DEPARTMENT OF POPULATION, FAMILY AND REPRODUCTIVE HEALTH

SCHOOL OF PUBLIC HEALTH

UNIVERSITY OF GHANA

ANAEMIA , DIET DIVERSITY, AND RISK FACTORS AMONG ADOLESCENT GIRLS IN THE UPPER MANYA KROBO DISTRICT.

BY

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THIS DISSERTATION IS SUBMITTED TO UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF PUBLIC HEALTH (MPH) DEGREE.

DECLARATION

I, BARTHOLOMEW WINNEI ASIRI, hereby declare that the content of this thesis is my original work and has not been presented to any university for the award of a degree, literature by other researchers cited in this work has been duly acknowledged.

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DEDICATION

To my lovely wife Sheila Ayabila and my daughter Elvina Winmalia Asiri I say a big thank you for their unflinching support.

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I thank the almighty God for his guidance and protection throughout this study.

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LIST OF ACRONYMS

GHS- Ghana Health Service

DD- Diet Diversity

DDS- Diet diversity Score

HB- Hemoglobin

UMKD- Upper Manya Krobo District

WHO- World Health Organization

GDHS- Ghana Demographic and Health Survey

FAO- Food and Agriculture Organization

CI- Confidence interval

UNICEF- United Nations Children's Fund

DHIMS- District Health Information Management System

ABSTRACT

Background

Anaemia is a serious public health concern in most poor countries. Anaemia can impair adolescent development and their future birth outcomes. Nutritional deficiencies affect both children and adults and diet diversity score is a scoring tool designed by the Food and Agriculture Organization to assess dietary intake. The objective of this study is to determine anaemia, diet diversity and risk factors among adolescent girls in the Upper Manya Krobo District in the Eastern Region of Ghana.

Methods

This is a cohort study involving a secondary data analysis of a data from a baseline cohort study as part of a larger study of adolescent financial literacy intervention among adolescent girls in the Upper Manya Krobo District in the Eastern region of Ghana. Multi-stage sampling involving cluster sampling of communities and stratified sampling of adolescents was applied during the original study. The six sub-districts were clustered by size (Large, Medium and small), one sub-district was randomly selected from each stratum, 60 villages were clustered from the three selected sub-districts, 30 of the clusters were randomly selected for the intervention and the remaining 30 clusters were the comparative group.

Results

Analysis was based on 1420 out of 1431 participants, mean age was 10.9 ± 1.4, mean Hb and diet diversity score were 12.73±9.57 and 7.79±2.31, respectively. The prevalence of anaemia and inadequate DDS were 29.87% and 29.22%, respectively. current schooling status, average

number of meals eaten at home and number of times participants exercised or played sports within a month were significantly associated with anaemia, while current schooling status, average number of meals/day within a week eaten outside the household as well as number of nutrition information received within the last one month were significantly associated with diet diversity score of adolescents.

Conclusion

Age, education, dietary intake as well as access to nutrition information and exercise may be important in preventing anaemia and ensuring adequate diet diversity. Anaemia prevalence among adolescent girls in the Upper Manya Krobo District is marginally lower than that of the national prevalence. However, it still remains a serious health concern among the adolescent girls in the District.

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CHAPTER ONE

INTRODUCTION

Anaemia is a global public health problem that affects both developed and developing countries. The world health organization estimates that about 2 billion people are affected by anaemia, globally (WHO, 2011). Pubertal changes occurring in adolescence elevates nutrient requirements (including iron), and therefore increase the risk of anemia among adolescents. Adolescence is also linked with suboptimal dietary and health practices (Liang et al., 2019), in low income settings exposure to infections and helminthic worm infestations, resulting from suboptimal water, and environmental sanitation constitutes additional risk of anemia among adolescents. Heavy menstrual bleeding and teen pregnancy also increases the risk of anemia among adolescent girls (Mahanta et al., 2015).

One of the major causes of anaemia is iron deficiency. This is a result of insufficient iron level for the production of hemoglobin (WHO, 2011). Low iron levels among adolescent girls is usually due to inadequate consumption of iron rich foods, menstruation and poor absorption of iron as a result of worm infestation or the consumption of foods that inhibit the absorption of iron (Bose et al., 2021). Poverty and lack of financial resources by adolescents prevents them from having access to enough food to meet their nutrient requirements, which subsequently leads to nutrient deficiencies, including iron which leads to anaemia (Reading, 2007).

There are different forms of anaemia. Nutritional anaemia which results from inadequate intake of nutrients essential for the production of hemoglobin (Villalpando, 2016). Inadequate nutrient intake can result from poor quality diets or poor handling and processing of food (Bose et al., 2021). For example, green leafy vegetables which are rich in Vitamin B12, Iron and Folic Acid

essential for blood production, usually lose their nutritional value due to prolonged exposure to heat (Shenton et al., 2020). Anaemia can also occur as a result of inadequate consumption of Vitamin C rich foods which aid in the absorption of iron, and the consumption of foods with high levels of nutrient-inhibiting factors (eg polyphenols, oxalates, etc) which are high in caffeinated drinks and tea); these factors inhibit the absorption of iron, a key component of hemoglobin (Bose et al., 2021). The short term effects of anaemia among adolescents include poor performance in school which is largely due to poor concentration, while the long term effects include school dropout, poor future birth outcomes and poverty (Bahadur et al., 2019).

Diet diversity score is an assessment tool used to assess nutrient intake within a population using food groups, the higher the number of food groups consumed, the more the likelihood to achieve adequate diet diversity score and eating from fewer food groups will lead to an inadequate DDS(A. Zhao et al., 2020).

The FOA determines adequacy and inadequacy of DDS based on the mean DDS of the population being assessed. Those consuming from a number of food groups below the mean DDS are said to have an inadequate DDS while those consuming above the mean DDS are said to have attained an adequate DDS(W. Zhao et al., 2017).

Adolescence is a period characterized by rapid growth and development, including cognitive development and physiological changes (Reading, 2007). During this stage of development, there are a lot of behavioral changes which affects their health and wellbeing. Adolescence, has been identified, globally, as a key developmental stage that requires nutritional support, in order to ensure their wellbeing and their future health outcomes (Bose et al., 2021).

The Upper Manya Krobo District (UMKD) is located in the eastern region of Ghana. Adolescent girls from three selected sub-districts in the district were exposed to 5 days financial literacy training, and were provided with savings and educational incentives. The adolescent girls, totaling 715 were followed for a period, and it was realized that the intervention had improved the financial literacy, educational outcome and sexual and reproductive health Outcomes of participants (Clark et al., 2018). The programme, however, is yet to assess its impact on the adolescents' nutritional (anaemia) status after successful implementation.

1.2: Problem statement

According to the world health Organization, Anaemia is the second highest cause of death and disabilities among adolescents (WHO, 2017). Based on WHO criteria, Ghana currently has a severe public health situation regarding anaemia. The estimated prevalence of anaemia is 56% among non-pregnant women (WHO, 2014). Also, the findings from the Demographic and Health Survey indicated that anaemia affects about 48% of adolescent girls in Ghana (DHS, 2015).

Adolescence is a period where there is still a widow of opportunity to catch up if all predisposing factors are controlled. Lack of appropriate knowledge, attitudes, and practice regarding healthy nutrition could also explain the high prevalence of anemia among adolescents. Despite the fact that it is a preventable problem, most adolescents engage in unhealthy eating habits and are unaware of anemia and how to prevent it (Abu-Baker et al., 2021).

The Ghana health service instituted an intervention in 2016 aimed at improving the blood hemoglobin levels of adolescent girls in school as well as those out of school, by giving iron and folic acid Supplementation and health education on nutrition to them. This is because anaemia is

among the top six health conditions among adolescent girls in Ghana (DHIMS Dataset, 2021). Financial literacy and saving accounts have been successful for improving financial knowledge, educational outcomes, and savings among adolescent girls in the UMKD. There is limited evidence of how such intervention can affect nutrition outcomes such as anemia. This research aims to ascertain the extent to which anaemia affects adolescent girls in the UMKD and provide valuable approaches to healthcare provider and policy makers in addressing adolescent anaemia in the UMKD.

1.4: Justification

According to the Ghana Demographic and Health survey, anaemia among adolescents is about 48% which indicates a high prevalence(DHS, 2015), this high prevalence will adversely affect Ghana's attainment of the sustainable development goal 3 which targets to ensure good health and wellbeing. When anaemia during adolescence is not controlled, it can lead to future maternal mortality among them. It is therefore important to focus on adolescent anaemia to avert this daunting prevalence rate.

This research will be valuable in attaining the sustainable development goal 3. The study will aim to provide up to date qualitative and quantitative data to all relevant stakeholders, including healthcare providers, policy makers on the burden of anaemia and its risk factors.

1.5: Research questions

1. What is the prevalence of anemia among adolescent girls and subgroups withing this population group?
2. What are the risk factors of anaemia among adolescent girls in the UMKD?
3. What are the risk factors of non-diverse diet among adolescent girls in the UMKD?
4. What is the mean diet diversity score among adolescent girls in UMKD?

1.6: Objectives

1.6.1: Main Objective

To determine the prevalence and risk factors of anaemia and non-diverse diet among adolescent girls in the UMKD.

1.6.2: Specific Objectives

1. To determine anaemia prevalence among subgroups adolescent girls in the UMKD.
2. Determine the risk factors of anaemia among adolescent girls in the UMKD.
3. To determine diet diversity among adolescent girls in the UMKD.
4. Determine the risk factors of non-diverse diet among adolescent girls in the UMKD.

1.7: Conceptual framework

5. Anaemia has a complex etiology. Drawing from the conceptual framework for malnutrition by UNICEF, the conceptual framework for anaemia is outlined based on three levels, underlying causes, immediate causes, and biological causes (P. H. Nguyen et al., 2015). The framework characterizes deficiencies in some micronutrients, including folate, vitamins A, C and B12 as well as iron to be directly involved in anaemia under the biological causes, inadequate dietary intake and physiologic loses are the immediate causes of anaemia, while the underlying stage includes lack of food security, poor healthcare systems, poor sanitation and unhygienic practices, which are resulting from economic status, ethnicity, education, occupation and demographic characteristics.

6.

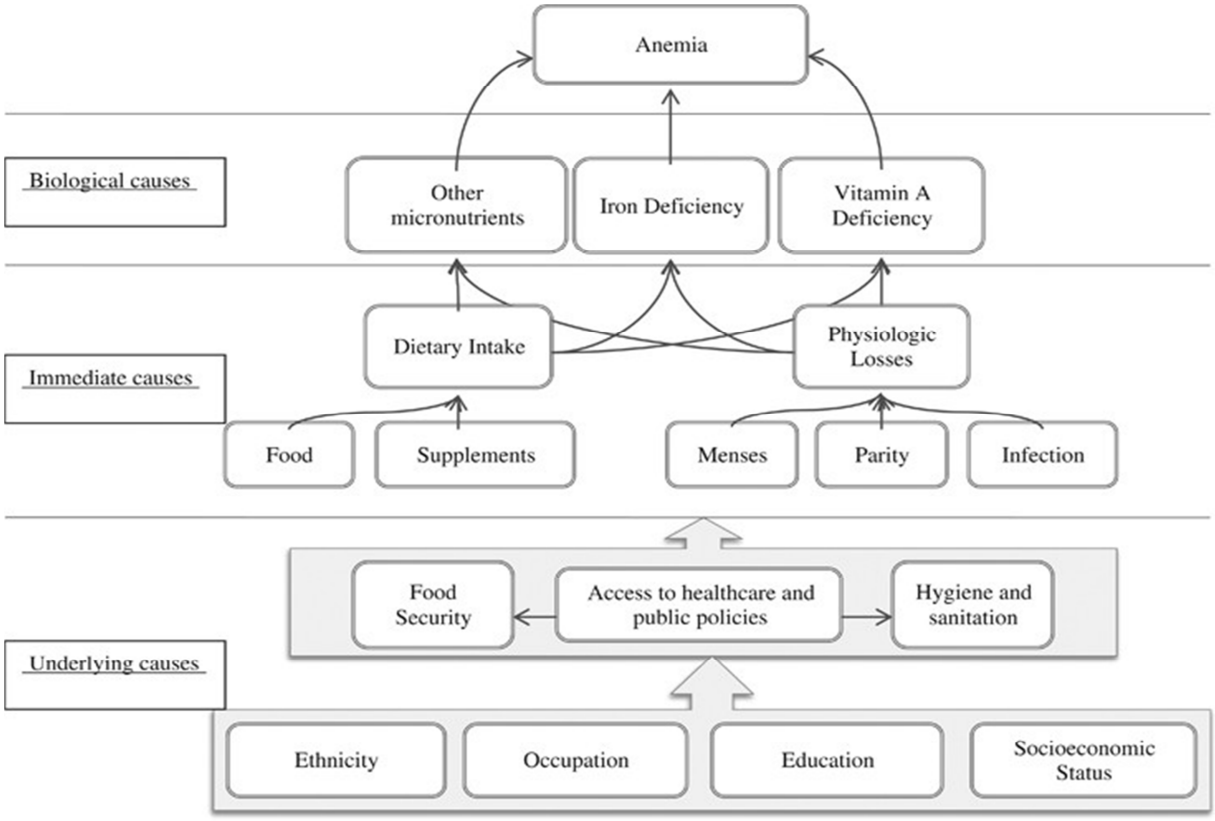

Figure 2.1: Factors associated to anaemia (P. H. Nguyen et al., 2015).

CHAPTER TWO

LITERATURE REVIEW

2.0: Introduction

This chapter consisted of the already existing knowledge on anaemia and diet diversity across the world and population sub groups. The chapter gave a brief introduction to anaemia and diet diversity, as well as anaemia diagnosis and reference cut-off points for public health importance.

2.1: Diagnostic Criteria for Anaemia

Anaemia is referred to blood hemoglobin concentration levels lower than normal. The WHO has defined blood hemoglobin concentration ranges to be used as standards for diagnosing anaemia, and these standards are dependent on individuals' characteristics such as age, sex and physiological needs. Anaemia according to the WHO refers to blood hemoglobin concentration less 13.0 g/dl for men, 12.0 g/dl in women and hemoglobin concentrations below 11.0g/dl in children and pregnant women. Anaemia can further be diagnosed as severe, moderate or mild based of the blood hemoglobin concentration. Nutritional anaemia is one the key causes of anaemia, and it results from inadequate intake of essential nutrients necessary for production of blood. Iron, folate and Vitamin B12 are the main essential nutrients used in blood production.

2.2. Prevalence of Anaemia

2.2.1: Prevalence of Anaemia.

The World Health Organization characterizes anaemia burden based on Global, Regional and Country level on its database which is the main source of anaemia data. The database segregates blood concentration based on the defined standards for diagnosing anaemia, and these defined standards are based on various population such as children, adolescents and pregnant woman (WHO, 2011).

The WHO has near sufficient data for regional estimates of pregnant women, adolescents and children of preschool age, the data covers about 69%, 73.5% and 76.1 % respectively for the various groups (WHO, 2011). There is still however insufficient data for men, aged and children of school age populations, data within these groups, stager around 40% for population of men, 39% for the aged population, while data for school age stands at around 33%(WHO, 2011). The global anaemia prevalence according to the World Health Organization is 25% of the world's population, therefore about 2 billion people worldwide live with some form of anaemia. Anaemia prevalence is highest in low and middle-income countries with Africa and South Asia being the most affected with prevalence of 65.7% and 67.5% respectively (Ngesa & Mwambi, 2014).

High income countries have the lowest prevalence with Europe, and both North and South America having prevalence of 20%, less than the world prevalence of 25%(Campbell et al., 2018). Pregnant women, Children and adolescent girls have the highest prevalence of anaemia according to the World Health Organization. Globally, the prevalence of anaemia among women is about 42% (WHO, 2011).

2.2.2 Prevalence Anaemia among Adolescents

Globally, the prevalence of anaemia among adolescents is high in Sub-Saharan Africa and south East Asia. Sub-Saharan Africa is highest with a prevalence of 47%, followed by south-East Asia with a prevalence of 34% (Al-othaimeen et al., 2009). The prevalence is low among adolescents in Western Pacific at 20% and lowest in Europe and both North and South America at 18%.

Anaemia among adolescent girls is about 43% in Ghana according to the Ghana Demographic and Health Survey (DHS, 2015).

According to studies by (Khan et al., 2019) the prevalence of anaemia among adolescent girls in Karachi University students, Pakistan is 39.7%, similar to the prevalence of 46.5% among adolescent girls in Uganda as recorded by (Adelman et al., 2019), also a prevalence of 53% was reported by (Dhillon et al., 2021)among adolescent girls in Government School at Border-belt of Indian Punjab Piverjeet, again the prevalence of 55.4% among adolescent girls in Riyadh City, Saudi Arabia reported by (Al-othaimeen et al., 2009).

Studies by (Gebreyesus et al., 2019) in a district in Ethiopia recorded a prevalence of 29.1%,also among adolescent girls in Bhutan.

However the prevalence recorded was marginally higher than the prevalence of 14% among adolescent girls in Kavrepalanchok, Nepal as reported by (Budhathoki et al., 2021), the prevalence of 18.1% among adolescent girls as reported in Dubai, United Arab Emirates by (Haleama Al Sabbah, 2020), also the prevalence of 19.9% reported by (Stabell et al., 2021)among adolescent girls in Northern Norway.

The variations in prevalence of this study as compared to other studies could be associated with differences in demographic locations, economic status, access to healthcare services and clean water and sanitation, eating practices as well as availability of healthy food, and knowledge on healthy diets.

2.3: Factors associated with anaemia among adolescent girls

2.3.1: Demographic factors

Demographic factors such as age, educational status, and residency are known to factors that can cause anaemia in adolescents. Studies in Uganda by (El-Sahn et al., 2000) recorded a significant association between age of adolescent girls and anaemia. In a population based study in india, older adolescents were more susceptible to anaemia as compared to younger adolescents. However, studies by (Siva et al., 2016) recorded weak association between age of adolescent and anaemia with a (p-value= 0.962 at significance level of p-value= 0.05), similar to studies by (Bharati et al., 2009) which also recorded weak association between age of adolescents and anaemia.

Educational status of adolescent girls according to findings by (Bharati et al., 2009) had significant association with anaemia, similar to findings by (Abdo et al., 2019) which also recorded adolescent girls educational status to be significantly associated with anaemia, a study in Urban area of Pakistan by (Baig-Ansari et al., 2008) also recorded a significant association between educational status with anaemia. However, studies by(Cappellini et al., 2020) on the risk factors of anaemia in Milan, recorded a weak association between educational status and anaemia.

2.3.2: Socio-cultural factors

According to studies by (Balarajan et al., 2011) socio cultural factors such as food taboos among adolescent girls is significantly associated to nutritional deficiencies including anaemia.

The intake of iron folic supplementation by adolescent girls is low, this is due to factors such as heavy menstrual flow, taste of the supplements, and myths that the supplement is a family

planning commodity(Dubik et al., 2019). It will be important to determine adolescent's access to nutritional information, this would be important because this information can lead to positive behavioral and socio-cultural change.

2.3.3: Dietary Intake and Eating Practices

Adolescent girls in poorer communities have limited access to adolescent health services; this makes them more susceptible to nutritional deficiencies including anaemia. Adolescents are mostly involved in unhealthy eating practices such as increased eating of junk(Abu-Baker et al., 2021). Adolescent's access to health services could improve healthy dietary behavior and good health practices.

2.3.4: Health related factors

Health related factors such as worm infestations, fever, vomiting and mensuration status according to studies by (P. H. Nguyen et al., 2015) are known to cause anaemia during adolescence.

According to (Pasqualino et al., 2021) worms usually spend the majority of their lifespan in a host, either biological or otherwise. Worms usually affect the body systems through meals, liquid, or a transfer mechanism. They survive on or consume a part of the person's meal. Hook worms, which wreak havoc on the walls of the intestines and live on the human blood, are particularly harmful and can cause anaemia

Mensuration leads to loss of blood among adolescent girls, according to (P. H. Nguyen et al., 2015) it also causes an increase in nutritional and dietary requirements, when these requirements are not met it can lead to anaemia.

2.4: Types of Anaemia

2.4.1: Nutritional Anaemia

This is caused by an inadequate intake of nutrients essential for the production of hemoglobin. Inadequate nutrient intake can be as a result of poor dietary intake or poor handling and processing of food (Cairo et al., 2014). For example, green leafy vegetables which are rich in Vitamin B12, Iron and Folic Acid, usually lose their nutritional value due to prolonged exposure to heat (Phuong H. Nguyen et al., 2006). Anaemia can occur as a result of inadequate consumption of Vitamin C rich foods which aid in the absorption of iron (Gebreweld et al., 2019). The consumption of polyphenols (caffeinated drinks, coffee and tea) has also been found to inhibit the absorption of iron. (Bose et al., 2021)

2.4.2: Iron Deficiency Anemia

This is a result of insufficient iron level for the production of hemoglobin. Low iron levels among adolescent girls is usually due to inadequate consumption of iron rich foods, menstruation and poor absorption of iron as a result of worm infestation or the consumption of foods that inhibit the absorption of iron(Clark et al., 2018).

Adolescence is characterized by rapid physiological changes which increases their nutritional requirements to make up for these changes. Iron requirement increases especially among adolescent girls to make up for developmental changes such as mensuration and muscles development. Adolescents, anaemia could be as a result of insufficient consumption of iron rich foods during this period of their life, it is however important that there is sufficient iron in the diet to meet the body's needs for that particular period of life (Villalpando, 2016).

Adolescents' anaemia could also be due to change in dietary habits during this stage of growth, this could be to achieve a desired body image, changes in adolescents feeding habits could also

be associated behavior changes as well as to affirm themselves within the society (Mahanta et al., 2015). In Adolescents, food is a way to express feelings of rebellion and resentment, especially in families that lack communication, this attribute of food can lead to poor dietary intake. Marketing of unhealthy foods by the media, skipping meals or refusal to eat in order to achieve excess weight loss are factors that make adolescents susceptible to anaemia (Cappellini et al., 2020).

Adolescents' consumption of fast foods which is significantly unhealthy because it frequently contains significant nutritional limitations, such as high energy, fat, and sodium content, as well as low fiber, vitamin, calcium, and iron content (Cappellini et al., 2020). Generally, socioeconomic and sociocultural determinants, a change in one's body image, poor households eating habits, household income, eating away from home, access to food, Simple and rapid food preparation, inappropriate advertisement (Abu-Baker et al., 2021). These are the major factors that influence insufficient dietary iron intake.

2.4.3: Folic Acid Deficiency Anaemia

Folic Acid is an essential component for the production of red blood cells. Inadequate consumption can lead to a change in the structure of red blood cells or the death of the cells (Megaloblastic anaemia). Adolescents (age 10-19 years) are at high risk of iron deficiency and anaemia due to accelerated increase in requirements for iron, poor dietary intake of iron, high rate of infection and worm infestation as well as the social norm of early marriage and adolescent pregnancy (Mahanta et al., 2015). Poor dietary intake among adolescent girls in rural communities in Ghana, is usually as a result of food insecurity due to financial instability and poverty (P. H. Nguyen et al., 2015). Adolescents girls again have increased susceptibility to anaemia due to the loss of blood through menstruation as well as an increased blood demand for

physiological activities due to rapid growth and development (Villalpando, 2016). Poverty and lack of financial resources by adolescents are directly related to their inability to have access to enough food, and the lack of enough food subsequently leads to nutrient deficiencies, including iron which as well lead to anaemia.(Reading, 2007)

2.5. Adolescents' Dietary Diversity

Dietary diversity is an assessment tool to determine access to varied food groups in the household this is referred to as household dietary diversity (HDD). It also used to determine an individual's access to sufficient nutrients in their diets referred to as individual dietary diversity (IDD) (Herforth et al., 2019). Dietary diversity is mainly used to assess nutrient adequacy of diets and the number of food groups a diet is composed of, it focuses on both macro and micronutrients composition of diets for different age groups such as in children, adolescent as well as the aged (Y. et al., 2019). Minimum dietary diversity is also used to assess whether individuals or household diets are composed of a minimum of five to ten food groups. Consuming between five to ten food groups increases the likelihood of attaining adequate nutrient requirements as compared to those who eat less (Baxter et al., 2022). The FOA defines the diet diversity distribution by the mean DDS of the population (W. Zhao et al., 2017). Food groups defined by FAO are placed according to whole grain, roots and tubers, legumes, seeds and nuts, animal sourced protein (poultry, fish, eggs, dairy foods, and other meat group), fruits and vegetables (green leafy vegetables, vitamin A rich fruits and vegetables, other fruits and vegetables) (Isabirye et al., 2020). Adolescent in low- and middle-income countries are at high risk of micronutrient deficiency as a result of non-diverse diet (A. Zhao et al., 2020).

2.6: Prevalence of Non-diverse diet Score

According to a study by (Birru et al., 2018) the prevalence of diet diversity among adolescent girls in Urban Northwest Ethiopia was recorded as 75.4%, also a study by (Fahmida Akter et al, 2021) recorded a prevalence of 55.4% among adolescent girls in Bangladesh, also a study by (Isabirye et al., 2020) in Uganda recorded a prevalence of 45.3% among adolescent girls. However, findings by (Baxter et al., 2022) recorded a prevalence of 13.5% among adolescent girls in rural parkistan.

These variations could be associated to socio-economic differences and varying food security situations across the various regions.

2.7: Factors Influencing Adolescents' Dietary Diversity

Demographic characteristics such age, educational status and residence are factors that influence diet diversity score among adolescents. According to a study by (Agrawal et al., 2018) older adolescents are at high risk of having an non-diverse diet score. A study by (Balci et al., 2012) recorded a significant association between age and diet diversity, similarly findings by (Isabirye et al., 2020) found a significant association between age and diet diversity.

However, a study by (Herforth et al., 2019) recorded a weak association between age and diet diversity, similarly (Abu-Baker et al., 2021) also recorded a weak association between age and diet diversity.

These variations could be as a result of differences in adolescent health and nutrition services, adolescents exposed to healthy dietary information are more likely to achieve an adequate DDS as compared to adolescent girls without access to such information or those exposed to unhealthy dietary information.

Studies by (A. Zhao et al., 2020) recorded a significant association between educational status of adolescent girls and diet diversity score, similarly a study by (Abu-Baker et al., 2021) recorded a significant association between educational status of adolescent and diet diversity score. Findings by (Isabirye et al., 2020) however recorded a weak association between educational status and diet diversity score, this was similar to findings by (Agrawal et al., 2018) that also recorded a weak association between educational status of adolescent girls and diet diversity.

The differences in these findings could be associated to geographic variations and adolescent school health services.

2.7.1: Behavioral factors

Adolescence is a period characterized by unhealthy dietary practices and could be associated to exposure to advertisement of unhealthy food products, increased availability of junk foods and inadequate information on healthy dietary practices(Agrawal et al., 2018).

Socio-cultural practices such as food taboos can lead to non-diverse diet score among adolescent girls.

2.7.2: Health related factors

Health related factors such as worm infestations, fever and vomiting can reduce appetite and the quantity of food consumed by adolescent girls, and this increases their susceptibility of having non-diverse diet score(Dubik et al., 2019).

2.8.1: Interventions to reduce anaemia prevalence

The ministry of health together with Ghana health services has outlined some strategies in the Safe motherhood policy which aims at reducing anaemia burden among adolescent girls, some of

the strategies outlined in the policy include weekly intake of IFA among adolescent girls, the use of insecticide treated bed nets and deworming (Protocol, 2016). The Girls Iron Folate tablet supplementation (GIFTS) is one of the interventions targeted at adolescent girls to reduce anaemia burden, the program targets both in school and out of school adolescent, In school adolescent girls are given a dose of the IFA tablet weekly (Wednesdays) at school, where as the out of school adolescent girls are given four (4) tablets to be carried home and taken on a weekly basis, only the first dose is taken at the health facility where the IFA is issued (GIFTS Survey, 2018).

The school health concept also creates the opportunity for health professionals to carry out education on anaemia prevention and control for adolescent girls. Adolescent health interventions including establishment of adolescent health corners in most health facilities helps in the education of adolescent girls on anaemia prevention and control (*ADOLESCENT POLICY*, 2020).

These interventions when implemented effectively can reduce the anaemia burden among adolescent girls.

Anaemia from the literature reviewed is still a situation that requires more attention from public health practitioners, and the factors discussed from the literature reviewed can be addressed through multi sectorial approach, that is, it requires commitment from Government, health workers, community member, family members and individuals to achieve the goal of reducing anaemia burden in Ghana and globally.

CHAPTER THREE

MATERIALS AND METHODS

3.1: Study Design

A district based secondary data analysis of a Cohort study to assess the anaemia levels among adolescent girls with financial literacy and savings in the Upper Manya Krobo District in the Eastern region. Primary study was conducted between July 2014 to March 2015.

3.2: Study Area

The study will be conducted in the upper Manya Krobo District, located in the Eastern region of Ghana. The UMKD is among the poorest district in Ghana, adolescent girls in the district are faced with poor educational and health outcomes as well as high risk of reproductive health issues.The UMKD has six sub-districts, however the study was carried out across villages located within three sub-districts (Asesewa, Otrokper and Sekesua) due to financial constriants. The selected villages have poor roads and very limited vehicular movements especially during the rainy season. A third of the adolescent girls in the study were selected from Asesewa. Asesewa is a commercial town with a rural bank, where the savings accounts for the girls were operated. The town also has a senior high school and a vibrant market.

3.3: Study Population

Adolescent girls aged 9-13 years both in school and out of school totaling 1431 were randomly selected from three sub-districts namely Asesewa, Otrokper and Sekesua. The sub-districts were further broken down into 60 village clusters. 30 out the 60 clusters with a total of 715 adolescent girls were given a 5 day financial literacy training, savings of $15 and educational incentives. The remaining 716 were observed as the comparative group. Fractions of the study population

(596) were selected for anaemia screening due to financial constraints. The aim of the study was to focus on early adolescents which will prepare and transition them into grown adolescents.

3.4: Sampling Method

Stratified sampling method was applied during the original study. The six sub-districts were stratified by size (Large, Medium and small). One sub-district was randomly selected from each stratum. 60 villages were clustered from the three selected sub-districts. 30 of the clusters were randomly selected for the intervention and the remaining 30 clusters were the comparative group.

Ethical consideration

Ethical approval was given for the conduct of the original study by McGill University (# 822-0514) and the Nuguchi Memorial Institute for Medical Research (# 060/13-14). Parent or guardians gave their consent and adolescent girls also assented for the conduct of the original study.

Data Collection Techniques and Tools

The primary data was collected through a longitudinal survey using a structured questionnaire. Data was collected from adolescent girls after they had given a written accent and their guidance also gave a written consent.

The data collected included age of participants, educational status, physical activity, feeding practices and hemoglobin levels among others.

Data Management and Analysis

The primary data was stored in an excel template. Data cleaning was carried out on the excel template based on the study objectives and then exported to Stata version 16 for data analysis. Hemoglobin levels were categorized into normal (Hb 12 and above), Moderate/mild anaemia

(Hb 10.9g/dl-11.9g/dl) and moderate anaemia (Hb 7g/dl-9.9g/dl) and severe anaemia (Hb ≤7 g/dl). Food was grouped into 11 main groups and dietary diversity score was categorized into Adequate DDS (eating from 7 or more food groups) inadequate DDS (eating from less than 7 food groups). Associations between independent variables to the dependent variables were tested using bivariate chi square test and multivariate analysis was carried out for statistically significant variables. Variables that had a p value of less than 0.05 of 95% confidence interval were considered to be associated with the outcome variables.

Table 1**: Study Variables**

	VARIABLE	OPERATIONAL DEFINITION	TYPE OF VARIABLE	SCALE OF MEASUREMENT
1	Hb of adolescent girls	Hb level of adolescent during the study	dependent	Continuous
2	Dietary Diversity of adolescent girls	Number of food groups adolescent diet is composed of	independent	Continuous
3	Age of participants	Age in completed years of adolescent during the study	independent	Continuous
4	Residential location	Residential location of adolescents during study	independent	Categorical
5	Educational level	Educational level of adolescent girl during the study	independent	Categorical
6	Occupation	The work adolescent girl does	Independent	Categorical
7	Ever Menstruated	Refers to whether adolescent girl has experienced manache	Independent	Categorical
8	Fever in the past 30 days	Refers to whether adolescent girl has had	Independent	Categorical

		fever within the last 30 days		
9	Vomiting in the past 30 days	Refers to whether adolescent girl has vomitted within the last 30 days	Independent	Categorical
10	diarrhea in the past 30 days	Refers to whether adolescent girl has had diarrhea within the last 30 days	independent	Categorical
11	Worms in stool in the past 30 days	Refers to whether adolescent girl has had worms in stool within the last 30 days	independent	Categorical
12	Number of days exercised/sports in the last week	Refers to the number of days adolescent girl has exercised or played sports within a week	independent	Continuous
13	Nutrition information received in the last one month	Refers to the number of times adolescent girl received nutrition information within the last one month	independent	Continuous

CHAPTER FOUR

RESULTS

4.1 Socio-demographic characteristics

The study was conducted among 1,431 adolescent girls. However the analyses were done using 1,420 adolescent girls who responded with complete information. The respondents were between 9 – 13 years, with mean age of 10.9 ± 1.4 years, the mean Hb and DDS were 12.73±9.57 and 7.79±2.31 respectively. Majority of the participants (80.7%) were above 10 years old. Majority (97.0%) of the participants were currently enrolled in school, majority (82.5%) were in primary school. About a third (37.2%) has lived in the community their whole lives.

Table 2: Socio-demographic characteristics of respondents

Characteristic	Frequency (N=1420)	Percentage (%)
Age, years		
9	273	19.24
10	320	22.55
11	286	20.16
12	295	20.79
13	245	17.27
Currently in School	1378	97.04
Level of Education completed		
Kindergarten 1/kindergarten 2	146	10.60
Primary	1,137	82.51
Junior High School	95	6.82

4.2 Health related events of respondents

From the table below, majority (85.6%) of the participants have not ever had menstruation. About half (51.1%) of the participants indicated that they had fever within the last 30 days. Majority of the participants (69.7%) did not report vomiting within the last 30 days. Majority (81.0%) of the participants indicated they did not have diarrhea within the last 30 days. Majority (97.1%) of the participants responded that they did not see worms in their stool within the last 30 days.

Table 3**: Health-related events of respondents**

Variable	Frequency (N=1420)	Percentage (%)
Ever Menstruated	80	5.64
Fever in the past 30 days	726	51.13
Vomiting in the past 30 days	429	30.21
diarrhea in the past 30 days	269	18.97
Worms in stool in the past 30 days	31	2.18

4.3 Diet-related factors of respondents

From table 4, majority 71.0% of the participants ate an average of three or more meals per day in the household. Almost half of the participants (42.1%) ate an average of one meal per day outside the household in the past week. Majority of the participants (84.2%) indicated that they ate sweets and sugars within the last week. More than two thirds (72.4%) of the participants indicated that they have eaten spices and condiments within the last week. Majority of the participants 53.38% responded to eating animal source foods within the last week. Almost all (97.3%) indicated they have eaten foods from roots, tubers, plantains and their products within the last week. Only 22.5% of the participants ate pulses, seeds, nuts and their products within the last week. About half of the participants (53.9%) indicated they have eaten cereals and cereal

products within the last week. Majority (90.2%) of the participants indicated they have received nutrition information in the last 12 months. About a third of the participants 37.6% indicated they never exercised within the last 12 months.

Table 4**: Diet-related factors of respondents**

Variable	Frequency (N=1420)	Percentage (%)
Average meals/day eaten in household in the last week		
One	4	0.028
Two	391	27.54
Three or more	1021	71.90
Don't know	4	0.28
Average meals/day eaten outside household in the last week		
None	148	10.42
One	598	42.11
Two	557	39.23
Three or more	117	8.17
Sweets and sugars	1196	84.23
Spices and condiments	1026	72.36
Animal source foods	758	53.38
Roots, tubers, plantains and their products	39	2.75
Vegetables and their products	865	61.00
Fats and Oils	1270	89.50
Fruits and their products	896	63.14
Pulses, seeds, nuts and their products	319	22.46
Cereals and their products	765	53.87
Received nutrition information in last 12 months	139	9.73

Number of days in last week played sports/exercise		
Never	534	37.61
1-2 days	397	27.96
3-4 days	207	14.58
5-6 days	135	9.51
Everyday	125	8.80
Don't know	22	1.55
Diet Diversity status		
Adequate (eaten from more than or equal to the mean DDS of 7)	968	70.78
Inadequate (eaten from less than the mean DDS of 7)	412	29.22
Anaemia status		
No anaemia	418	70.13
Anaemia	178	29.87

4.4: Socio-Demographic characteristics associated to anaemia

From table 5, five hundred and ninety six (596) of the participants were screened for anaemia, and 24% of the participants were 10 years old, of which 65.47% of them had no anaemia while 34.53% of them had anaemia. There was statistical association between age and anaemia (X^2=11.55, p-value= 0.0210).

Majority of the participants 96.8% were currently in school out of which 70.8% had no anaemia while 29.2 % had anaemia. There was a statistical association between being in school and anaemia (X^2=4.86, p-value=0.0275).

About one fourth of the participants 23.15% had kindergarten 1 or 2 (k1/k2) being their highest level of education out of which 69.34% had no anaemia while 29.4% had anaemia, Just a few 3.6% of the participants had Junior High School being their highest level of education out of

which 86.4% had no anaemia while 13.6% had anaemia. The was no statistical association between level of education and anaemia (X^2=5.15, p-value=0.1611)

Table 5**: socio-demographic factors associated to anaemia**

variable	**Anaemia status n=596**		**Adjusted Odds**	**Adjusted p-value**	**X^2**	**P- Value**
	No Anaemia n(%)	Anaemia n(%)				
Age,Years					**11.55**	**0.0210***
9	71 (60.68)	46(39.32)	1			
10	91(65.47)	48(34.53)	0.827 (.488-1.401)	0.48		
11	95(76.00)	30(24.00)	0.484 (.273-.857)	**0.013***		
12	92(77.31)	27(22.69)	0.442 (.245-.798)	**0.007***		
13	69(71.88)	27(28.13)	0.628 (.343-1.147)	0.13		
Currently in Sch.					**4.86**	**0.0275***
Yes	409(70.88)	168(29.12)				
No	9(47.37)	10(52.63)	2.547(.951-6.825)	**0.063***		
Level of Education					5.15	0.1611
Kindergarten 1/2	95(69.34)	43(30.66)				
Primary	295(70.74)	122(29.26)				
Junior High School	19(86.36)	3(13.64)				

*** Significance at p<0.05.**

4.5: Health-related events associated with anaemia

From table 6, out of 4.4% of the participants who have ever menstruated, 30.8% of them had anaemia while 69.2% had no anaemia. There was no statistical association between ever menstruated and anaemia (X^2=2.93, p-value= 0.2312). Majority 53.18% of participants responded to have had fever in the past 30 days out which 32.49% had anaemia while 67.5% had no anaemia. There was no statistical association between fever and anaemia (X^2=2.23, p-value= 0.1354). About a third of the participants 33.6% who vomited in the past 30 days had anaemia while 66.3% had no anaemia. There was no statistical association between vomiting and anaemia (X^2=2.10, p-value= 0.1469). Anaemia among participants who had diarrhea in the past 30 days was 34.2% while 65.8% had no anaemia. There was no statistical association between diarrhea and anaemia(X^2=1.31, p-value= 0.2518).40.0% of participants who had worm infestations had anaemia while 60.0% had no anaemia. There was no statistical association between worm infestation and anaemia (X^2=0.51, p-value= 0.7742)

Table 6**: Health related factors associated with anaemia**

Variable	**Anaemia Status N=596**		**X^2**	**P- Value**
	No Anaemia n(%)	Anaemia n(%)	2.93	0.2312
Ever Menstruated	18(69.23)	8(30.77)		
Fever in past 30 days	214(67.51)	103(32.49)	2.23	0.1354
Vomiting past 30 days	134(66.34)	68(33.66)	2.10	0.1469
diarrhea past 30 days	75(65.79)	39(34.21)	1.31	0.2518
Worms in stool in the past 30 days	8(60.00)	5(40.00)	0.51	0.7742

*** Significance at p<0.05.**

4.6: Diet related factors associated to anaemia

From table 7, Anaemia among participants who ate an average of three (3) or more meals in the household was 25.9% while 66.7% of the participants who ate an average of one (1) meal in the household had anaemia. There was a statistical association between average number of meals eaten in the household per day and anaemia (X^2=15.12, p-value= 0.0017). Anaemia among participants who ate an average of two (2) meals outside the household was 26.52% while 73.5% had no anaemia. Anaemia among participants who ate no meal on average per day outside of the household was 31.0% while 69.0% had no anemia. There was no statistical association between meals eaten outside the household and anaemia (X^2=4.64, p-value= 0.3263). Anaemia among participants who responded to have eaten sweets or sugars in the last one week was 22.8% while 77.2% had no anaemia. There was no statistical association between eating sweets or sugars and anaemia(X^2=2.57, p-value= 0.1086). Anaemia among participants who responded to have eaten spices and condiments in last week was 26.6% while 73.4% had no anaemia. There was no statistical association between eating of spices and condiments in last week and anaemia(X^2=1.33, p-value= 0.2495). Less than a third 28.3% of the participants who ate animal source foods in last week had anaemia while 71.7% had no anemia. There was no statistical association between eating of animal source foods in last week and anaemia(X^2=0.73, p-value= 0.3917). Less than a third 29.5% of the participants responded to have eaten roots, tubers, plantains and their products in the last week had anaemia while 70.5% had no anaemia. There was no statistical association between eating of roots, tubers, plantains and their products in the last week and anaemia (X^2=1.87, p-value= 0.1716). 29.0 % of the participants who ate pulses, seeds, nuts and their products in the last week had anaemia while 71.0% had no anaemia. There was no statistical association between eating of pulses, seeds, nuts and their products in the last

week and anaemia (X^2=0.60, p-value= 0.4395). less than a third (28.3% of the participants who ate cereals and their products in the last week had anaemia while 71.8% had no anaemia. There was no statistical association between eating of cereals and their products in the last week and anaemia (X^2=0.61, p-value= 0.4352). Less than a third 29.8% of participants who ate vegetables and their products had anaemia while 70.2% had no anaemia. There was no statistical association between eating of vegetables and their products in the last week and anaemia (X^2=0.0082, p-value= 0.928) .29.3% of the participants who ate fruits and their products had anaemia while 70.7% had no anaemia. There was no statistical association between eating of fruits and their products in the last week and anaemia (X^2=0.0914, p-value= 0.762). Less than a third 29.1% of the participants who ate fats and oils had anaemia while 70.8% had no anaemia. There was no statistical association between eating of cereals and their products in the last week and anaemia (X^2=3.4191, p-value= 0.064).Less than one fourth 19.5% of the participants received nutrition information in last 12 months had anaemia while 80.5% had no anaemia. There was no statistical association between receiving nutrition education and anaemia (X^2=2.25, p-value= 0.1333). About a third 34.3% of the participants never played sports/exercise in the last week had anaemia while 65.8% had no anaemia. There was a statistical association between playing sports/exercise and anaemia (X^2=13.99, p-value= 0.0298).

Table 7**: Diet related factors associated to anaemia**

Variable	**Anaemia status n=596**		**Adjusted Odds**	**Adjusted p-Value**	**X^2**	**P- Value**
Average meals/day eaten in household in last week	No Anaemia n(%)	Anaemia n(%)			**15.12**	**0.0017***
One	1(33.33)	4(66.67)	1			
Two	106(61.99)	65(38.01)	1.702 (1.152-2.516)	**0.008***		
Three or more	311(74.05)	109(25.95)	6.433 (.562-73.68)	0.135		
Average meals/day eaten outside household in last week					4.64	0.3263
None	49(69.01)	22(30.99)				
One	169(67.33)	82(32.67)				
Two	169(73.48)	61(26.52)				
Three or more	31(72.09)	13(27.91)				

Eaten sweets and sugars last wk.	71(77.17)	21(22.83)	2.57	0.1086
Fats and Oil	403(70.83)	166(29.17)	3.4191	0.064
Eaten spices and condiments in last week	127(73.41)	46(26.59)	1.33	0.2495
Eaten animal source foods in last week.	225(71.66)	89(28.34)	0.73	0.3917
Eaten roots, tubers, plantain and other products in last week	407(70.54)	170(29.46)	1.87	0.1716

Eaten pulses, seeds and nuts week	311(71.00)	127(29.00)	0.60	0.4395
No	107(67.72)	51(32.28)		
Eaten vegetables and their products	257(70.22)	109(29.78)	0.0082	0.928
Fruits and their products	217(70.68)	90(29.32)	0.0914	0.762
Eaten cereals and their products in last week	193(71.75)	76(28.25)	0.61	0.4352
Received any nutrition info. in last 12 mo.	33(80.49)	8(19.51)	2.25	0.1333
No	385(69.37)	170(30.63)		

Number of days in last week played sports/exercise					**13.99**	**0.0298***
Never	144(65.75)	75(34.25)	1			
1-2 days	125(75.76)	40(24.24)	.625 (.391-.999)	**0.05***		
3-4 days	70(70.00)	30(30.00)	.813 (.479-1.379)	0.442		
5-6 days	34(87.18)	5(12.82)	.268 (.099-.727)	**0.01***		
Everyday	38(61.29)	24(38.71)	1.126 (.615-2.059)	0.701		

*** Significance at p<0.05.**

4.7 Socio-demographic factors associated to diet diversity

From table 8 below, 1420 of the participants were assessed for diet diversity score, 22.4% were 10 years old, 31.1% of them had inadequate DDS while 68.9% of them had adequate DDS. There was statistical association between age and diet diversity (X^2=1.52, p-value= 0.8223).

Majority 96.4% of the participants were currently in school out of which 28.6% had inadequate DDS while 71.4% had adequate DDS. There was a statistical association between being in school and diet diversity (X^2=9.88, p-value=0.0017).

Less than one fifth 10.1% of the participant had kindergarten 1 or 2 (k1/k2) being their highest level of education out of which 25.7% had inadequate DDS while 74.3% had adequate DDS, Less than 10% (6.6%) of the participants had Junior High School being their highest level of education out of which 20.4% had inadequate DDS while 79.6% had adequate DDS. Level of education was not statistical associated to diet diversity (X^2=4.61, p-value=0.2023)

Table 8: **Socio-demographic factors and diet diversity**

Characteristics	**Diet Diversity status n=1420**		**Adjusted Odds**	**Adjusted P-Value**	**x^2**	**P- Value**
	Inadequate n(%)	Adequate n(%)				
Age, years					1.52	0.8223
9	77 (28.31)	195(71.69)				
10	99(31.13)	219(68.87)				
11	81(28.52)	203(71.48)				
12	80(27.40)	212(72.60)				
13	75(30.86)	168(69.14)				
Currently in School	391(28.56)	978(71.44)	2.398 (1.268-4.535)	**0.007***	**9.88**	**0.0017***
Level of Education					4.61	0.2023
kindergarten1/2	37(25.69)	107(74.31)				
Primary	335(29.62)	796(70.38)				
Junior High School	19(20.43)	75(79.57)				

*** Significance at p<0.05.**

4.8: Health-related events associated to diet diversity

From table 9, less than10% (5.5%) of the participants have ever menstruated, 30.8% of them had inadequate DDS while 69.2% had adequate DDS .Majority 94.5% of the participants have never menstruated out of which 29.6% had inadequate DDS while 70.5% had adequate DDS. There was no statistical association between ever menstruated and Diet diversity (X^2=1.11, p-value= 0.5729). More than half 50.6% of the participants responded to have had fever in the past 30 days out which 27.3% had inadequate DDS while 72.7% had adequate DDS. There was no statistical association between fever and Diet diversity (X^2=3.20, p-value= 0.5729). Less than a third 29.8% of the participants vomited in the past 30 days of which 26.0% had inadequate DDS while 74.0% had adequate DDS. There was no statistical association between vomiting and Diet diversity (X^2=3.02, p-value= 0.2021). Less than a third 18.7% of the participants had diarrhea in the past 30 days out of which 24.8% had inadequate while 75.2% had adequate DDS. There was no statistical association between diarrhea and anaemia (X^2=3.04, p-value= 0.0812). Less than 1% of the participants had worm infestations out of which 16.1% had inadequate DDS while 83.9% had adequate DDS. There was no statistical association between worm infestation and Diet diversity (X^2=5.59, p-value= 0.0610).

Table 9**: Health related events and diet diversity**

Variable	Diet diversity Status n=1420		x^2	P- value
	Inadequate	**Adequate**		
Ever Menstruated	24 (30.77)	54(69.23)	1.11	0.5729
Reported Fever in past 30 days	196(27.26)	523(72.74)	3.20	0.2021
Reported Vomiting in past 30 days	110(26.00)	313(74.00)	3.02	0.0822
Reported diarrhea in past 30 days	66(24.81)	200(75.19)	3.04	0.0812
Worms in stool past 30 days	5(16.13)	26(83.87)	5.59	0.0610

*** Significance at p<0.05.**

4.9: Diet related factors associated to DD

From table 10 below, Majority 71.4% of the participants ate an average of three (3) or more meals in the household out which 27.7% of the participants had inadequate DDS while 72.32% had adequate DDS. Less than 1% of the participants ate at least one (1) meal in the household out of which 25% had inadequate DDS while 75% had adequate DDS. There was a statistical association between average number of meals eaten in the household per day and Diet diversity (X^2=4.81, p-value= 0.1865). About a third 37.3% of the participants ate an average of two (2) meals outside the household out of which 27.5% had inadequate DDS while 72.5% had adequate DDS. Less than one fourth 10.2% of the participants ate no meal on average per day out of which 35.2% had inadequate DDS while 64.8% had adequate DDS. There was statistical association between meals eaten outside the household and Diet diversity (X^2=9.60, p-value= 0.0478). Less than 10% of the participants received nutrition information in last 12 months out of which 15.2% had inadequate DDS while 84.8% had no adequate DDS. There was statistical association between receiving nutrition education and adequate DDS (X^2=16.86, p-value= 0.0002). About a third 37.3% of the participants never played sports/exercise in the last week out of which 31.2% had inadequate DDS while 68.8% had adequate DDS. Less than 5% of the participants played sports/exercise every day in the last week out of which 32.8% had inadequate DDS while 67.2% had adequate DDS. There was a statistical association between playing sports/exercise and Diet diversity (X^2=6.06, p-value= 0.4170).

Table 10**: Diet-related factors and diet diversity**

Variable	Diet diversity n=1420		Adjusted Odds	Adjusted P-Value	x^2	p-value
	Inadequate (%)	Adequate (%)				
average meals/day eaten in household in the last week					4.81	0.1865
One	3(25.00)	5(75.00)				
Two	128(33.07)	259(66.93)				
Three or more	281(27.68)	734(72.32)				
average meals/day eaten outside household in the last week					**9.60**	**0.0478***
None	52(35.17)	94(64.83)				
One	183(30.70)	413(69.30)	0.609(0.376-0.989)	**0.045***		
Two	152(27.54)	400(72.46)	0.704(0.432-1.146)	0.158		
Three or more	25(21.55)	91(78.45)	0.528(0.299-0.933)	**0.028***		
Received any nutrition information in last 12 months	21(15.22)	117(84.78)	2.36(1.45-3.824)	**0.001***	**16.86**	**0.0002***
Number of days in last					6.06	0.4170

week played sports/exercise		
Never	165(31.19)	364(68.81)
1-2 days	98(24.81)	297(75.19)
3-4 days	59(28.64)	147(71.36)
5-6 days	48(31.58)	103(68.42)
Everyday	41(32.80)	84(67.20)

*** Significance at p<0.05.**

CHAPTER FIVE

DISCUSSION

5.1: Prevalence of Anaemia among Adolescent girls

The prevalence of anaemia among adolescent girls in the UMKD was 29.9% similar to prevalence of 29.0% recorded by (Choudhary et al., 2006), Studies by (Gebreyesus et al., 2019) in a district in Ethiopia also recorded a prevalence of 29.1%,also among adolescent girls in Bhutan, a prevalence of 29.0% was reported by (Campbell et al., 2018), in Babile District, Eastern Ethiopia, a prevalence of 32.0% was recorded among adolescent girls (Kedir Teji et al., 2016). Also among adolescent girls in Kenya, a prevalence of 28.8% was reported (Ngesa & Mwambi, 2014). This prevalence is a huge public health concern, because 3 out of 10 adolescent girls in the UMKD district according to the study are anaemic.

However the prevalence recorded was marginally higher than the prevalence of 14.0% among adolescent girls in Kavrepalanchok, Nepal as reported by (Budhathoki et al., 2021), the prevalence of 18.1% among adolescent girls as reported in Dubai, United Arab Emirates by (Haleama Al Sabbah, 2020), also the prevalence of 19.9% reported by (Stabell et al., 2021)among adolescent girls in Northern Norway and the prevalence of 24.0% among adolescent girls in the Volta and northern regions of Ghana reported by (Gosdin et al., n.d.,2020).

It is important to note that the prevalence recorded was marginally lower than the prevalence of 39.7% that which was reported by (Khan et al., 2019) among adolescent girls in Karachi University students, Pakistan, among adolescent girls in Uganda a prevalence of 46.5% was recorded by (Adelman et al., 2019), also a prevalence of 53.0% was reported by (Dhillon et al., 2021)among adolescent girls in Government School at Border-belt of Indian Punjab Piverjeet, also the prevalence of 55.4% among adolescent girls in Riyadh City, Saudi Arabia reported by

(Al-othaimeen et al., 2009) and also the prevalence of 48.0% reported among adolescent girls in Ghana by (DHS, 2015).This variations compared to other studies from Ghana could be associated with geographical differences, the differences can as well be associated to the introduction of the iron folic acid supplementation for adolescent girls.

The variations in prevalence of this study as compared to other studies could be associated with differences in demographic locations, economic status, access to healthcare services and clean water and sanitation, eating practices as well as availability of healthy food, and knowledge on healthy diets(P. H. Nguyen et al., 2015). Findings from this study though marginally lower than national prevalence there is the need for more attention to paid on adolescent girls within the district, this is important considering the fact that participants from this studies are early adolescents and will be likely exposed to more anaemia risk factors.

5.2: Factors associated with anaemia among adolescent girls in the UMKD

5.2.1: Age

Age of adolescent girls was significantly associated with anaemia, girls aged 12 was at higher risk of developing anaemia with odds of 0.45 (95% CI= 0.257- 0 .799) after a multivariate analysis of the of factors associated with anaemia, this was in line with studies by (El-Sahn et al., 2000) which recorded a significant association between age of adolescent girls and anaemia, also similar to studies by (Campbell et al., 2018) that also recorded an association between age of adolescent girls and anaemia. Adolescents aged 12 was the age at which most of the adolescents had onset of menarche which could be associated to the high odds among girls within that age group.

However findings from (Siva et al., 2016) recorded no association between age of adolescent and anaemia with a (p-value= 0.962 at significance level of p-value= 0.05), studies by (Bharati et al., 2009) also recorded no association between age of adolescents and anaemia. These disparities could be as a result of variations in difference in geographic locations, access to adolescent health services and availability of healthy foods as well as information of healthy diets.

5.2.2: Current schooling status

Current schooling status of adolescent girls was significantly associated with anaemia with adolescents currently not in school being at higher risk of developing anaemia with odds of 2.705(1.079-6.776) after a multivariate analysis of factors associated with anaemia, similar to findings by (Bharati et al., 2009) which recorded significant association between current schooling status and anaemia, (Abdo et al., 2019) also recorded adolescent current schooling status to be significantly associated with anaemia, schooling status was found to be significantly associated with anaemia by (Baig-Ansari et al., 2008) in Urban area of Pakistan, findings by (El-Sahn et al., 2000) among Egyptian adolescents also recorded a significant association between schooling status and anaemia.

Adolescent girls currently in school have an increased chance of being exposed to healthy eating behaviors and good health practices which can improve their health and decrease their risk of developing anaemia (Liang et al., 2019).

5.2.3: Number of meals/day eaten in household in last week

Average number of meals/day eaten in household was found to be significantly associated with anaemia with a(p-value=0.0017 at significance level of p-value= 0.05), after a multivariate analysis of all factors associated with anaemia, an average of two meals eaten in the household

was found to be significantly associated with anaemia with an adjusted odds of 0.1752439(.0157- 1.952) and a p-value=0.008. This was similar to findings by (Nabuuma et al., 2021)that reported association between dietary pattern and anaemia, and also similar to findings by (Isabirye et al., 2020) which also reported a significant association between dietary pattern and anaemia.

However this finding differs from findings by (Y. et al., 2019) and (Mahajan & Kshatriya, 2019) who recorded no association between dietary pattern and anaemia.

5.2.4: Number of days adolescent girls play sports or exercised

Number of days adolescents girls play sports or exercised in a week was significantly associated with anaemia with (p-value=0.0298 at significance level of p-value= 0.05), after a multivariate analysis of all factors associated with anaemia, adolescent girls who exercised at least 1-2 days as well as those who exercised at least 5-6 days had significant association with anaemia with an adjusted odds of 0.625 (0.391-0.999) with an adjusted p-value=0.05 and 0.268 (0.099-0.727) with an adjusted p-value=0.01 respectively. This was similar to findings by (Savanur et al., 2017) that reported an association between physical activity and anaemia, this was also similar to findings by (Chowdhury & Chakraborty, 2017) that also reported an association between physical activity and anaemia.

5.3: Prevalence of dietary diversity among adolescent girls in UMKD

The prevalence of diet diversity among adolescent girls in the UMKD was 29.2%, however the prevalence recorded was marginally higher than the prevalence of 13.5% recorded by (Baxter et al., 2022) among adolescent girls in rural Pakistan, It is important to note that the prevalence recorded was marginally lower than the prevalence of 45.3% was recorded by (Isabirye et al.,

2020) among adolescent girls in Uganda, and a the prevalence of 55.4% by (Fahmida Akter et al, 2021) among adolescent girls in Bangladesh, the prevalence recorded was however significantly lower than the prevalence of 75.4% was recorded by (Birru et al., 2018) among adolescent girls in Urban Ethiopia

5.4: Factors associated with diet diversity among adolescent girls in the UMKD

5.4.1: Current schooling status

Current schooling status among adolescent girls was significantly associated with diet diversity among adolescent girls, adolescent girls currently in school had lower chance of having non-diverse diet score with an AOR of 2.398 (1.268-4.535). studies by (A. Zhao et al., 2020) recorded no significant association between education and diet diversity, findings by (Isabirye et al., 2020) also recorded a weak association between diet diversity and anaemia.

5.4.2: Average number of meals/day eaten outside the household

The study also recorded average number of meals/day eaten outside the household be to significantly associated with diet diversity after a multivariate analysis on factors associated with diet diversity, those who ate one meal as well as those who ate three or more meals were found to be associated with non-diverse diet with AOR of 0.609(0.376-0.989) and 0.528(0.299-0.933) respectively. This is similar to finding by (Chauhan et al., 2021) and (Y. et al., 2019) that also recorded an association and meals eaten outside the household.

5.4.3: Nutrition information received

The study again recorded a significant association between nutrition information received and diet diversity score among adolescent girls, the AOR for adolescent girls who received nutrition information was 2.36(1.45- 3.824), this association could be as result of adolescents capacity to

make good health and dietary choices when nutrition information is accessible to them. This finding is similar to findings by (Baxter et al., 2022) and (Fahmida Akter et al, 2021) that recorded association between nutrition information received and diet diversity. This calls for the need to make nutrition information and education more accessible to adolescent girls to equip them with the requisite knowledge in making good dietary choices.

Strengths of the study

1. The study focused on early adolescents which is unique as most studies focuses on older adolescents.
2. The study focused on both anaemia and diet diversity which will give readers a more comprehensive view on the two outcome variables.

Weaknesses of the study

1. Literature on early adolescents is insufficient as most studies focuses on older adolescents.
2. The primary study did not test for the hemoglobin levels of all participants, this reduced the sample size of adolescent screened for anaemia, which made the outcome less representative.

CHAPTER SIX

CONCLUSION

Findings from this study show marginally lower anaemia than the national prevalence, more attention needs to be paid to anaemia among adolescent girls within the district, this is important considering the fact that participants from this study are early adolescents and are more susceptible to anaemia risk factors. Factors such as age, current schooling, average meals ate at the household and number of days exercised were found to be significantly associated to anaemia, while factors such as between current schooling status, average number of meals ate outside the household and nutrition information received were significantly association to DDS.

6.1: Recommendations

The following recommendations are made based on the findings from this study to reduce the prevalence of anaemia and diet diversity among adolescent girls in the Upper Manya Krobo District.

6.1.1: Public health Practitioners

- The GHS through the District Health Administration and health facility should intensify sensitization of adolescent girls on anaemia and diet diversity.

6.1.2: Policy makers

- Government and other relevant stakeholders should institute interventions to ensure household food security.
- The food and drug authority as well as other relevant stakeholders should regulate exposure of adolescents to unhealthy advertisement.

- Government should collaborate with other relevant stakeholders in education to promote and support education of adolescent girls.
- Government and other relevant stakeholders should institute more adolescent girls centered interventions on anaemia. Adolescents through these interventions will be equipped with adequate information to improve their heamoglobin levels, this includes measures to ensure proper dietary practices among adolescents, Iron and folic acid intake and good hygiene practices among others.

6.1.3: Research

Research should be conducted to determine the association between anaemia status of mothers and other parental factors and adolescent anaemia.

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