UNIVERSITY OF GHANA

COLLEGE OF HEALTH SCIENCES

ASSOCIATION BETWEEN DIETARY PATTERNS AND BODY MASS INDEX OF PRIMARY AND JUNIOR HIGH SCHOOL CHILDREN IN ACCRA METROPOLITAN AREA

BY

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DECLARATION

I, Deborah Adwoa Konadu Amoah, do hereby declare that, except for references to people's work which has been duly cited, this thesis has entirely resulted from my personal original research under the supervision of Dr. Joana Ainuson Quampah and Rev. Dr. Thomas Akuetteh Ndanu at the University of Ghana, School of Biomedical and Allied Health Sciences, College of Health Sciences, Department of Dietetics.

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ABSTRACT

Background: The analysis of dietary pattern has emerged as a useful epidemiological approach to understanding the diet-disease relationships in both adults and children. Child malnutrition is still being combated worldwide and the situation is even worse in Sub Saharan Africa. In Ghana, childhood malnutrition continuous to be alarming, while managing the incidence of underweight and micronutrient deficiencies, emerging research suggest that childhood obesity is also on the rise in Ghana. The Ghanaian diet is changing from the traditional foods to western diets and this transition has greatly influenced the diet pattern of Ghanaians and their children.

Aim: To assess the possible relationship between the dietary patterns of school children and their Body Mass Index.

Methods: A retrospective cross-sectional study design that used questionnaires from a secondary cross-sectional data at the Department of Community and Preventive Dentistry, University of Ghana Dental School. This secondary data assessed the dietary habits and oral health of Primary and Junior High school children from both Private and Public schools in the Accra Metropolitan area. 512 questionnaires of students between ages 9-15 years were pooled for analysis in this study. Food Frequency, anthropometric data and demographic data of the school children was extracted from the questionnaire. IBM Statistical Package for Social Sciences (SPSS) version 25 was used for analysis. Descriptive summaries were presented as frequencies for categorical variables and as means and standard deviations for continuous variables. The dietary patterns were determined by PCA analysis. Pearson's correlation and simple linear regression tests were used to determine the association between dietary pattern scores and BMI as well as socio-demographic characteristics. An independent t-test was used to find the differences in means between males and females for weight, height, and BMI. Statistical significance was set as $p<0.05$.

Results: Four (4) dietary patterns were identified: Fruits and Energy dense, Non-Traditional, Sweets and Protein and Dairy dietary patterns. The four (4) dietary patterns explained 37.7% of the total variance in the dietary intake data. More females (60.3%) than males (40.8%) were obese. The Fruit and Energy dense dietary pattern was significantly associated with age, class level, staying with parents, mother's occupation, and a medium household SES. The Sweets and Protein dietary pattern was significantly associated with age, class level and high household SES. Both the Non-Traditional and Diary dietary pattern were significantly associated with mother's education. The Non-Traditional and Dairy dietary patterns were significantly associated with BMI.

Conclusion: There was a high prevalence of obesity among the female school children than their male counterpart. Four dietary patterns were identified and out of this number two dietary patterns thus, the Non-Traditional and Dairy dietary patterns were significantly associated with BMI. This study has also demonstrated that there is an association between dietary patterns and socio-demographic characteristics such as age, household SES and mother's educational level.

DEDICATION

I dedicate this work firstly to God for giving me strength in this season. To my Mum and Dad, I am very grateful for your support, prayers, and encouragement, I hope you reap the benefits of the precious time and money invested in this program. Finally, to Pastor Nk and his wife, Rev. Bernard Lartey and Bishop Odenkey for all the support and prayers you meted out to me in this season.

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LIST OF ABBREVIATIONS

DP- Dietary Patterns

BMI- Body Mass Index

PCA- Principal Component Analysis

FFQ- Food Frequency Questionnaire

KMO- Keiser-Meyer-Olkin test

SES- Socioeconomic Status

NCDs- Non-Communicable Diseases

FBDG- Food Based Dietary Guidelines

CHAPTER 1

1.0 INTRODUCTION

1.1 Background

Dietary pattern is an area of nutrition that has contributed to providing explanation to the occurrence of non-communicable diseases (Ashigbe, 2015). The foods we eat deliver energy and nutrients which are essential for human health, as a result, consuming a poor diet over a period of time leads to poor health outcomes (Tapsell et al., 2016; Leech et al., 2015). The daily food choices (what people decide to buy and eat) eventually culminate into a pattern (Neacsu, Mcbey & Johnstone, 2017). Dietary pattern refers to the general profile of food taking into consideration the quantity, variety or combination of different foods and beverages as well as the frequency with which they are habitually consumed (Villegas-Sanchez & Sanchez-Tainta, 2017).

Studies have revealed that adequate intake of nutrients improves our health, and excess or limited consumption of some nutrients increases our risk of developing chronic diseases and or results in adverse health outcomes (Muscaritoli et al, 2010; WHO, 2003). As a result, “previous studies in nutritional epidemiology examined diseases in relation to single nutrients or a few nutrients or some particular foods” (Hu, 2002). Though this approach was very valuable especially that it informed the development of certain dietary interventions, it had some limitations. One of such limitations was that it could not account for the synergistic or possible antagonistic relationship that may exist between components in a particular food (Tapsell et al., 2016). In recent years the study of dietary patterns is preferred when interpreting the burden of diet-related diseases (Hu, 2002; Tapsell et al., 2016). This is because “the analysis of dietary patterns gives a more comprehensive impression of the food consumption habits within a population and it is better at predicting the risk of diseases than the analysis of isolated nutrients or foods" (Omage & Omuemu, 2018).

Globally, the observed changes in lifestyle and dietary patterns are due to technological advances, environmental and social changes, which in turn have also greatly affected the health of people (McMichael & Beaglehole, 2000). Often this change has increased the prevalence of overweight and obesity, and Non-Communicable Diseases (NCDs) such as hypertension, type 2 Diabetes, cardiovascular diseases (CVDs) and cancers (Madrigal et al, 2019). In the Europe and North American regions, changes in lifestyle and dietary pattern have caused them to gather enough data on the dietary pattern of their population, which has enabled them to develop national Food-based Dietary Guidelines (Herforth et al., 2019; Clay, 1997; La Vecchia & Majem, 2015). "Food-based Dietary Guidelines (FBDGs) provide context-specific advice and principles on healthy diets and lifestyles, which are rooted in sound evidence, and respond to a country's public health and nutrition priorities as well as food production and consumption patterns, sociocultural influences, food composition data and food accessibility" (FAO, 2021). The FBDGs provide general indications of what foods a population should eat rather than nutrients (Montagnese et al, 2015). The FBDGs also help to optimize nutritional status, prevent under and over nutrition, and decrease risk of non-communicable diseases in populations. This is possible because the FBDGs provide an easy-to-understand and a basic framework (of a healthy balanced diet) for use when planning daily meals and menus (Montagnese et al, 2015). Unfortunately, several Sub-Saharan countries including Ghana have limited data on the dietary pattern of their population and as a result may not be able to formulate their own FBDGs (La Vecchia et al., 2015; Abizari & Ali, 2019).

These Sub-Saharan African countries are still battling with the triple burden of malnutrition: this is characterized by the co-existence of under-nutrition (stunting, wasting), micronutrient deficiencies and over-nutrition (overweight and obesity) (Davis et al., 2019). Over-nutrition and under-nutrition are conditions associated with an increased risk of developing non-Communicable diseases. Therefore, the analysis of dietary pattern in areas like Sub-Saharan Africa has emerged as a useful epidemiological approach to understanding the diet-disease relationships (Abizari & Ali, 2019).

Ghana is undergoing nutrition transition. The Ghanaian diet is changing from the traditional foods (less saturated fats and sugars, more whole grains, fruits and vegetables) to westernized diets (saturated fats, protein, refined carbohydrates and salts) (Ogum Alangea et al., 2018). This nutrition transition has had a great influence on the food choices of Ghanaian children and consequently their food patterns (Abizari & Ali, 2019). It is reported that dietary patterns formed during childhood usually do not change much and are often carried into adulthood (Movassagh et al., 2017). A study done among Junior High School children in the urban cities of Cape Coast, a town in Ghana, found that they preferred and chose high fat, high sugar and energy dense foods such as fried rice, fried chicken, fried plantain, soft/carbonated drinks, sugar bread among many others (Buxton, 2014). These findings show unhealthy eating pattern among school children which is a risk factor in the development of overweight and obesity. It is therefore necessary to conduct more of such studies in different parts of the country to know the dietary pattern of school age children and to tailor appropriate intervention. Unfortunately, for the past few years, there exist limited data on the dietary patterns of the school age Ghanaian children.

1.2 PROBLEM STATEMENT

Child malnutrition (over and under nutrition) remains a public health problem in Sub-Saharan Africa (Akumbi et al, 2017). Childhood malnutrition begins right from infancy as WHO reports showed that about 45% of deaths of children under 5 years were attributed to under nutrition in West Africa (WHO, 2018). According to the United Nations International Children's Emergency Fund (UNICEF), in Ghana, one in every five children under 5 years is stunted at the same time one in every ten children under 5 years is underweight (Keeley et al., 2019). Additionally, obesity cases are on the rise among Sub-Saharan African children including Ghana (Santos et al, 2016: Abarca-Gomez et al, 2017).

A recent study on childhood obesity done among school age children in the urban settings of Ghana, found a prevalence of 46.9% and 21.2% of overweight and obesity respectively (Ganle et al., 2019). This can primarily be attributed to poor dietary patterns that these children follow (Liu et al., 2018; Movassagh et al., 2017). Promotion of healthy dietary habits in children is therefore necessary to prevent diet-related diseases (Liu et al., 2018).

Unfortunately, limited studies exist among Sub-Saharan African countries to understand the dietary patterns of this population. In Ghana, very few studies have assessed the dietary patterns of school age children. One of such studies which assessed the dietary pattern of school age children in the Northern part of Ghana found two (2) dietary patterns that is sweet-tooth pattern and traditional pattern (Abizari & Ali, 2019). Another study that was conducted at the Ga-East municipality identified four (4) dietary patterns; energy dense pattern, starchy roots and vegetables pattern, grain-based and poultry pattern and fish/seafood pattern (Ogum Alangea et al, 2018). The energy dense dietary pattern was associated with overweight/obesity. The identification of different dietary patterns in these few studies highlight the need for further studies to understand the dietary patterns of children and its association with risk factors of chronic diseases.

1.3 SIGNIFICANCE OF STUDY

This study provides relevant information on dietary patterns and its association with the body mass index of school children in the Accra Metropolitan Area. Examination of the dietary pattern of children will equip stakeholders with the necessary information to provide appropriate intervention to deal with child malnutrition. The data collected serves as a practical and evidence-based information to nutrition related professionals and other public health providers in educating and promoting healthy eating patterns among school children.

1.4 Aim and Objectives

1.4.1 Aim

- To assess the possible relationship between the dietary patterns of school children and their Body Mass Index.

1.4.2 Specific Objectives

- To determine the frequency and variety of food consumption patterns of Primary and Junior High School children.
- To determine the BMI and nutritional status of Primary and Junior High School children.
- To determine the relationship between the dietary patterns and BMI and the impact of selected demographic characteristics on the relationship.

CHAPTER 2

2.0 LITERATURE REVIEW

2.1 Dietary Pattern and Nutritional Transition in Ghana

Dietary pattern refers to the general profile of food and nutrient consumption which is characterized based on usual eating habits (Sanchez & Sanchez-Tainta, 2017). The analysis of dietary patterns gives a more comprehensive impression of the food consumption habits within a population than the single-nutrient analysis (Omage & Omuemu, 2018). Dietary pattern has been seen to be better at predicting the risk of diseases than the analysis of isolated nutrients or foods because, the joint impact of different nutrients involved would be better identified (Hu, 2002). Patterns that are formed during childhood (especially the first decade of life) and during adolescence usually do not change and are often carried into adulthood (Ashigbe, 2015). Poor dietary habits formed during childhood and teenage years have public health implications due to evidence relating poor nutrition in childhood to subsequent obesity and elevated risks for type 2 diabetes, metabolic syndrome, and cardiovascular diseases (Omage & Omuemu, 2018).

Ghanaians, like most West Africans, usually consume carbohydrate-rich foods like millet, rice, maize, yam, cassava among many others and these energy dense meals are accompanied by protein-rich legumes and small quantities of vegetables and spices to add flavor and nutrition (Ashigbe, 2015). Nonetheless, Ghana is experiencing nutrition transition, and more people in the country are changing from consuming the traditional foods (less saturated fats and sugars, more whole grains, fruits and vegetables) to a more westernized diets (saturated fats, protein, refined carbohydrates and salts) (Ogum Alangea et al., 2018). The change in Ghanaian dietary habits and food choices was first noticed and described in the early 1990s and since then Ghana's nutrition transition has already started affecting the health of majority of its population including children (Abizari & Ali, 2019).

According to Ogum Alangea et al. (2018), there have been reports of consumption of sub-optimal diets among the school children and adolescents in Ghana. However, few research have assessed the dietary patterns that exist in the Ghanaian population, both in adult and in children. One of such studies which assessed the dietary pattern of school age children in the Northern part of Ghana identified two (2) dietary patterns: the sweet-tooth pattern and traditional pattern (Abizari & Ali, 2019). Another study that was conducted at the Ga-East municipality identified four (4) dietary patterns; energy dense pattern, starchy roots and vegetables pattern, grain-based and poultry pattern and fish/seafood pattern (Ogum Alangea et al, 2018).

2.2 The Food Choices of the Pediatric Population

Food preferences/choices are an important factor to the establishment of dietary pattern. Under the influence of social, biological and environmental factors, food preferences play a key role in food choices and quality of diet (Scaglioni et al., 2018). According to UNICEF many children around the world are introduced to the wrong diets when they are transitioning from soft foods to solid foods, as a result, modern day children are driven largely towards processed foods, fast foods and highly sweetened beverages (Keeley et al., 2019). Currently there is so much exposure of the pediatric population to television and mass media and there is research evidence that has established childhood obesity with television. This is because food advertisement that are shown on these platforms are either confectionary or foods and beverages that are high in sugar, fats and salt (Amos et al., 2012). The family greatly influences an individual's food choices. Some studies have shown that younger children's diet are influenced by their parents diet choices as well as the older children these younger ones look up to (Amos et al., 2012). Education and socioeconomic status (SES) also have great influence on dietary choices of children. According to Scaglioni et al. (2018), in developed countries, children born to parents of low SES have been associated with obesity and poor dietary choices (diet that are affordable to them are usually convenient processed foods). In Ghana, a study done among Junior High School children at the urban cities in Cape Coast found that these children preferred and chose high fat, high sugar and energy dense foods including fried rice, fried chicken, fried plantain, soft/carbonated drinks, sugar bread among many others (Buxton, 2014). Thus, the food choices of the school children are greatly influenced by the school and home food environment, and in Ghana now, the food systems in the home and school environment are failing (Laar et al., 2020).

2.3 Prevalence of Childhood Malnutrition

Under nutrition, over nutrition, anaemia and dental caries are major health concerns in the paediatric population (Abdollahi, Kianfar, Abtahi, & Amini, 2011; Hayter et al., 2015). Over the years there have been very little improvement in child malnutrition worldwide and Africa has not seen much of this improvement. The 2015 Millennium Development Goal reported that, globally about 7.7% of children were wasted, 24.5% were stunted and 15% were also underweight (United Nations, 2015). The African region reported the highest prevalence of these markers of under nutrition (Akumbi et al, 2017). The UNICEF also reported in the "State of the World's Children" that, in Ghana, one in every five children under 5 years is stunted at the same time one in every ten children under 5 years is underweight (Keeley et al., 2019).

Excess weight accumulation during childhood and subsequently into adolescence, remains one of the most important global health concern (Di Cesare et al., 2019). The recent prevalence of overweight and obesity worldwide has increased to 27.5% for adult and 47.1% for children (Danquah et al., 2019). Current studies have propounded that about 40 million children under the age of five years and more than 330 million children and adolescents aged 5-19years globally, were overweight or obese as at 2016 (Di Cesare et al., 2019; WHO, 2017). The World Health Organization stated in their report that the rate of increase of childhood obesity is 30% higher in developing countries than in developed countries and about 9 million overweight and obese cases comes from Africa alone (WHO, 2017). Low and middle income countries, such as the Sub-Saharan African (SSA) countries have seen a dramatic increase in obesity over the past two decades (Danquah et al., 2019). According to Tochie et al. (2019), data from the demographic health survey done in the SSA region from 2010 to 2014 suggest that 10.7million (6.8%) children under five were overweight and obese. The Ghanaian adult population is already battling with an obesity rate of 43% and emerging research suggest that childhood obesity is on the rise (Ganle et al., 2019). In a recent research where studies were done on childhood obesity in the urban settings of Ghana, 46.9% of the children studied were overweight while 21.2% were obese (Ganle et al., 2019).

2.4 Effects of Childhood Malnutrition

The effects of childhood malnutrition are both short and long term. Childhood obesity is known to affect the child's physical, social and emotional well-being as well as the child's self-esteem, academic performance and quality of life (Bhadoria et al., 2015). Medically, the conditions that can develop in an obese child include but are not limited to; asthma, fatty liver disease, Type 2 diabetes, sleep apnea, high cholesterol, cholelithiasis, glucose intolerance and resistance, skin conditions, menstrual abnormalities, impaired balance, orthopedic problems, cardiovascular diseases (Bhadoria et al., 2015). According to Di Cesare et al.(2019), overweight or obese children are at risk of also suffering from psychological comorbidities such as depression, anxiety, low self-esteem, a series of emotional and behavioral disorders. The long term consequences of childhood obesity is that, during adulthood the individual is at a risk of developing cardiovascular diseases, diabetes, some cancers and musculoskeletal disorders that can lead to disabilities and sometimes premature death (Di Cesare et al., 2019).

Also malnourished children are not able to reach their full physical and mental potential (Bain et al, 2013). Health and physical consequences of prolonged states of malnourishment among children include physical growth retardation and delay in motor development; lower intellectual quotient (IQ), more behavioral problems and deficient social skills and also susceptibility to contracting diseases (Kandala et al., 2011).

2.5 Methods for Defining Dietary Patterns

Determination of dietary pattern is not a direct procedure (Hu, 2002). Dietary pattern analysis measures the cumulative, interactive, and total consumption of foods and or combinations of nutrients in individuals and groups (Agnoli et al., 2019). The methodology for dietary pattern analysis was new two decades ago and have since undergone several developments and improvements and may still evolve in the near future (Agnoli et al, 2019; Hu, 2002). Currently there exist two types of dietary pattern analysis, 'A priori' method and 'A posteriori' method.

The A priori dietary pattern analysis involves the use of scores and indices to determine how well a diet adheres to a predetermined 'ideal' diet type or use these scores to measure diet quality (Agnoli et al, 2019; Hodge & Bassett, 2016). This analysis associate's adherence to a good-diet quality with health outcomes or specific diseases (Hodge & Bassett, 2016). Examples of this kind of analysis are the Healthy Eating Index, Recommended Food Score and Diet Quality Index (Nettleton et al, 2008). Though the A priori method is beneficial, it is noteworthy that food groups used in this method of analysis are broadly defined, that is the method does not take into consideration the small differences that exist among the nutrients and phytochemicals in the foods (Nettleton et al, 2008).

On the other hand, the A posteriori method is a data driven approach where eating patterns are derived through statistical modeling of dietary data (Hu, 2002; Agnoli et al, 2019). Unlike the A priori method, this approach is not based on preexisting knowledge or theory (Agnoli et al, 2019). Examples of the common methods used under this approach include factor analysis and cluster analysis (Hodge & Bassett, 2016). Factor analysis is based on inter-correlations between dietary variables while cluster analysis is based on individual differences in the mean intakes of dietary components (Agnoli et al, 2019). The types of factor analysis are Principal Component Analysis (PCA) and Common Factor Analysis. Currently, the PCA is more commonly used to derive the dietary patterns of food or nutrients. This is because dietary pattern derived using PCA were more predictive than those from factor analysis (Tucker, 2010). The aim of the PCA is to "identify the linear composites of food items or nutrients that account for the largest amount of variation in the diet of the sample members; while each observed nutritional variable contributes one unit of variance to the total variance in the dataset, the variance of the components to be retained is greater than 1" (Agnoli et al, 2019). Most of the available statistical software (Including SPSS) can run the principal component analysis with great precision

CHAPTER 3

3.0 METHODOLOGY

3.1 Study design

This study employed a retrospective cross-sectional study design. The questionnaires from a cross-sectional study at the Department of Community and Preventive Dentistry, University of Ghana Dental School were used. The secondary data that was used assessed the dietary habit and oral health of Primary and Junior High school children from both Private and Public schools in the Accra Metropolitan Area.

3.2 Study Site

The original sites for the data collection were the 8 private and 5 public schools within the Accra metropolitan area. The secondary data source was kept at the Department of Community and Preventive Dentistry, at the University of Ghana Dental School. This department deals with dental public health and carries out oral health outreaches for screening and oral health education in schools as well as the community. The Dental school is the major referral center for many oral health and dental challenges in Accra and the environs. It has various departments such as restorative dentistry, maxillofacial surgery department, Orthodontic and pedodontics department and runs daily dental clinic for the public.

3.3 Study Population

This study used data obtained from Primary and Junior High School children between age 9-15years. Data was collected from eight (8) Primary and Junior High private schools in the Accra Metropolitan Area.

3.3.1 Inclusion criteria

Completed data on the demographic, anthropometric and the food frequency questionnaire was used.

3.3.2 Exclusion Criteria

- Questionnaires with incomplete data.

3.4 Sample Size

All the data available that met the eligibility criteria was used. Available data was 547 private school children. Out of this number 512 had completed questionnaire.

3.5 Sampling

The original data from the secondary source was collected from eight private and five public schools in Accra. A list of all schools in Accra metropolitan area for both private and public schools were obtained from the Regional Education office. The list was stratified into Private and public schools. A multistage sampling was used to select the schools and children. First, the Schools were randomly selected by balloting. Then in each school two streams of classes were randomly selected and all children from classes 5 to JHS3 were recruited for their anthropometric data. In each class students were examined for their BMI and those who were obese were then matched for age and sex with the non-obese children. At the time of this study only 547 questionnaires from the 8 private schools were available. A total of 512 questionnaires were included in the study.

3.5.1 Recruitment of participants within schools from the original secondary data

Within each school, children (9-15years) in the primary classes 4-6 and JHS 1-3 were targeted. All the schools selected had more than one stream of classes. Two of the streams were randomly selected by balloting. All the children in classes 4 to JHS 3 who were present were screen for their weight categories.

Their weights, heights and ages were taken and used to compute their BMI-for-Age using WHO AnthroPlus software, 2006. Child obesity was defined as BMI-for-Age percentile greater or equal to 95th percentile (WHO,2002). The age and sex of those identified as obese were matched with the non-obese children in the same class.

3.6 Data Collection

The data were extracted using the eligibility criteria of this study. The secondary data had the following information about the school children; background/socio-demographic data, eating habits data, physical activity data, anthropometric data, food frequency questionnaire, oral health habits data and oral screening data. A data extraction form (appendix 1) was used to obtain information on the various socio-demographic characteristics of participants (Age, gender, class, living with parents, number of children in family, parent's level of education, parents' occupation, household Socioeconomic status and tenancy status), food frequency consumption, as well as anthropometric information (Height (m), weight (kg) and BMI (kgm^{-2}). The weight and height data were classified using CDC Anthro Growth Reference Charts, 2021. The questionnaires were collected from the office of the Department of Community and Preventive Dentistry.

3.6.1 Assessment and classifications of BMI

The Center for Disease and Control Prevention (CDC) recommended BMI-for-Age percentile cutoffs was used to determine the weight categories for the children. That is, children whose BMI-for-Age percentile was below the 5th percentile were classified as underweight. And those who had from the 5th percentile to < 85th percentile was classified as healthy or normal weight. And those who had from the 85th percentile to <95th percentile was classified as overweight. Lastly those who had from 95th percentile or greater were classified as obese.

3.7 Analysis of Data

Data were cleaned and analyzed using IBM Statistical Package for the Social Sciences (SPSS) version 25. Data were summarized as frequencies and proportions for categorical demographic characteristics such as gender, class, living with parents, parent's level of education, parents' occupation, household Socioeconomic status and tenancy status. Arithmetic means and standard deviations were used to summarize the continuous variables such as age, weight and height and BMI. Independent sample T-test was used to analyze the differences in means between males and females for weight, height, and BMI while Cross-tabulation was used to compare percentages of males and females among BMI categories.

The Dietary patterns were derived using principal component analysis-PCA (a type of factor analysis) that reduces large sets of dietary intake variables into smaller sets of variables and to identify underlying 'dietary patterns' (Roberts et al., 2018). Thus, this method forms linear combinations of the original observed dietary intake variables and groups together foods that are correlated with each other to derive a new, smaller set of composite variables. The resulting composite variables (or components) are uncorrelated with each other and therefore can be considered as representative of discrete dietary patterns (Roberts et al., 2018). For each component are coefficients defining the linear combinations called 'factor loadings. These factor loadings are the correlations of each food item with that component (Northstone et al., 2008; Roberts et al., 2018).

For this study, before conducting the PCA, the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity were undertaken to ensure that the data were suitable for factor analysis. The KMO reached the acceptable limit of 0.8 and Bartlett's test of sphericity was significant (0.01), indicating that correlations between items were sufficiently large to undertake PCA (Roberts et al., 2018). The 49 food variables from the FFQ of this study were entered into the PCA. Orthogonal rotation (varimax) was applied. The purpose of applying the rotation is that it redistributes the explained variance for each component and thus achieves a simpler structure and increases the number of larger and smaller loadings (Northstone et al., 2008).

For this type of analysis, to know the number of components to retain, we subjected the data to a Monte Carlo parallel analysis to know the eigenvalues above approximately 1.0, to identify the fewest number of patterns that explained the largest proportions of variance. Food groups that had factor loadings ≥ 0.4 were considered as making significant contribution to a particular pattern (Abizari, 2019). A factor score was created for each individual for each of the components identified. The factor scores were generated by summing the product of the factor loading coefficient and the participants' reported consumption frequency for each food item (Ryman et al., 2014). The dietary patterns extracted from the PCA were labeled subjectively but appropriately based on food items that correlated highly with a component to account for variation in the diet. Factor scores of the identified patterns were used for further analysis such as their correlation with BMI and selected socio-demographics.

Simple linear regression was used to find the association between dietary pattern factor scores and BMI as well as the demographics. Statistical significance was set at level, $P<0.05$ for all analysis. Regression analysis was done with the dietary pattern scores as dependent variable and other demographic characteristics as well as anthropometric variable to establish factors that significantly predict the food pattern.

3.8 Ethical Approval

Approval of the study was obtained from the Ethics and Protocol Review Committee (EPRC) of the College of Health Sciences, University of Ghana. Permission to access data was sought from the Head of Department of the Community and Preventive Dentistry, University of Ghana Dental School. Confidentiality and anonymity were ensured by excluding names of children who participated in the study and giving them code numbers. The data collected remained confidential by being stored in a password protected laptop. All the questionnaires were kept under lock and key at the Dietetics laboratory during the data entry. The questionnaires were returned to the Department of Community and Preventive Dentistry when the study was completed.

CHAPTER 4

4.0 RESULTS

A total number of 512 students were enrolled in this study from 8 Private Primary and Junior High schools in the Accra Metropolitan Area.

4.1 Socio-demographic characteristics of the school age children

Table 4.1 shows the socio-demographic characteristics of school age children from the age of 9 to 15 years. The mean age was 11.6 years and majority of the participants were females (56.8%). There were more primary students included in this study than Junior high school students. Most were staying with their parents (70.7%). Majority of the participant's parent had a tertiary level education (64.1% for father's educational level 43.9% for mother's educational level). The parents of the students were mainly self-employed (fathers 33%; mothers 56.7%) and or professional or non-professional salaried workers. More of the students stayed in houses that were not owned by their family (57.6%). More than half of the participants had a medium socio-economic status, (n=512).

Table 4.1: Socio-demographic characteristics of participants. (N = 512)

Socio-demographic Characteristics	Mean (±SD)	n (%)
Age (years)	11.6 (1.7)	
Number of children in family	3.7 (1.9)	
Gender		
Male		221 (43.2)
Female		291 (56.8)
Level of Education		
Primary		289 (56.4)
JHS		223 (43.6)
Staying with both parents		
Yes		362 (70.7)
No		150 (29.3)
Father's Education level		
≤Secondary[1]		102 (19.9)
>Secondary[2]		400 (78.1)
Don't know		10 (2.0)
Mother's Education level		
≤Secondary		180 (35.2)
>Secondary		315 (61.5)
Don't know		17 (3.3)
Tenancy Status		
Own house		217 (42.4)
Do not own house[3]		295 (57.6)
Socio-economic Status (SES)		
Low		35 (6.8)

Table 4.1 continued

Socio-demographic Characteristics	Mean (±SD)	n (%)
Medium		313 (61.1)
High (SES)		164 (32.0)
Mother's occupation		
Non-professional Salaried work		56 (10.9)
Professional Salaried work		133 (26.0)
Self employed[4]		290 (56.7)
Not employed		20 (3.9)
Don't know		13 (2.5)
Father's occupation		
Non-professional Salaried work		140 (27.3)
Professional Salaried work		182 (35.5)
Self employed		171 (33.4)
Not employed		1 (0.2)
Don't know		18 (3.5)

[1]Includes no education and primary education; [2]includes post-secondary and tertiary education; [3]includes family house, rented house, company/mission house, government house and caretaker; [4]includes trader/businessman or woman and artisan

4.2 Dietary patterns of school age children determined using principal component analysis

Table 4.2 outlines the food variables characterizing each dietary pattern that was derived using the Principal Component Analysis. A total of four dietary patterns (DP) were derived and these are: Fruits and energy dense DP, Non-Traditional DP, Sweets and Protein DP and Dairy DP. Energy dense DP accounted for 24.96% of the variability in the food consumption data while Non-traditional DP, Sweets and Protein DP and Diary DP accounted for 6.0%, 3.85% and 2.9 % of the variability in food consumption respectively. Together the four (4) dietary patterns explained 37.7% of the total variance in the dietary intake data.

Table 4.2: Dietary patterns of school age children determined using principal component analysis.

Component	Foods with factor loadings ≥ 0.4	% of variance	Label for dietary pattern
Component 1	Avocado, Watermelon, Guava, Pawpaw, Fruit salad, Mango, Pineapple, Apple, Corned beef, Burgers, khebab, Chocolate spread, Jam, Groundnut, Nuts[1], Banana, Chocolate bar, Kose, Salad cream, Popcorn, Fried plantain	24.96%	Fruits and Energy dense
Component 2	Malt drinks, Yogurt, Fried rice, Pizzas, Soft drinks, Cakes, Cowbell, Sweetened drink, Cheese, Fruit juice	6.01%	Non-Traditional
Component 3	Sugar, Sausage, Eggs, Toffees, Biscuits, Evaporated milk, White bread, Ice cream	3.85%	Sweets and Protein
Component 4	Condensed milk, Powdered milk	2.92%	Dairy

[1]nuts includes tiger nuts, cashew nuts

4.3 Anthropometry and Nutritional status of school age children

Table 4.3 shows the average height, weight, and BMI of the study participants. The female students had a mean height slightly higher than the males. The mean weight and BMI of the females were higher than the males and the difference was statistically significant (weight, p=0.046 and BMI, p=0.014). A large proportion (45.3%) of the study participants had normal weight at the same time a significant proportion of the participants were obese (40.8%). Also, majority of the females (60.3%) were obese than males (39.7%).

Table 4.3: Anthropometry and Nutritional status of school age children

Anthropometric index	Total mean (±SD)	Male mean (±SD)	Female mean (±SD)	P-Value
Height (cm)	151.82 (11.35)	151.64 (11.63)	151.95 (11.15)	0.760
Weight (kg)	51.68 (15.44)	50.11 (15.30)	52.86 (15.47)	**0.046***
BMI (kg/m²)	22.04 (4.99)	21.41 (4.80)	22.50 (5.08)	**0.014***
Nutritional status	**N (%)**	**n (%)**	**n (%)**	
Underweight	2 (0.4)	0 (0.0)	2 (100.0)	
Normal	232 (45.3)	107 (46.1)	125 (53.9)	
Overweight	69 (13.5)	29 (42.0)	40 (58.0)	
Obese	209 (40.8)	83 (39.7)	126 (60.3)	

*Shows statistical significance at 0.05. BMI classifications are based on the Growth Chart of Centre for Disease Control, 2021

4.4 Correlations between dietary patterns and BMI and selected socio-demographic characteristics

Table 4.4 shows the correlation between BMI and the identified dietary patterns and some demographic characteristics. As school age children increase in age, they consume less fruits and energy dense DP and consume more sweets and protein DP and this relation is statistically significant (p=0.026). Increasing number of household children resulted in a significant increase in Fruits and energy dense diet consumption as compared with the other diets (p=0.006). There was a significant positive correlation between BMI and the Non-Traditional DP and a negative correlation with the dairy DP.

Table 4.4: Correlations between dietary patterns and BMI and selected socio-demographic characteristics

Dietary Patterns	Age (years)		Number of Children in family		BMI	
	r	p	R	p	r	P
Fruits and Energy-dense	-0.099	**0.026***	0.121	**0.006***	-0.008	0.865
Non-Traditional	-0.025	0.576	0.000	0.994	0.120	**0.007***
Sweets and Protein	0.201	**<0.001***	0.070	0.116	0.044	0.324
Diary	0.000	0.997	0.059	0.183	-0.116	**0.009***

*Shows statistical significance at 0.0

4.5 Relationship between socio-demographic characteristics and dietary patterns

Table 4.5 shows the association between dietary pattern and socio-demographic characteristics. It can be observed that fruits and energy dense dietary pattern was negatively associated with age ($p=0.026$), being in JHS ($p=0.014$) and having a medium socioeconomic status (0.024) as compared to low socioeconomic status. On the other hand, fruits and energy dense dietary pattern was positively associated with living with both parents ($p=0.007$), mother being a non-professional salaried worker ($p=0.001$) and mother unemployed (<0.001). The Non-Traditional diet pattern was positively associated with mother having a tertiary education ($p=0.009$) and being a non-professional salaried worker ($p=0.029$) but was negatively associated with father being self-employed ($p=0.20$). There was a positive association between the sweets and protein dietary pattern and the age ($p=<0.001$) of the school children and also identifying as a JHS student ($p=<0.001$). A negative association is observed between having a high socioeconomic status ($p=0.034$) and the sweets and protein dietary pattern. The diary dietary pattern was negatively associated with both mother and father having more than a secondary level education ($p=0.011$) and being house owners ($p=0.022$). However, there were positive association between the diary diet pattern and mother and the father being self-employed ($p=0.045$ and $p=0.002$) and the father being unemployed.

Table 4.5: Relationship Socio-demographic characteristics and Dietary patterns

	Fruits and Energy		Non-Traditional		Sweets and Protein		Dairy	
Variables	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**
Age	-0.59	**0.026***	-0.015	0.576	0.120	**<0.001***	0.001	0.997
Number of children	0.031	0.183	0.000	0.994	0.037	0.116	0.031	0.183
Gender								
Male					*Reference*			
Female	0.024	0.785	0.024	0.785	0.159	0.075	0.061	0.498
Level of Education								
Primary					*Reference*			
JHS	-0.218	**0.014***	-0.060	0.502	0.456	**<0.001***	-0.126	0.158
Staying with both parents								
No					*Reference*			
Yes	0.263	**0.007***	0.097	0.319	0.099	0.310	0.030	0.754
Father's Education level								
≤Secondary[1]					*Reference*			
>Secondary[2]	-0.008	0.939	-0.005	0.966	0.028	0.802	-0.283	**0.011***
Don't know	-0.581	0.080	0.021	0.950	0.080	0.811	0.025	0.941
Mother's Education level								
≤Secondary					*Reference*			

	Fruits and Energy		Non-Traditional		Sweets and Protein		Dairy	
Variables	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**
>Secondary	-0.102	0.275	0.246	**0.009***	-0.054	0.562	-0.237	**0.011***
Don't know	-0.043	0.865	0.211	0.403	-0.040	0.875	0.293	0.246
Tenancy Status								
Do not own house[3]					*Reference*			
Own house	-0.002	0.981	0.167	0.062	0.126	0.160	-0.205	**0.022***
Socio-economic Status								
Low					*Reference*			
Medium	-0.218	**0.024***	-0.133	0.168	-0.075	0.438	0.137	0.155
High	0.037	0.841	-0.352	0.059	-0.394	**0.034**	0.222	0.234
Mother's occupation								
Professional Salaried work					*reference*			
Non-professional Salaried work	0.522	**0.001***	0.347	**0.029***	0.045	0.692	0.063	0.576
Self employed[4]	0.006	0.953	-0.085	0.417	-0.013	0.901	0.214	**0.045***
Not employed	0.832	**<0.001***	0.260	0.276	0.670	0.504	0.374	0.709
Don't know	-0.051	0.858	0.109	0.706	-0.478	0.053	0.289	0.242
Father's occupation								
Professional Salaried work					*reference*			

	Fruits and Energy		Non-Traditional		Sweets and Protein		Dairy	
Variables	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**
Non-professional Salaried work	-0.034	0.763	-0.065	0.565	0.053	0.738	0.034	0.830
Self employed	0.044	0.683	-0.249	**0.020***	0.076	0.470	0.326	**0.002**
Not employed	-1.011	0.315	0.281	0.779	-0.238	0.322	0.923	**<0.001***
Don't know	-0.011	0.963	-0.088	0.721	0.134	0.644	0.419	0.142

*Shows statistical significance at 0.05

4.6 Relationship between Dietary patterns and Body Mass Index (BMI)

Table 4.5 shows the association between dietary pattern and BMI. The Non-Traditional DP is positively associated with BMI and specifically the obese category (p=0.005). The Dairy DP is also negatively associated with BMI and specifically the obese category (p=0.045).

Table 4.6: Relationship between Dietary patterns and Body Mass Index (BMI)

	Fruits and Energy DP		Non-Traditional DP		Sweets and Protein DP		Dairy DP	
Variables	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**
BMI	0.004	0.837	0.600	**0.004***	-0.124	0.566	-0.615	**0.004***
Nutritional status								
Normal					*reference*			
Underweight	-0.709	0.318	-0.001	0.986	-0.017	0.859	0.648	0.360
Overweight	-0.252	0.066	0.086	0.065	0.222	0.105	-0.263	0.055
Obese	-0.023	0.813	0.268	**0.005***	-0.566	0.426	-0.191	**0.045**

*Shows statistical significance at 0.05

CHAPTER 5

5.0 DISCUSSION

This study assessed the dietary patterns of school children between the ages 9 to 15 years who attended private schools and also the relationship between those dietary patterns and BMI, as well as certain socio-demographic factors. In this study, there were more primary students than Junior high school students. Most of the children in this study were staying with their parents (70.7%), and also majority of the participant's parent had a tertiary level education.

This study revealed that the mean weight and BMI of female school children were higher than the mean weight and BMI of their male counterpart. There were more females who were obese in this study than males. A recent study that assessed childhood obesity in Ghana found that obesity was also higher among girls (27.2%) than boys (19%) (Ganle et al., 2019). It is also reported in a research work done in Tanzania among school age children between 8-13years that more females (26.7%) were found to be overweight and obese as compared to males (17%) (Pangani et al., 2016). According to a study conducted among Nigerian adolescents, they explained that during adolescence the females tend to have increased fat mass than males and male adolescents are usually taller than the females, it is important to note that both factors contribute significantly to BMI categories (Adesina et al., 2012).

This study identified four (4) dietary patterns among school age children who attended private school in Ghana, these four dietary patterns were: Fruits and Energy dense dietary pattern, Non-traditional dietary pattern, Sweets and Protein dietary pattern and Dairy dietary pattern. In total these dietary patterns accounted for 37.7% of the total variance in the dietary intake of the private school children. The Fruits and Energy dense dietary patterns consisted of fruits like banana, avocado, pineapple, apple, pawpaw, watermelon, guava, mango, fruits salad, together with energy dense foods like fried plantain, kose, jam, chocolate spread, burgers, khebab, groundnuts and other nuts, corned beef, chocolate bar, salad cream and popcorn. The Non-Traditional dietary pattern consisted of foods such as malt drinks, fried rice, pizza, cakes, cowbell, fruit juice, sweetened drink, yogurt, soft drinks and cheese. The Sweets and Protein dietary pattern also consisted of foods such as sugar, toffees, ice cream, biscuits, white bread, sausage, and evaporated milk. And finally, is the Dairy dietary pattern that consisted of powdered milk and condensed milk. The prevalence of these dietary patterns was varied across the socio-demographic characteristics.

5.1 Association between the Dietary patterns and Body Mass Index

The Non-traditional DP was found to be positively and significantly associated with BMI in this study. The Non-Traditional DP in this study typically consisted of foods that are high in sugars and calories. According to Malik and Hu (2015), foods that are high in calories and added sugars are risk factors of obesity and its related complications such as diabetes, dyslipidemia, pancreatitis, high blood pressure, heart diseases and so on. So, the reduce intakes of these foods can reduce the risk of the above-mentioned diseases. The education of the public on limiting the excessive intake will go a long way to prevent or reduce these risk factors. The results provide another line of evidence as the basis for advocacy in the reduction or avoidance of excessive intake of these food patterns. Several studies have related a high consumption of western type (similar to the Non-Traditional DP) diet pattern with increased BMI as well as certain Non-communicable diseases such as type 2 diabetes, hypertension, cardiovascular diseases among others (Omage & Omuemu, 2018; Ganle et al., 2019). A recent study in Ghana, reported that those adolescents who were overweight or obese tend to have higher score of consuming a western type of diet pattern (sweet tooth DP), but this observation was not statistically significant (Alangea et al.2018). Another study showed that schoolchildren from urban areas were more likely to consume an 'Industrialized' DP (also known as a western DP or Non-Traditional DP), that will in turn increase their risk of overweight and obesity (Garcia-chavez et al, 2018). Other studies have showed that western or a Non-Traditional dietary pattern is a major determinant of a higher BMI and overweight status (Roberts et al, 2018; Krieger et al., 2018). Another study conducted in China among school age children reported obesity was more prevalent among children with the Western dietary pattern (17.1%) (Shang et al., 2012).

It was also found in this study that the Dairy DP was negatively and significantly associated with being obese. This is confirmed by another study that evaluated the association between dairy consumption and body mass index among school age children and found a significant inverse relationship between the frequencies of consumption of milk and BMI *z*-scores (Barba et al, 2005). In contrast to our finding a study which also evaluated the relationship between dairy consumption and anthropometry of adolescents did not find any significant association between dairy intake and obesity (Nezami et al., 2016). This finding is also consistent with longitudinal studies that were reviewed by Louie et al. (2011), which reported that "out of the 10 studies reviewed, six showed no significant association, one with an increased risk of obesity, and three with a protective association between dairy consumption and risk of being overweight or obese". The differences in the association between the dairy dietary pattern and obesity depend on the total fat content of the dairy products. Whole milk often has a high fat content than the skimmed milk as a result the overall energy content of the dairy product may influence obesity status. Diary product can be encouraged since it is a rich source of protein and not a risk factor for increase BMI.

The Fruits and Energy dense DP and Sweets and Protein DP was not significantly associated with BMI in this study. Contrary to our findings a study done in adolescents found that as the score of prudent DP (a healthy diet pattern consisting of high consumption of fruits) increases, BMI decreases and this observation were statistically significant (Gutierrez-Pilego et al., 2016). Though in this study there was no significant association between fruits and energy dense diet pattern and BMI, this study showed a negative association between fruits and energy dense diet pattern and BMI.

In this study the sweets and protein DP was negatively associated with obesity. Similar findings were seen in a study that assessed the relationship between the intake of confectionary and obesity outcomes. The study reported that high intakes of sweets and confectionary products were linked to reduced odds of being overweight or obese, and this relationship was significant (Gasser et al., 2016).

5.2 Association between Fruits and Energy dense dietary pattern and socio-demographic characteristics

From the analysis of this study, it was observed that the fruits and energy dense dietary pattern consisted of healthy foods and not so healthy foods. Thus, this pattern comprised of high consumption of fruits and spreads as well as corned beef, burgers, salad cream, popcorn, and chocolate bar. This kind of pattern, usually comprising of both healthy and unhealthy foods, have been reported in other studies as mixed dietary pattern and associated with adolescents, (Liberali et al., 2020; Wrottesley et al, 2017; Tavares et al., 2014; Nobre et al., 2012; Correa et al., 2017).

For this study, the fruits and energy dense dietary pattern was negatively associated with age, being in JHS and having a medium socioeconomic status. According to Correa et al. (2017), the quality of dietary pattern decreases as one increase in age. This observation is consistent with our findings from this study, as it is seen that sweets and protein diet pattern was positively associated with age. This finding was also reported in a longitudinal study conducted among American adolescents that assessed the maintenance of dietary pattern as children age (Northstone et al, 2008). It was discovered in that study that as children age into adolescence they migrate from healthy diets into unhealthy diets. A possible reason for these observations could be because, as school children age, the influence of their parents on their diet reduces and they become more independent with their choices especially their food habits (Correa et al., 2017). The same reasons can be attributed to the fact that the fruits and energy dense dietary pattern was negatively correlated with being a JHS student as compared to being a primary student, but there was a positive association between being a JHS student and consuming a dietary pattern of sweets and protein-which turn to be an unhealthy diet pattern.

In this study the school age children who had a medium socioeconomic status (SES) tend to eat less of the fruits and energy dense diet pattern. According to Mullie et al. (2010), “the general socioeconomic nutritional pattern is directly proportional to food costs, implying that lowest cost diets are mainly eaten by the lowest socioeconomic positions, and consequently, low-cost diets are unhealthy”. Fruits are high-cost foods, and they are usually associated with people with high SES especially in developing countries (Ogum Alangea et al., 2018). Globalization has caused a shift in the economic state of developing countries such that energy dense foods and unhealthy foods are low priced as compared to healthy foods. Though one may expect that the children with medium SES should be able to afford and consume fruits more often, it is a normal occurrence in

Ghanaian setting for pupils to be given pocket money by their parents and that can result in the purchase of unhealthy foods instead of healthy foods like fruits (Abizari et al, 2019). The above reason can be the explanation for the inverse relationship observed between fruits and energy dense dietary pattern and medium socioeconomic status of private school children.

This study also found a positive association between the fruits and energy dense dietary pattern and living with both parents, mother having a non-professional salaried work or not employed. A study done among adolescents in Iran found that living with parent and or having parental support increased your chances of taking more fruits than not having parental support (Ziaei et al., 2020). According to a study that assessed mother's employment status to children's dietary habit, they found that unemployed mothers limit children's access to unhealthy snacks (Gaina et al., 2009). Also, our findings were slightly contrary with a study done among adolescents in Ghana, which showed that adolescents whose mothers had a low-grade occupation consumed fruits more frequently than those whose mothers were unemployed (Doku et al., 2011). Nonetheless, according to the same study, they explained that fruits were cheap in Ghana especially when they are in seasons and as a result, material affluence does not have much effect on fruit consumption frequency.

5.3 Association between Non-Traditional dietary pattern and socio-demographic characteristics

The second dietary pattern which was named Non-Traditional dietary pattern included foods such as malt drinks, fried rice, pizza, cakes, cowbell, fruit juice, sweetened drink, yogurt, soft drinks and cheese. This dietary pattern though may be named differently in other studies (industrialize DP, fast food and soda DP, Western DP, Unhealthy DP, and sweet tooth DP among many others) has been reported in several studies (Gutierrez-Pliego et al., 2016; Oh et al., 2021; Garcia-Chavez et al., 2018; Krieger et al., 2019; Abizari & Ali, 2019) done in both children and adults. The Non-Traditional dietary pattern was positively associated with mother having a tertiary level education, a non-professional salaried work, BMI, and obesity. Contrary to the findings in this study, a study that assessed the effects of maternal education on diet and iron deficiency found that, school age children of mothers with more education were less likely to have unhealthy eating patterns (Choi et al., 2011). Another study also associated low secondary education of the mother with high scores of the Western (or Non-Traditional) dietary pattern (Borges et al, 2018). For maternal occupation being positively associated with Non-Traditional dietary pattern in this study, a similar study which also assessed the dietary pattern of school age children had findings which were at variance with this study. They found that higher levels of mother's education and occupation were associated with more likelihood of a “healthy” dietary pattern (Chen et al., 2019). This observed difference can be attributed to the fact that mothers with a form of tertiary education and as a result are salaried workers may not have time to prepare home cooked meals and may subject their children to purchase and consumed western foods (Data et al, 2014). In addition to this, intake of unhealthy foods such as seen in the Non-Traditional DP is linked to affluence in developing countries like Ghana but in developed countries, affluence is rather linked to the intake of healthy diets (Abizari & Ali, 2019).

5.4 Association between Sweets and Protein dietary pattern and socio-demographic characteristics

The third pattern sweets and protein dietary pattern which was characterized by the consumption of sausage, toffees, biscuits, sugar, eggs, evaporated milk, white bread, and ice cream was positively associated with age and being in JHS but negatively associated with high socioeconomic status. The constituents of sweets and protein diet pattern have similarities with the constituent of energy dense dietary pattern identified in the study conducted by Alangea et al. (2018) in school age children in Ghana. The findings from the study by Alangea et al. (2018) is oppose to the findings from this study, in that, they found Energy dense DP, to be significantly associated with higher SES and private school. It was explained by the same study that other research studies done in Ghana and other developing countries have found unhealthy diet patterns among higher SES categories. However, a research work done in Ghana and Kenya reported that unhealthy diets (sweets food, sugar sweetened beverages and fried foods) were commonly consumed among lower SES individuals (Holdsworth et al., 2020). Also, findings from Craige et al. (2010) reported energy dense DP among school children with a lower SES which is consistent with this study. A report from a systematic review that assessed dietary pattern and socioeconomic positions showed that there was a higher daily consumption of salt and sweet energy-dense DP and nutrient-poor snacks when SES was lower, but such associations were not statistically tested (Desbouys et al., 2020). The reason for this observation is that energy-dense diet tends to be cheaper in modern times, so those in the lower SES category habitually consume these nutrient-poor foods hoping to maximize their value for money (Holdsworth et al., 2020).

5.5 Association between Dairy dietary pattern and socio-demographic characteristics

The last dietary pattern that was identified in this study was the dairy dietary pattern which was characterized by the consumption of condensed milk and powdered milk. This pattern was labeled in a similar study conducted in Malaysia as 'Alternative protein dietary pattern' while another study than among Korean adolescents also identified a similar dietary pattern (Man et al., 2017; Hong et al., 2012). This dietary pattern was negatively associated with higher parental education (tertiary) and being house owners. Findings from this study were consistent with a study that assessed the frequency and determinants of adolescents' consumption of fruits, vegetables, and dairy foods (Videon & Manning, 2003). It was reported in the study mentioned above that higher levels of parental education were associated with reduced odds of poor vegetable, fruit, and dairy food consumption. Results from the above study also showed that adolescents whose parents had higher education were more likely to skip breakfast. In the Ghanaian setting dairy products are rarely consumed because they are expensive (Intiful and Lartey, 2014). Nonetheless most Ghanaian household consume milk and milk products usually as breakfast or as part of their breakfast, therefore if higher parental education cause school children to skip breakfast, then this will subsequently result in low intake of dairy products. It was also observed from this study that there were positive association between the dairy diet pattern and parents being self-employed (p=0.045 and p=0.002) and father being unemployed.

5.6 Limitations

This study had some limitations:

1. Since it was a cross-sectional study, data was collected only during one season so did not factor in seasonal variations in diet.
2. Food frequency questionnaire was based on recalls so it may introduce recall bias in the study.
3. Study results may differ from other school children in different environment and regions in the country.

CHAPTER 6

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

This research aimed at determining the dietary patterns of school age children and its association with Body Mass Index.

Among the school age children, most of them had either a normal BMI or they were obese, the females were more obese than the males. The four (4) dietary patterns that were identified in this study are Fruits and energy dense dietary pattern, Non-Traditional dietary pattern, Sweets and Protein dietary pattern and Dairy dietary pattern. The Non-Traditional and Dairy dietary patterns were significantly associated with BMI. An increase in the intake of Non-Traditional dietary pattern was associated with being obese and an increase in the intake of dairy dietary pattern was negatively associated with being obese.

This study has also demonstrated that there are association between dietary patterns and socio-demographic characteristics such as age, household SES and mother's educational level. Thus, from this study sweets and protein diet pattern was associated with age, class level and high household SES. Also, the Fruit and Energy dense dietary pattern was associated with age, class level, staying with parents, mother's occupation and a medium household SES. Both the Non-Traditional and Diary dietary pattern was associated with mother's educational level.

6.2 Recommendation

The following recommendations are given based on the findings of this study:

1. Dietary patterns which are associated with higher BMI must be considered in the management of obesity and its related diseases
2. There must be enhanced education on healthy eating by health care professionals especially nutritionists and dieticians.
3. This study can be replicated in different regions of the country to get the broader picture of the overall dietary pattern of basic school children.
4. Every 5 to 10 years, this study can be repeated to monitor the change in dietary patterns. This is important to help policy makers and health providers to be informed when developing dietary guidelines to promote healthy eating for school age children and also the general populace.

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APPENDIX

Appendix 1: DATA EXTRACTION FORM

Study Title	
Author/year	
Study Objective	

Socio-demographic Information

Name of school; ……………………………………………………………………………
Sex; [ ] Male [ ] Female
Age ………………………………………………………………………………………
Living with both parents; [ ] Yes [ ] No
School level; [ ] Primary [ ] Junior High
Father's educational level; [ ] None [ ] Primary/elementary [ ] Secondary [ ] Post-Secondary [ ] Tertiary [ ] other (specify)…………………
Mother's educational level; [ ] None [ ] Primary/elementary [ ] Secondary [ ] Post-Secondary [ ] Tertiary [ ] other (specify)…………………
Father's occupation; …………………………………………………………………………..
Mother's occupation; ………………………………………………………………………….
Tenancy status;

[ ] Own house [ ] Family house [ ] Rented house [ ] Company/mission house [ ] Government house [ ] Caretakers
Number of children in the family; ……………………………………………………………

Anthropometric Data

The objective of this section is to be able to determine the BMI and associate it to the dietary pattern.

Weight (Kg); ………………., Height (Kg); ………………, BMI (Kg/m^2); ……………….

Dietary Data

Food Frequency Questionnaires

Foods eaten during the past 24 hours and the past week and how often they are eaten

CODE	SWEETENED DRINKS AND FRUIT JUICES	24hrs 1= Yes, 2= No	No. of times in the past week	Where do you get your food from? 1=HOME, 2=SCHOOL 3=STREET
	Sweetened drinks (Tampico, kalyppo, Refresh)			
	Fruit juices (Pure heaven, Ceres, Nourisher)			
	Malt drinks (Malta Guinness, Vitamalt, Amstel)			
	Minerals (Fanta, Sprite, Coca-Cola)			
	MILK AND DAIRY PRODUCTS			
	Evaporated milk			
	Powdered milk			
	Whole milk (Fresh milk)			
	Milk drinks (Country milk, milko)			
	Yogurts			

	Cheese/ Wagashi			
	Cowbell			
	Other;			
	BREADS, BISCUITS AND CEREALS			
	White bread (Sugar and Tea bread)			
	Biscuits/ Cream crackers			
	Cakes/ cookies			
	Pie (meat and fish)			
	Pizzas			
	Fried rice			
	Other;			
	FRIED FOODS			
	Bofrot/ Donuts			
	Akara/ Koose			
	Fried plantain/ Kelewele			
	Fried Sweet Potatoes			
	Fried yam/ Fried cocoyams			
	Chips/ Pastries			
	Fried eggs			
	Fried Chicken and Poultry			
	Fried meat			
	Other;			
CODE	**PROTEIN FOODS**	**24hrs 1= Yes, 2= No**	**No. of times in the past week**	**Where do you get your food from? 1=HOME, 2=SCHOOL 3=STREET**
	Meat (Pork, beef, mutton, bush meat)			

	Poultry (chicken, duck, turkey, birds)			
	Kebab			
	Corned beef/luncheon meat			
	Sausage / bacon			
	Eggs			
	Burgers			
	Other;			
	SPREADS AND TOPPINGS			
	Margarine / Butter			
	Jam			
	Groundnut (peanut) butter			
	Chocolate spread			
	Salad cream/ Mayonnaise			
	Other;			
	FRUITS			
	Citrus (orange, Tangerine, Grape)			
	Pineapple			
	Water melon			
	Mango			
	Banana			
	Avocado pear			
	Pawpaw			
	Guava			
	Apple			
	Fruit salad			
	Other;			
	OTHER HIGH FAT/CALORIE FOODS			

	Chocolate			
	Toffees/candies/lollipops			
	Nuts (groundnuts/peanuts/cashew/tiger nuts)			
	Sugar			
	Ice cream			
	Popcorn			
	Other;			

UNIVERSITY OF GHANA
COLLEGE OF HEALTH SCIENCES
ETHICAL AND PROTOCOL REVIEW COMMITTEE

Ref. No.: EPRC/JULY/2021

July 21, 2021

Ms. Deborah Adwoa Konadu Amoah
Dept. of Nutrition and Dietetics
School of Biomedical and Allied Health Sciences
Korle-Bu.

ETHICAL CLEARANCE

Protocol Identification Number: ***CHS-Et/M.5 –5. 3 /2020-2021***

FWA: 000185779 **IORG: 0005170** **IRB: 00006220**

The College of Health Sciences Ethical and Protocol Review Committee (EPRC) on July 21, 2021 reviewed and approved your research protocol.

Title of Protocol: **"Association of Dietary Patterns with Body Mass Index of Primary and Junior High School Children at the Accra Metropolitan Area".**

Principal Investigator: **Ms. Deborah Adwoa Konadu Amoah**

This approval requires that you submit six-monthly review report(s) of the study to the Committee and a final full review report to the EPRC at the completion of the study. The Committee may observe, or cause to be observed, procedures and records of the study before, during and after implementation.

Please note that any significant modification(s) to this project/study must be submitted to the Committee for review and approval before its implementation.

You are required to report all serious adverse events related to this study to the EPRC within seven (7) days verbally and fourteen (14) days in writing.

As part of the review process, it is the Committee's duty to review the ethical aspects of any manuscript that may be produced from this study. You will therefore be required to furnish the Committee with any manuscript for publication.

This ethical clearance is valid until July 21, 2022.

Please always quote the protocol identification number in all future correspondence in relation to this protocol.

Signed: ....

Professor Andrew Anthony Adjei
Chair, Ethical and Protocol Review Committee

cc: **Provost, CHS**
Dean SBAHS
Head, Nutrition and Dietetics.

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