wine, pito, gin, brandy, bonsamnsou, yebudidi, schnapps, Johnny Walker, or Guinness. Drinking alcohol does not include drinking a few sips of wine for religious purposes. A “drink” is a glass of wine, a bottle of beer, a small glass of liquor, or a mixed drink.

812. How old were you when you had your first drink of alcohol other than a few sips?

- [1] I have never had a drink of alcohol other than a few sips
- [2] 7 years old or younger
- [3] 8 or 9 years old
- [4] 10 or 11 years old
- [5] 12 or 13 years old
- [6] 14 or 15 years old
- [7] 16 or 17 years old
- [8] 18 years old or older

813. During the past 30 days, on how many days did you have at least one drink containing alcohol?

- [1] 0 days
- [2] 1 or 2 days
- [3] 3 to 5 days
- [4] 6 to 9 days
- [5] 10 to 19 days
- [6] 20 to 29 days
- [7] All 30 days

814. During the past 30 days, on the days you drank alcohol, how many drinks did you usually drink per day?

- [1] I did not drink alcohol during the past 30 days
- [2] Less than one drink
- [3] 1 drink
- [4] 2 drinks
- [5] 3 drinks
- [6] 4 drinks
- [7] 5 or more drinks

814. During the past 30 days, how did you usually get the alcohol you drank? SELECT ONLY ONE RESPONSE.

- [1] I did not drink alcohol during the past 30 days
- [2] I bought it in a store, shop, or from a street vendor
- [3] I gave someone else money to buy it for me
- [4] I got it from my friends
- [5] I got it from my family
- [6] I stole it or got it without permission
- [7] I got it some other way

815. Where were you the last time you had a drink of alcohol?

- [1] I have never had a drink of alcohol
- [2] At home
- [3] At someone else's home
- [4] At school
- [5] Out on the street, in a park, or in some other open area
- [6] At a bar, pub, or disco
- [7] In a restaurant
- [8] Some other place

816. Which of your parents or guardians drink alcohol?

- [1] Neither
- [2] My father or male guardian
- [3] My mother or female guardian
- [4] Both
- [5] I do not know

817. During this school year, were you taught in any of your classes how to tell someone you did not want to drink alcohol?

- [1] Yes
- [0] No
- [2] I do not know

Staggering when walking, not being able to speak right, and throwing up are some signs of being really drunk.

818. During your life, how many times did you drink so much alcohol that you were really drunk?

- [1] 0 times
- [2] 1 or 2 times
- [3] 3 to 9 times
- [4] 10 or more times

819. During the past 30 days, how many times did you drink so much alcohol that you were really drunk?

- [1] 0 times
- [2] 1 or 2 times
- [3] 3 to 9 times
- [4] 10 or more times

820. During your life, how many times have you got into trouble with your family or friends, missed school, or got into fights, as a result of drinking alcohol?

- [1] 0 times
- [2] 1 or 2 times
- [3] 3 to 9 times
- [4] 10 or more times

821. How many of your friends frequently drink 5 or more drinks on one occasion?

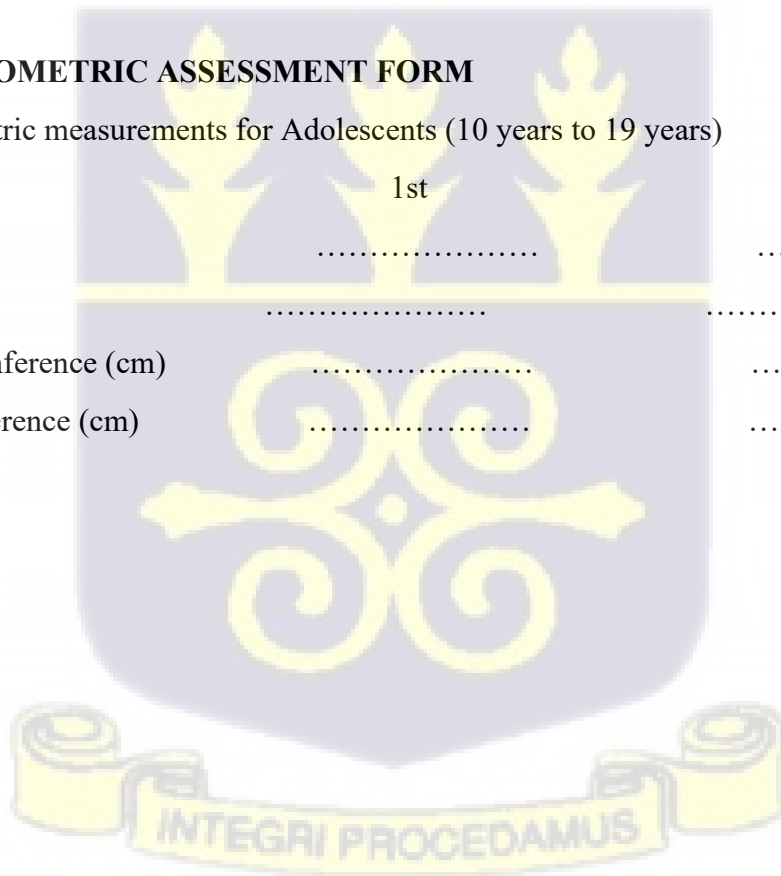
- [1] None
- [2] A few
- [3] Some
- [4] Most
- [5] All

ANTHROPOMETRIC ASSESSMENT FORM

Anthropometric measurements for Adolescents (10 years to 19 years)

Variable	1st	2nd
Weight (kg)		
Height (cm)		
Waist circumference (cm)		
Hip circumference (cm)		

Thank you



Appendix 8: Adolescent Interview Guide

Title

The aim of research (5 Minutes)

6. Greetings and introduction
7. The aim of research: The aim of the research is to explore the eating habits of adolescents in different cultures: what kind of differences can be explored in the eating habits of different ethnic groups. What kind of factors influence food choice, especially cultural characteristics, such as values, family, tradition, religion, sustainability).
8. General rule: There are no good or bad answers.
9. Anonymity, recording
10. Introduction of the main topics of the interview

V. Individual factors (10 Minutes)

- Could you please introduce yourself with a few words?
- What is your name? How old are you? What is your profession? Where did you go to school?
- Where were you born? In which region? What is your ethnicity?
- Where do you live at present? How long have you been living in your current place?

Food consumption and favourite foods

- Could you talk a little bit about your food?
- Generally, what type of food do you eat? Is there any food that you don't eat or you are not allowed to eat?
- What foods do you like? Why? What foods do you dislike? Why? Any cultural and religious taboos about food? What are these foods?
- Tell me about your food intake, fruit intake, vegetable intake, energy dense food intake, sugar-sweetened beverages intake, oily foods, meat,
- What are your favourites dishes? Are these healthy or not?
- Do you follow any kind of special diet? If yes, which one and what is your reason?
- How often do you eat in a day?

Place of eating

- Where do you usually eat during day time?

Who?

- With whom do you usually eat together?

Beliefs about food

- Your beliefs about food. What is healthy food? What is unhealthy food?
- Your beliefs about food, what is a healthy diet, the effects of what you eat on your health.
- Tell me about your beliefs about food, healthy foods, spending money on food, being wasteful.

Barriers

- Let's us talk about your biggest barrier to healthy eating
- How do other people in your life impact how many fruits and vegetables you eat?
- Think about when you are at home; is there anything that prevents you from eating fruits and vegetables?

Socio-economic barriers

- What are the barriers to your intake of fruits and vegetables?
- Are you able to pay for the fruits and vegetables that are available?

Facilitators

- What helps you eat healthy?

Knowledge

- Let's talk about your knowledge or awareness of nutrition
- Why do you think people need to eat fruits and vegetables? What are the benefits of consuming fruits and vegetables?
- What do you believe is the main reason why some adolescents do not consume enough fruits and vegetables?
- Tell me about your understanding of dietary restrictions, and ability to identify healthy foods
- Tell me about eating habits and what's in food and things like that.
- How many fruits and vegetables do you eat a day?

Availability

- Are there always fruits and vegetables at home?

Preference

- Fruits and vegetables, what do you prefer? Why?

Skill

- Do you take time to prepare your meal so you can eat healthy? How easy is it for you to choose a healthy snack?
- How do you prepare fruits and vegetables before consumption? Is that difficult?

VI. Social Environmental

3. Parental Influence

- Could you talk a little bit about your family?
- What kind of food do people usually eat in your culture? What do they prefer?

Parental influence on the home environment (10 Minutes)

- At home do your parents monitor what you eat?
- Do your parents influence what you eat? How you eat? Do your parents encourage healthy eating behaviours at home? How? Do they eat fruits and vegetables? Do they eat while watching TV?
- Are there fruits and vegetables at home?
- Are there any family negative attitudes and beliefs that affect your diet?
- What does a typical family lunch look like in your home? Have you got any special habits?
- Are there any differences between the food that you eat weekdays and in the weekend?
- Who does food shopping in your family? Who does the cooking in your family?
- Do you cook? How often do you cook?
- How do you usually prepare the food in your home and in your community?
- How does the eating habits change on festive occasions in your culture?
- What role does food play in your culture?
- Besides traditional food, what kind of special food do you eat?
- **Modelling**
- How common is it to find your father/mother or other family members eating junk foods?
- How common is it to find your father/mother or other family members eating fruits and vegetables?

4. Peer Support (5 Minutes)

- Who are your friends? How often do you meet them? What do you usually do together in your free time?
- What is your hobby? What do you like doing in your spare time?
- Interpersonal support for healthy behaviour change.
- Do your friends share information with you about diets?
- What do they usually eat?
- Do you eat what they eat?
- Do you feel pressurized to eat what they eat? Are these healthy foods?
-

VII. THE FACTORS OF FOOD CHOICE (10 Minutes)

- What factors do you take into consideration when choosing food? (E.g. Traditional, climate friendly, cost, friends like it, family likes it)
- What do you usually look at first on the food product when purchasing?
- How important is quality for you? And what about the risks?
- What do you usually read on the label of the product?
- Are you afraid of any risks in food consumption?
- Who buys the food in your family? What kind of shops do you prefer when it comes to purchasing food?
- How much do you insist on traditional food?
- How much are you willing to try new or unknown food? Are you ready to cook such kind of food?
- **Modelling**
- How common is it to find your friends and peers eating junk foods?
- How common is it to find your friends and peers eating fruits and vegetables?
-

VIII. CULTURE AND FOOD CONSUMPTION (10 Minutes)

- What does the definition of culture mean to you? Could you please describe your thoughts?
- What are the main values in your life?
- How important are these values in your food consumption?
- From the statements below, please choose the one that you most agree with:
 - I pay attention to healthy nutrition and balanced diet
 - For me, it is more important that the food is tasty even if it is not so healthy
 - Price is the most important factor in food choice
 - The lunch that I consume together with my family is the most important for me
 - In my opinion, healthy diet can contribute to the prevention of diseases
- What type of food do you know that originally belongs to other nations? How often do you prepare or buy such kind of food?
- How often do you meet people of different origin, from different ethnicities or cultures?
- Do you travel to other regions? How often? When did you last travel? What was the reason?
- Which was the longest time that you spent in another community or region? Why?
- What kind of differences did you meet between the habits of people with different cultures?
- What cultural differences did you meet between the habits of people with different cultures?

- What cultural differences did you notice between the eating habits of other people of different ethnicities?
- What can be the reason for these differences?
- Was it hard for you to accommodate yourself to these different habits when you were away from your community? Could you describe your feelings?

V. Physical Environmental

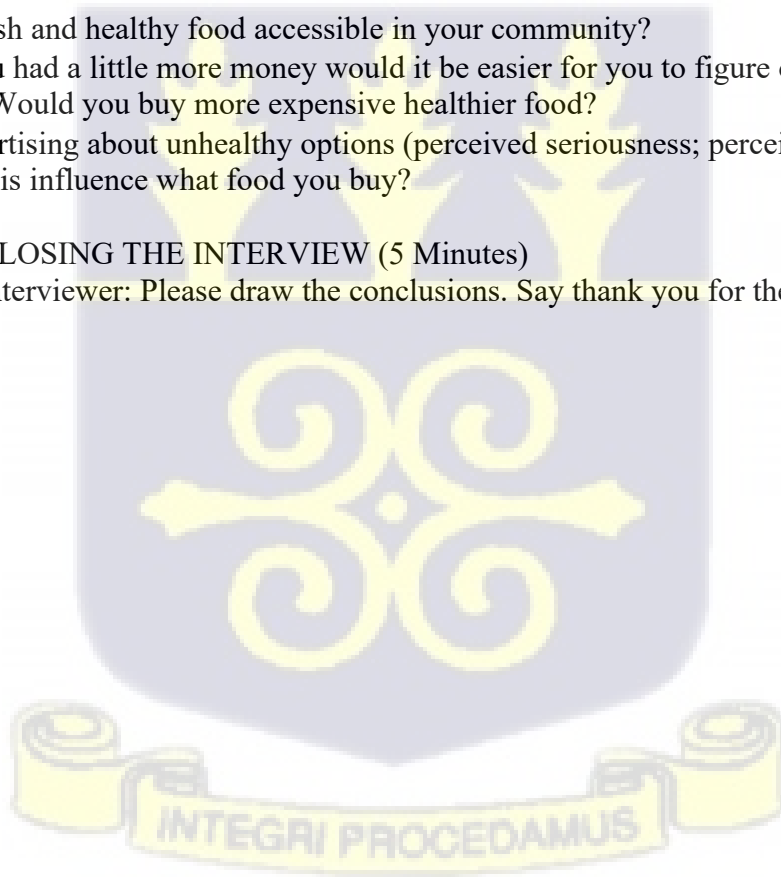
- What aspects of your community environment foster healthy eating?
- Your living situation: Available foods: Are there healthy options? limited healthy options or not?
- Availability and accessibility of fruits and vegetables
- Unhealthy options
- Socioeconomic status
- How many fruits and vegetables do you eat a day?
- How do other people in your life impact how many fruits and vegetables you eat?
- Think about when you are at home; is there anything that prevents you from eating fruits and vegetables?

Macrosystem (Social media, government policy)

- Do you see or watch promotions about vegan or vegetarian diets or healthy foods?
- **Cost**
- Is fresh and healthy food accessible in your community?
- If you had a little more money would it be easier for you to figure out what food to eat? Would you buy more expensive healthier food?
- Advertising about unhealthy options (perceived seriousness; perceived susceptibility). Do this influence what food you buy?

VI. CLOSING THE INTERVIEW (5 Minutes)

Interviewer: Please draw the conclusions. Say thank you for the participation



Appendix 9: Ethical Clearance

NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH
Established 1979A Constituent of the College of Health Sciences

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Your Ref. No:

INSTITUTIONAL REVIEW BOARD

University of Ghana
Post Office Box LG 581
Legon, Accra
Ghana

5th May, 2021

ETHICAL CLEARANCE

FEDERALWIDE ASSURANCE FWA 00001824 **IRB 00001276**

NMIMR-IRB CPN 051/20-21 **IORG 0000908**

On 5th May 2020, the Noguchi Memorial Institute for Medical Research (NMIMR) Institutional Review Board (IRB) at a full board meeting reviewed and approved your protocol titled:

TITLE OF PROTOCOL : Drivers of healthy lifestyle behaviour among adolescents in the Volta and Oti Regions of Ghana

PRINCIPAL INVESTIGATOR : Amuna Norbert Ndaah, MPhil Cand.

Please note that a final review report must be submitted to the Board at the completion of the study. Your research records may be audited at any time during or after the implementation.

Any modification of this research project must be submitted to the IRB for review and approval prior to implementation.

Please report all serious adverse events related to this study to NMIMR-IRB within seven days verbally and fourteen days in writing.

This certificate is valid till 4th May, 2022. You are to submit annual reports for continuing review.

Signature of Chair:
Dr. Abraham Hodgson
(NMIMR – IRB CHAIR)