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PREDICTORS OF ANAEMIA AMONG ADOLESCENTS: A CASE STUDY OF MAKONI DISTRICT, MANICALAND 2021

BY

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Abstract

Anaemia is the third and final stage of iron deficiency, a reduction in circulating haemoglobin (Hb) concentration. Adolescents are at high risk of anaemia due to rapid growth and maturation. Globally anaemia is a major contributor to the burden of disease with a prevalence of 32.9% as at 2010, and resulting in 68.4 million years lived with disability. In Zimbabwe, anaemia has been rising among adolescent boys from 13,5% in 2005 to 20.4% in 2015. Trends have remained static in girls ranging from 26.2% in 2005 to 26.5% in 2015. A case study to identify predictors of anaemia among school going adolescents was conducted using secondary data involving 411 school going adolescents aged 10-19 years. The study setting was 10 primary and secondary schools in Makoni district that appear in the IFA database. SPSS was used to perform logistic regression for binary outcomes and general regression for continuous variables. The prevalence of anaemia was 9.3% and the prevalence of underweight was 8.0%, and both were higher in boys than girls (10.3% vs 8.4% and 12.6% vs 3.8%; respectively). The prevalence of stunting was 11.2% and also higher among boys compared to girls (18.1% vs 4.7%). Having < 5 household members had a 60% protective effect on anaemia compared with a household size > 5 people [(OR: 0.4: 95% CI 0.2-0.9) p value = 0.02]. Staying in urban was protective against anaemia by more than 90% compared with living in the peri-urban [OR: 0.0, 95% CI: (0.0-0.6) p value=0.02]. Odds of anaemia increased by 50% as height increased by 1 meter [OR 1.5: 95% CI (1.0, 2.1) p value = 0.03]. The odds of anaemia decreased by 50% as weight increased by 1kg [OR: 0.5 95% CI (0.3, 0.8) p value = 0.01]. Hb level is 0.4g/dL lower in adolescents who live in households with solar or electricity [β = -0.4: 95% CI (-0.7,-0.0) p value = 0.02]. 15.8% of the adolescents had ever heard of anaemia and the majority (89.3%) had low knowledge on anaemia. Prevalence of anaemia among adolescents in Makoni is not within the normal levels and is of mild public health concern. The Ministry of Health and Child Care, Provincial Medical Director of Manicaland to consider household size, residence in peri-urban settings and underweight for selecting adolescents for targeted interventions that address anaemia in Makoni District. The Ministry of Primary and Secondary Education in Makoni district has to promote knowledge on anaemia and behaviour change communication through school health clubs, strengthen home grown school feedings programs in secondary schools, and avail weight scales and height meters in schools for constant monitoring of learners' nutritional status. Increase in weight had a protective effect on anaemia, residence in peri urban settings and having household members >5 are important predictors of anaemia. 9 in 10 school going adolescents have a knowledge gap on anaemia.

Key words: Adolescents, anaemia, weight, household size, residence

Declaration Page

I declare that this dissertation proposal is my original work except where sources have been cited and acknowledged. The work has never been submitted, nor will it ever be submitted to another university for the award of a degree

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Dedication

I dedicate this dissertation report to my husband, Alexander Ndangana, for supporting me all the way.

List of Abbreviations

AUREC	Africa University Research Ethics Committee
BMI	Body mass index
BAZ	BMI for Age Zscore
DALYs	Daily adjusted Life Years
DMO	District Medical Officer
HAZ	Height for age Zscore
Hb	Haemoglobin
IDA	Iron Deficiency Anaemia
IFA	Iron and Folic Acid
LMICs	Low- and Middle-Income Countries
MOHCC	Ministry of Health and Child Care
PMD	Provincial Medical Director
UNICEF	United Nations Children's Fund
WASH	Water, Sanitation and Hygiene
WAZ	Weight-for-age Z-score
WHO	World Health Organization
YLD	Years lived with Disability
ZDHS	Zimbabwe Demographic Health Survey

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CHAPTER 1 INTRODUCTION

1.1 Introduction

This section seeks to provide an overview of anaemia in adolescents. It shows the magnitude and severity of the problem that warrants research. Subtopics covered include background information, the problem statement, and significance of the study, research questions and objectives.

Adolescence is a critical period of rapid growth and maturation characterized by a dramatic increase in iron requirements among boys and girls due to expansion in blood volume, increase in muscle mass, and in girls also due to onset of menstruation. (Vir, 2011). These physiological changes put adolescents at high risk of developing iron deficiency and anaemia. Iron loss may also occur due to malaria and soil transmitted helminths, hemoglobinopathy and other inherited red cell disorders, poor iron absorption due to inadequate personal hygiene, environmental sanitation and unsafe drinking water (Kapil et al., 2018).

Anaemia is the third and final stage of iron deficiency, a reduction in circulating haemoglobin (Hb) concentration that is high enough to be recognized as anaemia. Haemoglobin is an iron containing protein that is responsible for transporting oxygen. Global reports indicate that there are approximately 2.5 cases of iron deficiency for each case of anaemia hence many more adolescents are suffering from iron deficiency than are anaemic (World Health Organisation [WHO], 2011).

Iron deficiency is the common cause of nutritional anaemia with some recent studies suggesting that fifty percent of all the anaemia cases in developing countries may be estimated to be due to iron deficiency. Iron deficiency occurs when an insufficient amount of iron is absorbed to meet the body's requirements. This insufficiency may be due to inadequate iron intake from the diet, to reduced bioavailability of the dietary iron, or to increased needs of iron such as during periods of infancy, adolescence and pregnancy. Anaemia occurs when iron deficiency is prolonged. Iron deficiency anaemia (IDA) is characterized by a gradual decrease in blood haemoglobin level to below normal levels, which results in different degrees of anaemia ranging from mild to moderate to severe. Other nutritional deficiencies such as low intake of folic acid, vitamin B12, riboflavin, vitamin A and vitamin C can influence the aetiology of anaemia. Clinical symptoms due to IDA include anorexia, flatulence, nausea, dimness of vision and headaches (Vir, 2011).

IDA during adolescence has serious implications for a wide range of outcome which include; impaired physical growth, weakened cognitive development, reduced physical and work performance/capacity and diminished concentration in daily tasks and school performance, loss of appetite resulting in reduced food intake as well as irregular menstruation. Iron deficiency also adversely affects the immune system. Impaired physical performance affects productivity, especially in income earning activities that are dependent on physical efforts. It has been estimated that each 1% decrease in haemoglobin results in a 1.5% decrease in work capacity and a 1–2% decrease in work output with economic consequences (Vir, 2011). It has been reported that anaemia results in poor attention and memory, poor concentration and scholastic performance and is associated with disturbances in attention and perception resulting in poor academic achievements (Vir, 2011).

Anaemia in chronic diseases may occur due to chronic inflammation of the gut and atrophy of the intestinal villi caused by poor quality of water, sanitation and hygiene (WASH) conditions, characterized as environmental enteropathy (EE) (Kapil et al., 2019). Inflammation leads to malabsorption of nutrients and disturbs the iron homeostasis by reducing iron absorption and utilisation, suppressing haemoglobin synthesis and red blood cell production (Kapil et al., 2019). Knowledge has also been shown to be an important factor, which is a cornerstone of attitude and practice changes to prevent anaemia (Agustina et al., 2021)

Adolescent girls are considered to be more at risk of anaemia as they have high nutritional demands to account for their growth acceleration, sexual maturation, and future pregnancy. Increase in growing body tissue and red cell mass causes a double iron requirement. Even when the growth spurt has passed, the risk of anaemia is still high due to menstruation (Agustina et al., 2021). Iron deficiency in adolescent girls also has serious implications on the future generation by adversely affecting the health of the foetus.

WHO. (2011) classification of public health significance of anaemia in populations on the basis of prevalence estimated from blood levels of haemoglobin puts prevalence of anaemia into the following categories; 40% or higher – severe, 20% – 39.9% moderate, 5% – 19.9% mild, 4.9% or lower – normal. Estimating haemoglobin has been the major criterion for determining anaemia, both due to all cause as well as iron deficiency.

Methods of estimating haemoglobin can be broadly divided into qualitative and quantitative. Quantitative measurements of haemoglobin can be performed using the hemocue analyser. The former requires low skill since only a drop of whole blood is used in the test and it does not require carefully calibrated amount; nor does it need dilution. However, it is well established that the hemocue overestimates haemoglobin levels and therefore the method provides an under estimation of the anaemia levels. More accurate quantitative methods are the cyanmethemoglobin and the oxyhemoglobin methods. These are based on dilution of a very small amount of blood and require high level of skill and training (Vir,2011). This study sought to identify predictors of anaemia among school going adolescents in Makoni District, 2021.

1.2 Background of the study

Globally anaemia is a major contributor to the burden of disease with a prevalence of 32.9% as at 2010, and resulting in 68.4 million years lived with disability (YLD) (Weze et al., 2020). It is also a leading cause of adolescent disability-adjusted life years (DALYS) lost by girls 10-19 years, and boys 10-14 years (WHO, 2011). Prior studies that have investigated the prevalence of anaemia and associated factors among adolescent girls suggest that, the prevalence of anaemia differs by country and region with estimates ranging from 5.3% in high-income country settings to over 50.0% in some Low- and Middle-Income Countries (LMICs) (Zhu et al., 2021).

Prevalence of anaemia remains high in Sub Saharan Africa, affecting 36% of adolescents and about half of anaemia cases are associated with iron deficiency (Weze et al., 2020). In Zimbabwe, a significant proportion of adolescent boys with anaemia has been on the rise from 13,5% in 2005 to 20.4% in 2015 (ZDHS, 2015) and trends have remained almost static in girls ranging from 26.2% in 2005 to 26.5% in 2015 (ZDHS,2015). Anaemia in adolescence may cause a wide range of functional consequences across the life course, including reduced resistance to infection, impaired physical performance and neurodevelopment, and suboptimal schooling outcomes (Zhu et al., 2021).

However, nutrition programming has been focused on assessing micronutrient requirements for preadolescents overlooking exacerbated requirements in adolescents due to rapid growth and physiological changes that occur during puberty (Schulze et al., 2014).

Apart from the problem of hidden hunger as shown by high prevalence of anaemia in some LMICs, under and over nutrition is also a common challenge among adolescents. In sub Saharan Africa 2.1% and 9% of adolescent boys (15-19) years old are thin and overweight/obese respectively. In Zimbabwe prevalence of thinness among adolescents (15-19) years is much higher at 10% in boys and 1.9% in girls. The country is not spared from over nutrition in adolescents with 25.2% and 10.8% of adolescent girls (15-19) years living in urban and rural areas respectively being overweight/obese (Benedict et al., 2018). Anaemia-stunting coexistence is prevalent in many LMICs. Shared factors, including poverty, limited education and access to knowledge, inadequate dietary and nutrient intake and infectious diseases, are suggested to contribute to anaemia and stunting co-occurrence (Agustina et al., 2021). Anaemia is also common in children suffering from severe protein energy malnutrition (Vir. 2011).

According to the Parischa et al. (2013), diet plays an important role in iron deficiency and anaemia. Zimbabwe Demographic Health Survey 2005-6, showed that the mean diet diversity score for girls 15-19 years was very low at 2.6%. 10.2 % of girls 15-19 years consumed eggs whilst, 33.9% consumed meat, poultry or fish (Benedict et al., 2018).

Generally, there has been slow progress in dealing with anaemia in LMICs. Important factors contributing to the lack of progress include failure to recognize the factors associated to iron deficiency and anaemia, lack of political commitment to control it, inadequate planning of control programmes, insufficient mobilization and training of health staff, and insufficient community involvement in solving the problem (WHO, 2020).

Currently, there are gaps in documented data on predictors of anaemia in adolescents at both national and subnational levels in Zimbabwe. Only a few active programmes in both developed and developing countries have succeeded in reducing iron deficiency and anaemia (WHO, 2020).

1.3 Statement of the problem

Anaemia is of grave public health concern in view of its wide ranging adverse functional consequences that include impaired physical work, impaired cognitive functions and adverse pregnancy outcomes that include higher perinatal mortality (Vir, 2011).

A report from a baseline survey conducted in Makoni District indicate that the prevalence of anaemia among school going adolescents is around 12.5%, with 16% of girls and 8% of boys being affected. WHO (2011) classifies anaemia prevalence of 5.0-19.9% as of public health concern. Makoni District is currently the only district in Zimbabwe that has reported anaemia among adolescents and the prevalence is of mild public health concern. The situation requires attention to stop progression to becoming a moderate public health concern or even worse. The slow progress in dealing with anaemia is due to failure to recognize the factors associated to iron deficiency and anaemia. It is against this background that the researcher seeks to determine factors associated with anaemia among adolescents in Makoni District.

1.4 Justification of the study

The burden of micronutrient deficiencies among adolescents (aged 10–19 years) has received insufficient attention from public health researchers, programmes and policymakers alike. This has resulted in limited data on anaemia prevalence among both adolescent boys and girls. There adolescent boys' anaemia that is required to better understand the problem and ensure anaemia prevention strategies encompass efforts to target boys as well.

1.5 Significance of the study

The study will inform program managers and policy makers with critical information on the factors associated with anaemia among adolescents that is useful in program planning and policy making within local context. The research will contribute in characterizing patterns and drivers of distribution of anaemia among adolescent boys and girls aged 10-19 years at subnational level which will facilitate the development of effective anaemia policies and programs for adolescents. Furthermore, the study will serve as a baseline against which to measure the future progress of such programs.

1.6 Research Objectives

1.6.1 Broad Objective

- To identify predictors of anaemia among school going adolescents in Makoni District, 2021.

1.6.2 Specific Objectives

- To identify socioeconomic and demographic factors associated with anaemia among school going adolescents in Makoni District, 2021.
- To determine the effects of anaemia on weight, height-for-age, and BMI-for-age among school going adolescents in Makoni District in 2021.
- To assess knowledge levels on anaemia among school going adolescents in Makoni District, 2021.

1.7 Research Questions

- What are the socioeconomic and demographic factors associated with anaemia among school going adolescents in Makoni District?
- What are the effects of anaemia on weight, height for age and BMI-for-Age among school going adolescents in Makoni District?
- What is the level of knowledge on anaemia among school going adolescents in Makoni District?

CHAPTER 2 REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter presents a survey of preceding literature on predictors of anaemia in adolescents. This section assisted the researcher in selecting an appropriate methodology and approach for the research. It also highlighted different perspectives and debates related to the topic that the researcher built on.

2.2 Relevance of the conceptual framework

The conceptual framework for this study is based on the determinants of iron deficiency anaemia by Parischa et al. (2013) and the theoretical framework of determinants of anaemia and growth faltering in adolescents by Agustina et al. (2021). Socio-economic, and demographic factors such as adolescents' age, sex, education level, place of residence, household head source of income, family size, and household assets, availability of electricity /solar are recognised as intermediate factors to anaemia that may also affect the current adolescents' knowledge on anaemia. For example, people in low-income settings such as rural areas may have poor access to iron rich and iron fortified foods which might lead to iron deficiency and anaemia (Parischa et al., 2013).

Intermediate factors will affect the diet quality, access to nutrient-rich diets, health, hygiene, sanitation, and underlying diseases as the proximal factors contributing to iron deficiency anaemia. Meanwhile, anaemia may also be related to adolescent growth faltering observed through stunting, wasting and underweight.

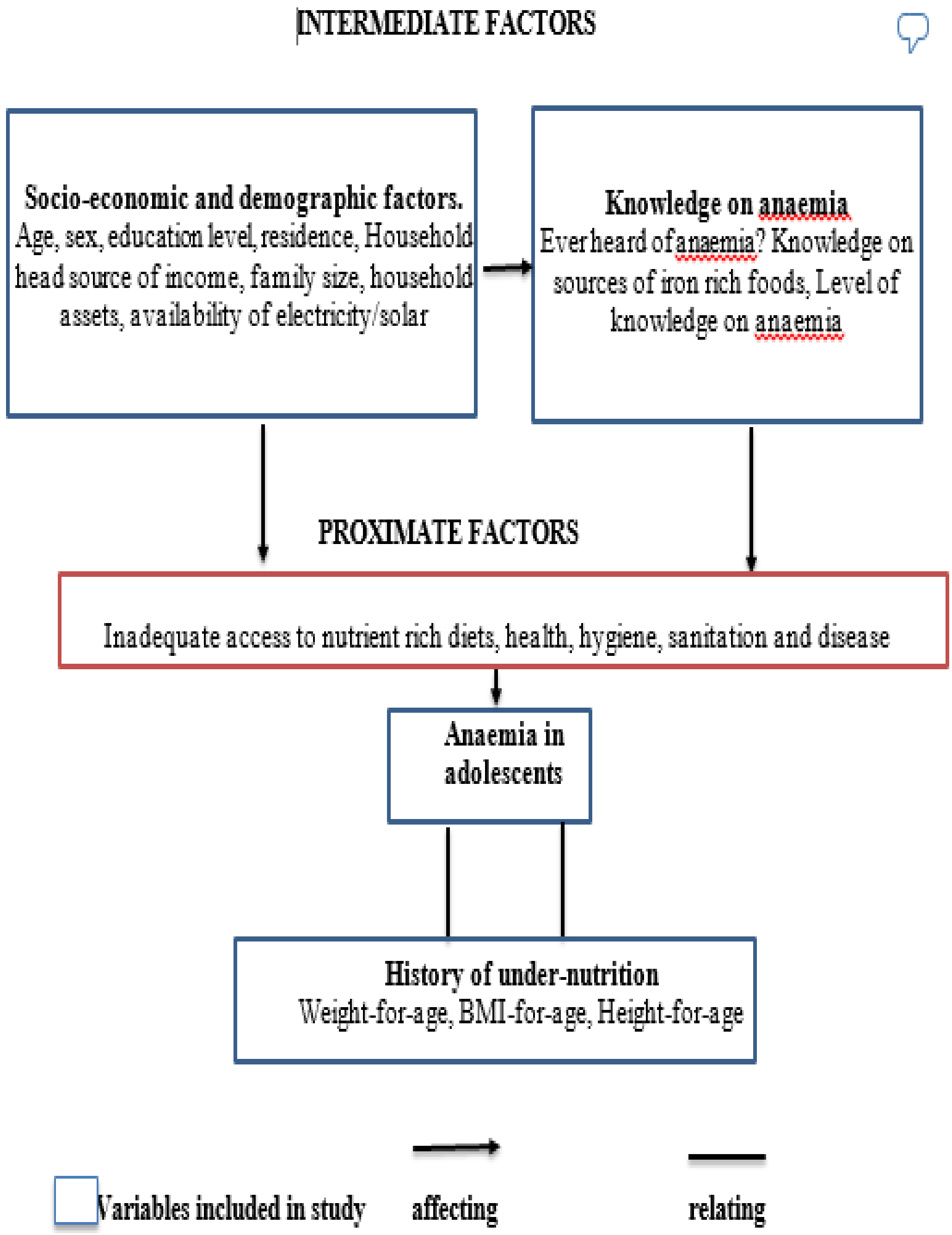

Figure 1 Conceptual Framework for factors associated with anaemia among adolescents

(Parischa et al, 2013; Agustina et al, 2021)

2.3 Anaemia, gender and age group

Vir (2011) asserts that the incidence of anaemia in school age children tends to increase with age and corresponds with acceleration in growth during adolescence. This explains why the prevalence of anaemia in school children has been shown to increase from 10 years old upwards and remains high until 18 years of age during the growth period. Studies in India have shown that the age group of 12–15 years has the highest prevalence with over 50% girls reported to be anaemic. This trend in prevalence of IDA with age is due to inability to meet the higher requirement for iron with increase in body mass which is correlated to variations in velocity of growth of adolescents (Vir, 2011).

A study conducted in India showed that girls were 2.58 times more likely to suffer from anaemia compared to boys. Being a female adolescent was associated with lower haemoglobin concentrations. A separate study in India showed that anaemia was consistently higher in girls aged 15-19 years compared to same-aged boys (Shinde et al., 2021). Several studies showed that likelihood of anaemia was significantly higher among females (Chalise et al., 2018).

On the other hand, a review of country level statistics showed that more adolescent boys aged 15-19 years (35.7%) were anaemic compared to girls (34.8%) in sub–Saharan Africa (Benedict et al., 2018). This is consistent with findings from a study in South Ethiopia which showed that female adolescents were less likely to be anaemic than adolescent boys (Shaka et al., 2018).

A study in Lao PDR, showed that there was no difference in the prevalence of anaemia between younger and older adolescents but the prevalence of anaemia was higher in females than in males (Kounnavong et al., 2020). However, differences in prevalence of anaemia was observed from a study in South Ethopia were anaemia was higher among those in early adolescence period (10-13 years) compared to late adolescence (17-19 years) (Shaka et al., 2018). This was similar to a study in Egypt that identified a significant inverse relationship between the level of anaemia and age especially among boys. Contrarily the likelihood of anaemia was significantly higher among older adolescents in a study conducted in Nepal (Chalise et al., 2018). el-Sahn et al. (2000) found out that gender differences were almost none existent in a study conducted among adolescents in Egypt. Looking at these differences it is important to know the predictors of anaemia within local text.

2.4 Nutrition Status and anaemia in adolescents

A study conducted in India by Shinde et al. (2021) showed that mean BMI for Age (BAZ) was higher among girls than boys, thus girls had a tendency of being heavier than boys. A number of studies reports underweight in adolescent boys being worse than that in girls in the 15-19 years age group (Lynfield, 2021).

Very few studies have tried to determine association of anaemia to BAZ and Height for Age (HAZ). According to Agustina et al. (2021) there was no significant association between anaemia and stunting but anaemic adolescents were 1.28 times more likely to be stunted than none anaemic adolescents. A study by Lawless et al. (1994) among Kenyan primary school children concluded that improved haemoglobin concentrations were associated with improved growth.

In China, adolescent girls with HAZ <-2 were 2.14 times more likely to be anaemic than their non-anaemic counterparts (Zhu et al, 2021). Thus stunting was found to be associated with anaemia. Shaka et al. (2018) also got the same results were anaemia was higher among adolescents with a HAZ <-2 in South Ethiopia. This is also similar to a study in Sub-Saharan countries were children who were stunted (HAZ <-2), moderately wasted (WHZ -2 to -3) or who had severe acute malnutrition (WHZ ≤-3) had lower haemoglobin concentration compared to their counterparts (Weze et al., 2021).

Furthermore Weze et al. (2021) also showed that adolescents who were overweight had lower haemoglobin concentration than those who were of normal BMI potentially signalling the impact of poor-quality energy-dense diets on anaemia risk in the context of global nutrition transition. This is consistent with other studies which show that obesity contributes to iron deficiency by causing low-grade inflammation that blocks iron uptake (Cepeda-Lopez et al., 2011).

Higher Hb levels appeared to be necessary for achieving higher weight gains as suggested in a study on iron and folic acid supplementation among girls aged 9-13 years in India. The same study also observed BMI gains to be higher in those who showed higher Hb increments (Sen et al, 2012). Increase in Hb levels were not associated with any gains in height in a study among adolescent girls aged 13-16 years in Indonesia.

A study on school children in Thailand by Sungthong et al. (2002) revealed that height gain was greater in children who received weekly iron and folic acid supplementation which increased Hb levels. In Vietnam, primary school children who were underweight, wasted, or in anthropometric failure (either underweight, stunted or wasted) were more likely to be anaemic (all $p \leq 0.004$). Stunted children were more likely to be anaemic ($p = 0.018$) than those who were not stunted.

Overweight/obese children were less likely to be anaemic (p = 0.026) (Hoang et al., 2019). A study among 335 Indonesian adolescent girls found that 1-point knowledge, attitudes and practices score increment was associated with an increase of height for age z score (HAZ) by 0.037 SD (P ¼ .012).

In sub-Saharan Africa, nutritional status significantly predicted haemoglobin concentration among pregnant women, adolescents, and children. Stunting and wasting frequently co-occurred with anaemia in the context of poor socioeconomic condition and endemic infections. More importantly, the relationship of under nutrition and anaemia was likely to be a causal relationship (Weze et al., 2021).

2.5 Socioeconomic and demographic factors and anaemia

Based on the literature on risk factors for adolescent nutrition, variables of importance include demographics, parental, social factors and depressive symptoms. A study in China showed that Demographic factors that might be associated with anaemia include respondent's age, residence, religion, household wealth, and mother's education (Zhu et al., 2021). Among both boys and girls' prevalence of anaemia is higher in rural than urban areas and in poorer households than wealthier households (Zhu et al., 2021).

In a study conducted in Indonesia, adolescents who were in senior school were 1.45 times more likely to be anaemic than those in junior school. Adolescents aged 15-19 years were 1.51 times more likely to be anaemic than adolescents in the 10-14 age group (Agustina et al., 2021).

Zhu et al. (2021), reported that mothers who reached high school were less likely to have anaemic adolescents compared to mothers with less than 3 years in school. However, the association was not significant for paternal education and anaemia.

A study in Sub-Saharan countries showed that adolescents from homes that cooked with electricity and gas had lower haemoglobin concentration than those who cooked with kerosene, or other cooking fuels. Also, adolescents who had bed-nets lower haemoglobin than those who did not (Weze et al., 2021).

Kounnavong et al. (2020), found no significant association between anaemia and factors such as parent's employment, family size and living conditions in Lao PDR. On the other hand, Shaka et al. (2018), found that anaemia was higher among those in households with a family size greater than five members, adolescents from rural areas, and families that purchase food needed for daily consumption. el-Sahn et al. (2000), also observed an inverse relationship between anaemia and socioeconomic level and educational level. No demographic or socio-economic factor was associated with any type of anaemia among Primary school children in Vietnam (Hoang et al., 2019).

2.6 Knowledge on anaemia among adolescents

Agustina et al. (2021) asserts that knowledge is an important factor, which is a cornerstone of attitude and practice changes to prevent anaemia. Limited access to knowledge has been postulated as one of the causes of the increased prevalence of anaemia and stunting. However, a study in Indonesia among adolescent girls by Agustina et al. (2021) found out that, none of the individual knowledge, attitudes and practices variables were associated with anaemia prevalence after adjusting for the covariates (adjusted odds ratio [AOR] ¼ 1.26; P ¼ .43).

A study done by Ghosh et al. (2020) in Noakhali district, Bangladesh showed that almost 50% of adolescent girls had good balanced diet related knowledge.

Wiafe et al. (2021) reported that in a rural district in Ghana 40% of adolescence 10-14 years had knowledge of iron deficiency anaemia, 29.4% knew anaemia causes, 86% knew symptoms of anaemia and 35% knew anaemia consequences. In the study knowledge of food sources of iron was positively associated with intake of chicken, fresh fish and dried fish. Anaemia was negatively associated with chicken (β = -0. 310, p = 0.416) and dried fish (β = -1.299, p = 0.045) consumption.

2.8 Summary

In this chapter the researcher attempted to outline the conceptual framework of the study. The researcher also managed to identify what has already been done in relation to the topic in order to establish gaps and inadequacies in the existing literature.

CHAPTER 3 METHODOLOGY

3.1 Introduction

This chapter looks at the methodology and is arranged in the following order: research design, study setting, study population, inclusion criteria, exclusion criteria sample size, sampling procedure, data collection instruments, data collection procedure, analysis and organization of data, plan for data dissemination, ethical consideration, and summary for the chapter.

3.2. Research Design

This study was an analysis of unpublished data from a cross sectional study conducted in Makoni District among 411 school going adolescent boys and girls aged 10-19 years old. A case study was employed to determine factors associated with anaemia. 35 students were found to be anaemic from 411 students in the IFA database. The IFA baseline database contains data on individual demographic characteristics, household characteristics, nutrition, health and knowledge on anaemia of school going adolescents aged 10-19 years. Socioeconomic status data included parental occupation, and household ownership of assets. It also contained data on the adolescents Hb concentrations, weight, and height.

The data included participants from the fifth primary level grade to upper sixth high school level. BMI-for- age and sex Z-score (BAZ), height-for-age and sex Z-score (HAZ) and weight-for-age and sex Z-score (WAZ) were used to classify the nutritional status as thinness (BAZ < -2 SD) or stunting (HAZ < -2 SD), and overweight (BAZ > 1 SD) or stature above average (HAZ > 1 SD) or underweight (WAZ <-2 SD) according to the World Health Organization (WHO) growth standards.

3.3 Population and sampling

3.3.1 Study site

The study analyzed data appearing in the IFA baseline survey database done in Makoni District in 2021. The data was collected from 10 purposively selected primary and secondary schools in the rural and peri-urban areas of Makoni District. Makoni is the second largest district in Manicaland Province covering a total of 787 050 Ha of which a total of 109 581 Ha is arable land.

According to the 2012 Census report, it has a total population of 357 541 people with 23% of this being adolescents. Ten percent of the land is under natural farming region IV which has chronic food shortages. Wards in natural farming region IV are prone to drought and people in these areas are often assisted with food aid in times of serious food shortages. Sources of income differ as the poor and middle class mainly depend on cash from crop production as a source of income. There are 186 primary schools and 98 secondary schools including private schools and independent colleges.

3.3.2 Study population

The study population was school going adolescent boys and girls aged between 10 and 19 years appearing in the IFA baseline survey database done in Makoni District in 2021.

3.3.2.1 Inclusion criteria

School going adolescent boys and girls aged between 10 and 19 years appearing in the Makoni District IFA baseline survey data base.

3.3.2.2 Exclusion criteria

School going adolescents aged from 10-19 years who do not appear in the IFA database were excluded.

3.3.2.3 Study delimitations

Study population defined as all school going adolescent boys and girls aged between 10 and 19 years appearing in the Makoni District IFA baseline survey data base.

3.3.2.4 Study limitations.

Sample excluded out of school adolescents which makes it less generalizable. Data on dietary diversity was not collected.

3.3.3 Sampling technique

Census sampling technique was used to select all participants appearing in the IFA baseline survey to come up with the study population.

3.3.4 Sample size

Expected sample size using Dobson formula and an anaemia prevalence rate of

12.5% was 175. Dobson formula $n = \frac{\{\frac{Z\alpha}{2}\}^2 p(1-p)}{\epsilon 2}$ Where Zα/2=1.96,

p=12.5%=0.125, Є =5%, α =1.96. Maximum sample size calculated using response rate of 96% (ZDHS, 2015). Census sampling technique was used to select all 411 participants appearing in the IFA baseline database.

3.4 Data collection procedure

3.4.1. Dependent variable

Anaemia is the dependent variable of the study. Anaemia was defined and adjusted for age as recommended by WHO, and was classified using the table below.

Table 1: Haemoglobin levels to diagnose anaemia at sea level

	Anaemia			
Population	**Non anaemic**	**Mild**	**Moderate**	**Severe**
	Hb concentration (g/dL)			
Children 5-11 years of age	>11.5	11.0-11.4	8.0-10.9	<8.0
Children 12-14 years of age	>12.0	11.0-11.9	8.0-10.9	<8.0
Non-pregnant women (≥15 years)	>12.0	11.0-11.9	8.0-10.9	<8.0
Pregnant women	>11.0	10.0-10.9	7.0-9.9	<7.0
Men (≥15 years)	>13.0	11.0-12.9	8.0-10.9	<8.0

(WHO, 2011).

3.4.2. Independent variables

The independent variables are socio-economic, demographic characteristics, nutrition status and knowledge on anaemia. Socio-economic and demographic characteristics include adolescent's age, household head main source of income and relationship to adolescent, family size and place of residence.

3.5 Statistical Analysis

Quantitative and descriptive analysis was done using SPSS v21. Statistical significance was considered as a two-tailed P-value of ≤0·05 at a 95 % CI. Percentages for categorical variables and means±standard deviations (SDs) for continuous variables were used to describe characteristics of the study population. Bivariate and multivariable logistic regression models were performed to examine factors associated with anaemia including socioeconomic status, adolescent age, sex, nutrition status and knowledge on anaemia. Influencing factors of continuous haemoglobin concentrations using generalized linear models were also analysed.

The flow chart in Figure 2 illustrates the processes the researcher undertook to meet the objectives of the research. Census sampling technique was used to select all 411 participants in the database. Statistical analysis was carried out as described to obtain answers for the study objectives.

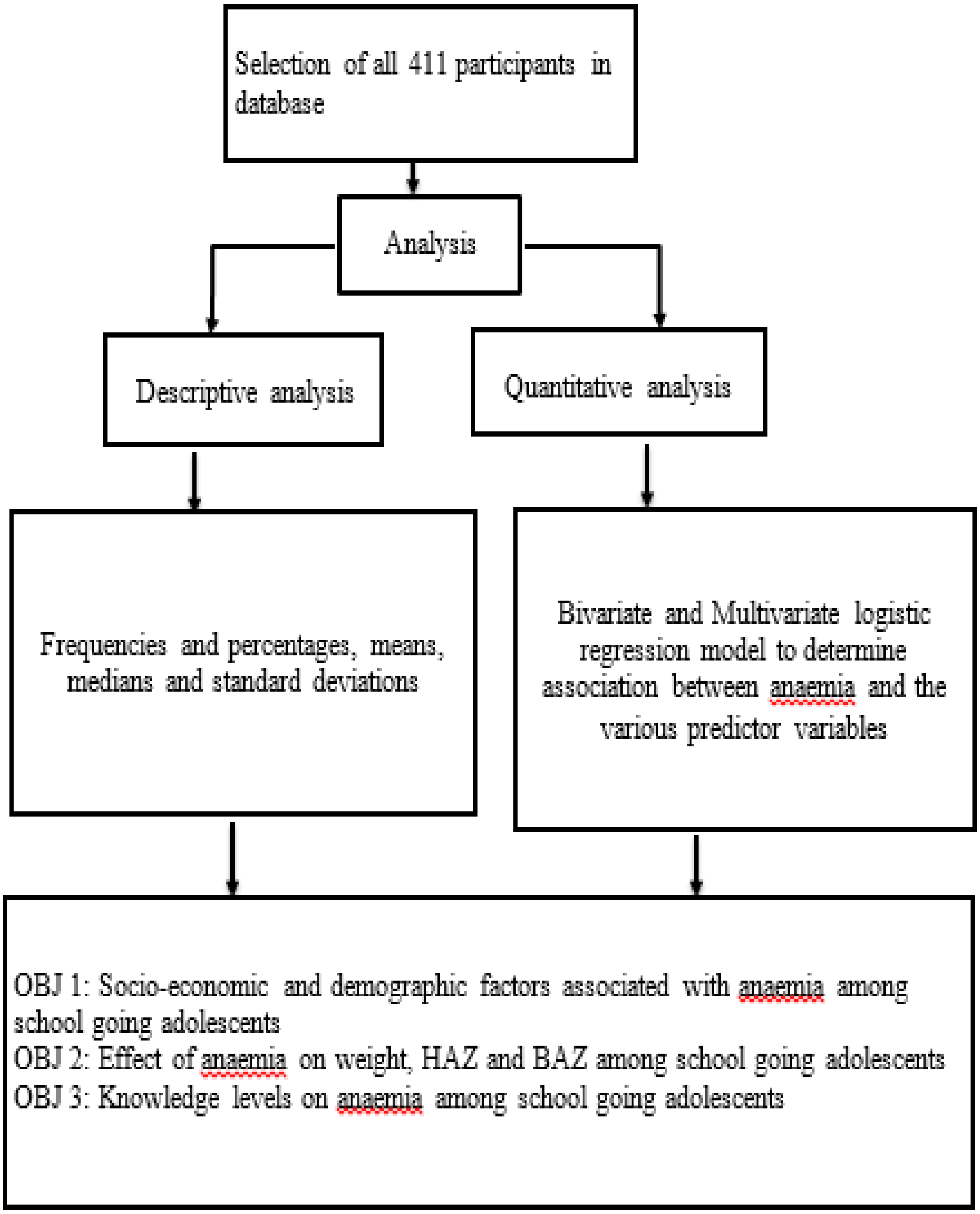

Figure 2: Study Flow Chart

3.6 Ethical considerations

The study was approved by MOHCC PMD, DMO and ethical clearance was obtained from AUREC. All the information concerning the study was kept private and confidential.

3.7 Dissemination of results

Presentation of results will be done for the District Health Team and Manicaland Provincial Health Executive (PHE). A manuscript will be developed and will be published in a peer reviewed journal.

3.8 Summary

The chapter managed to cover the methodology and of particular interest were the study settings, design, population sampling, data collection, data presentation and analysis, and ethical considerations.

CHAPTER 4 DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter presents findings which were gathered from this secondary data analysis. The results will be presented through graphs, charts and tables.

4.2 Demographic and socio-economic characteristics of participants

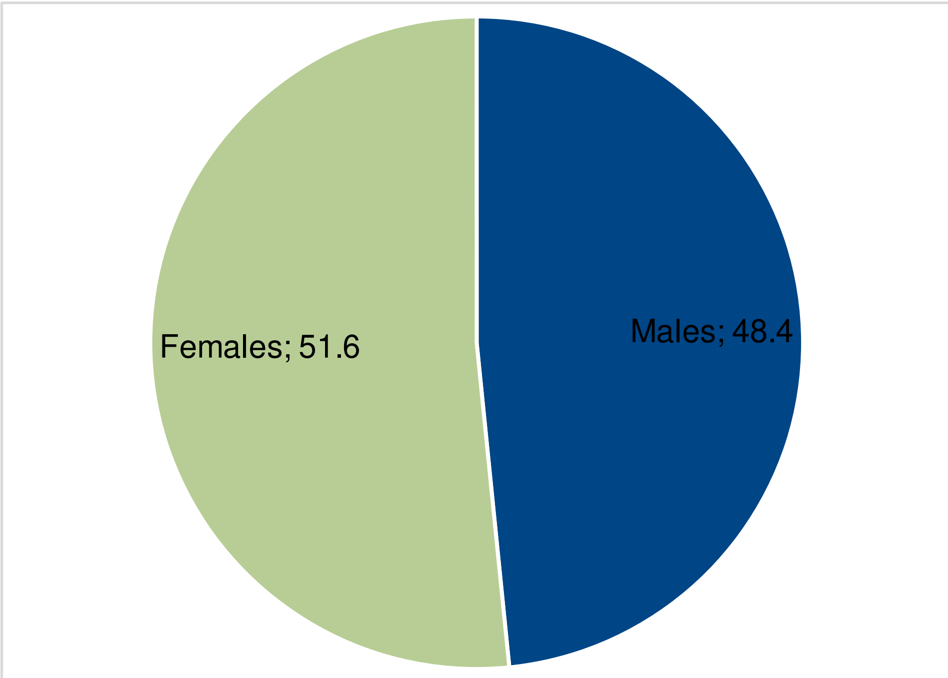

Figure 3: Gender distribution of study participants

Figure 3 above shows that the study sample consisted of slightly more females (51.6%) than males (48.4%).

Table 2: Demographic and Socio-economic status of adolescents in Makoni District

Characteristic	**Girls N=212 n(%)**	**Boys N=199 n(%)**
Mean age (in years; SD)	13.7±2.1	14.1±2.2
Residence		
Urban	22(10.4)	21(10.6)
Peri-urban	190(89.6)	178(89.4)
Level of education		
Primary	68(38.2)	81(34,2)
Secondary	131(61.8)	131(65.8)
Household size		
<5	69(32.5)	60(30.2)
>5	143(67.5)	139(69.8)
Income source of head		
Formal	18(8.5)	21(10.6)
Informal	194(91.5)	178(89.4)
Relationship to Household head		
Parent	166(78.3)	143(71.9)
Guardian	46(21.7)	56(28,1)
Household ownership of assets		
>4 assets/animal drawn cart/car/truck	132(62.2)	121(60.8)
< 4 assets	80(37.7)	78(39.2)
Household Energy Source		
Have Electricity or solar	146(68.0)	151(75.9)
Don’t have electricity or solar	66(31.1)	48(24.1)

Girls were slightly younger (13.7±2.1 years) than boys (14.1±2.2 years). 89.5% of adolescent boys and girls in the study were from a peri-urban setting. Regarding family characteristics, 68.6% of the adolescents are from households with family size of above five, (89.5%) of the respondents' family live in peri-urban settings and three quarters of the adolescents stayed with their parents. Concerning level of education, 63.7% or the respondents were in secondary school. Most of the adolescents (90.5%) reported that the main source of income of their household head was informal. Information on household ownership of assets showed that 61.6% of the adolescents lived in households that owned more than 4 of the common household assets. About a third of the adolescents (27.7%) lived in households that do not have had electricity or solar.

4.3 Anaemia and Hb levels in adolescents

Table 3: Anaemia and Hb levels in adolescents

Characteristic	Girls N=191 n(%)	Boys N=184 n(%)
Prevalence of anaemia	16(8.4)	19(10.3)
	175(91.6)	165(89.7)
Mean Hemoglobin g/dL	13.7g/dL±1.4	14.1g/dL±1.6

The prevalence of anaemia was 9.3% and it was higher in boys than girls (10.3% vs 8.4%). The mean (±SD) Hb level was 13.9g/dL and slightly higher among boys (14.1g/dL±1.6) than girls (13.7g/dL±1.4).

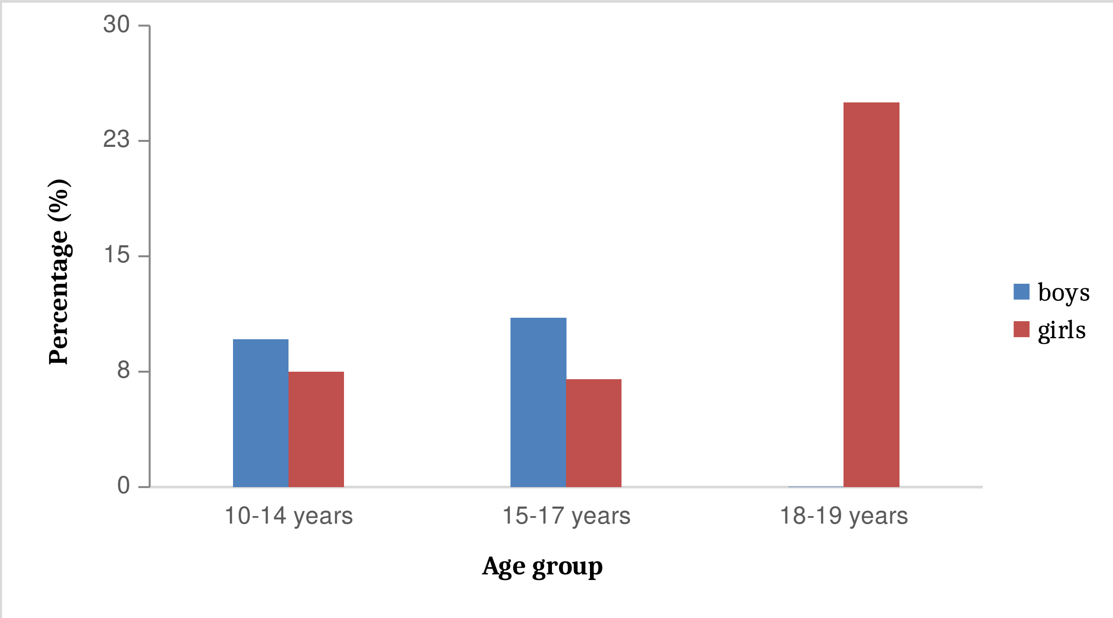

Figure 4: Proportion of adolescents with anaemia by sex and age group

Nine point six percent (8/100) of adolescent boys in the 10-14 age group had anaemia whilst 7.5% (8/73) of adolescent girls in the same age group had anaemia. More adolescent boys in the age group 15-17 years had anaemia 11% (11/100) compared with adolescent girls of the same age group 7% (7/73). There was no anaemia among boys aged 18-19 years, but 25% (1/4) of the adolescent girls in the 18-19 age group had anaemia.

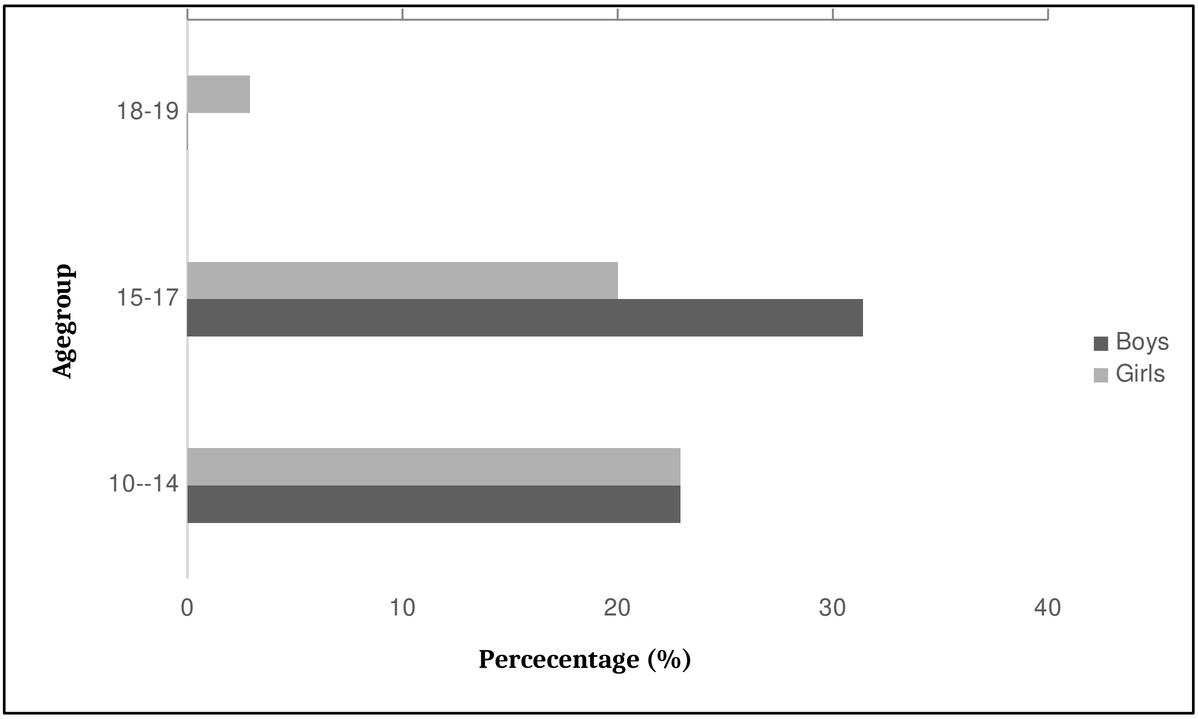

Figure 5: Distribution of anaemia among anaemic adolescents

Thirty one point four percent (11) of adolescents with anaemia were boys aged 15-17 years old. Girls aged 18-19 years had the lowest proportion of adolescents with anaemia of 2.9% (1), whilst there was no anaemia in adolescent boys aged 18-19 years. Twenty percent (1 out of 5) of girls aged 18-19 years old had anaemia. The 10-14 years age group had a similar proportion of adolescent boys and girls with anaemia of 22.9% each.

4.4 Adolescent anaemia and nutrition status

Table 4: Anthropometric measurements

Variable	**Category**	**N = 411** **n(%)**
BMI for age	Severely thin (z <-3)	1(0.2)
	Moderately thin (z <-2)	21(5.1)
	Normal (z>=-2 & =<+2)	384 (93.4)
	Overweight (z > +2)	5(1.2)
Height for age	Severely stunted (z <-3)	6(1.5)
	Moderately Stunted (z <-2)	40(9.7)
	Normal (z>=-2 & =<+2)	361(87.8)
	Moderately Too tall (z 2)	3(0.7)
	Severely Too tall (z 2)	1(0.2)
Weight for age	Severely underweight (z <-3)	5(1.2)
	Moderately underweight (z <-2)	28(6.8)
	Normal (z>=-2 & =<+2)	376(91.5)
	Possibly overweight (z <-2)	2(0.5)

Moderate malnutrition was the most common form of malnutrition among adolescents with 9.7%, 6.8% and 5.1% of the adolescents presenting with moderate stunting, 6.8%, moderate underweight and moderate thinness respectively. 1.2% of the adolescents were overweight and 0.7% were possibly too tall. Less than 3% of the adolescents had severe forms of under nutrition; stunting (1.5%), underweight (1.2%) and thinness (0.2%).

Table 5: Adolescent nutrition status

Characteristic	**Girls N=212 n(%)**	**Boys N=199 n(%)**
Prevalence of underweight	8(3.8)	25(12.6)
Normal	204(96.2)	174(87.4)
Prevalence of stunting	10(4.7)	36(18.1)
Normal	202(95.3)	163(81.9)
Prevalence of wasting	4(1.9)	18(9.0)
Normal	208(98.1)	181(91.0)

The prevalence of underweight was 8.0% and the prevalnce of stunting was 11.2% and both were higher in boys than in girls (12.6% vs 3.8% and 18.1% vs 4.7%) respectively. Five point four percent of the adolescents were wasted and wasting was also high in boys (9.0%) than girls (1.9).

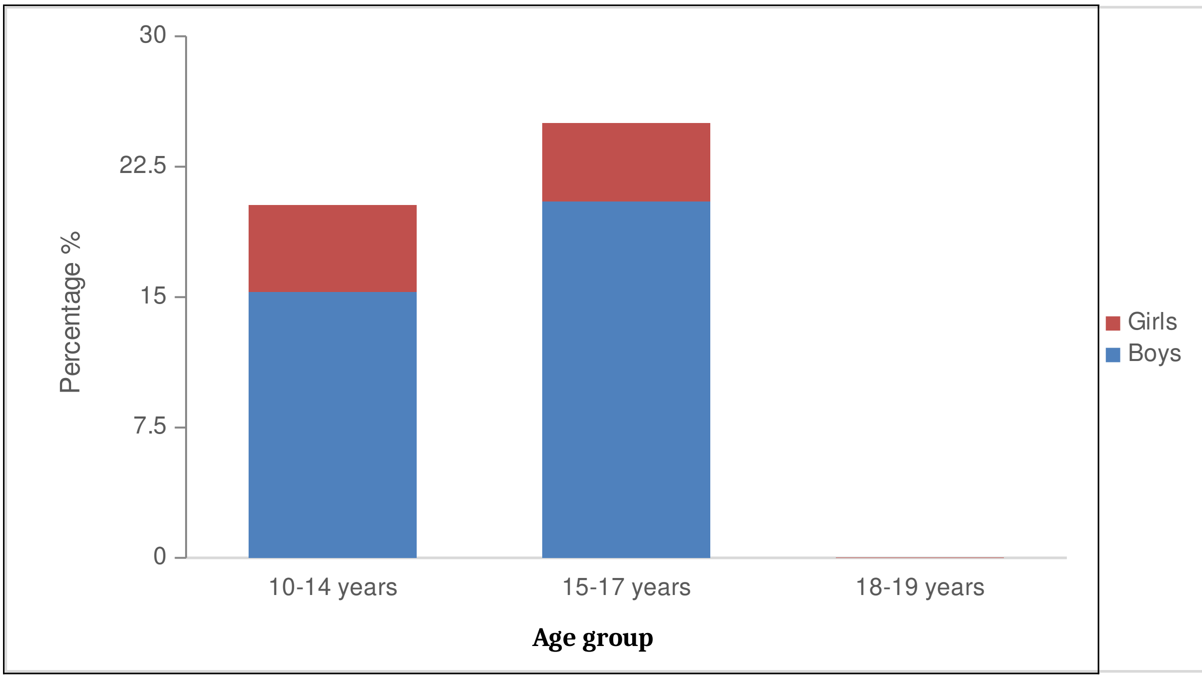

Figure 6: Comparison of stunting in adolescents by sex and age group

Stunting was more prevalent among boys (20.5%) in the age group 15-17 years compared with all other age groups (15.3% vs 5% and 20.5% vs 4%) in boys and girls aged 10-14 years and 15-17 years respectively. There was no stunting in the age group 18-19 years.

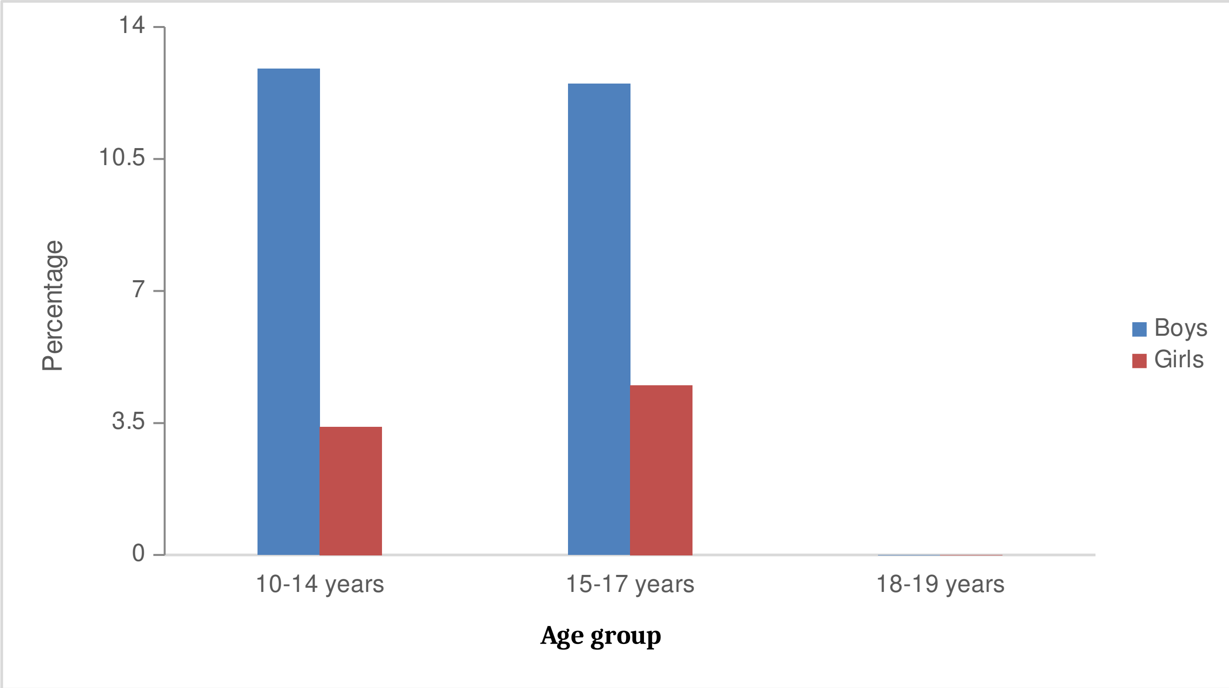

Figure 7: Comparison of underweight by sex and age group

More boys than girls were underweight in all ages (12.9%vs3.4% and 12.5% vs4.5% in 10-14 years and 15-17 years age groups respectively). There were no underweight adolescents in the age group 18-19 years.

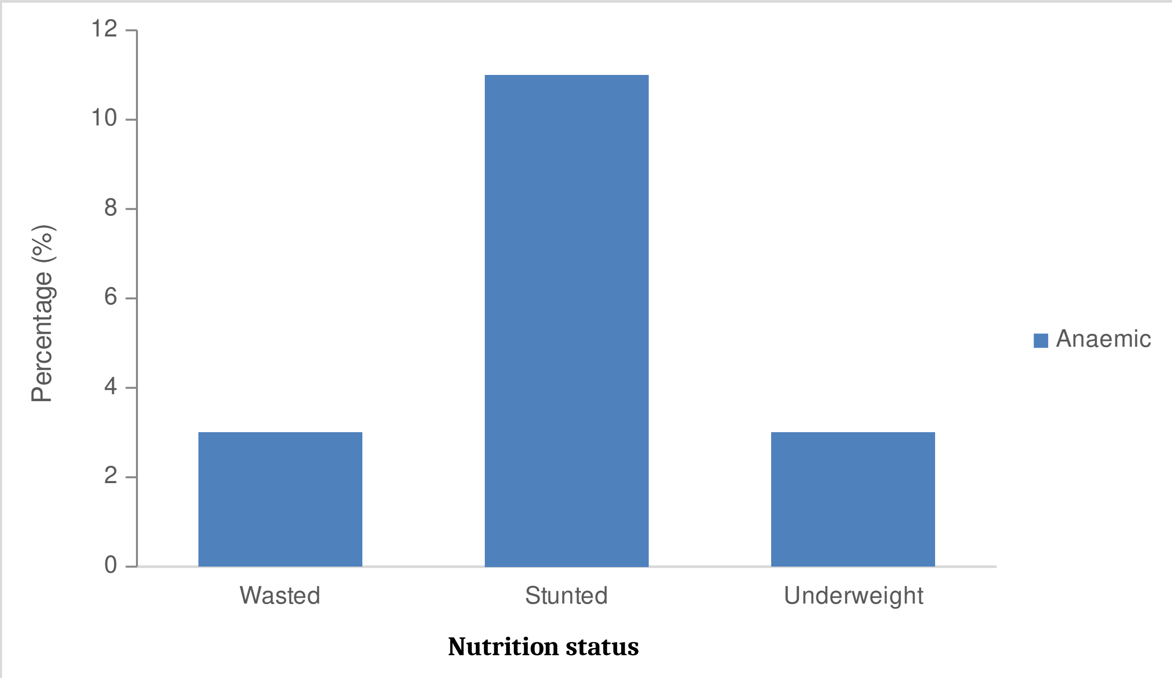

Figure 8: Distribution of malnutrition in anaemic cases

Eleven percent (4 Males and 0 females out of 35) of the adolescents with anaemia were stunted, whilst 3% was wasted and another 3% was underweight. Stunting was the most prevalent form of malnutrition in anaemic adolescents.

Prevalence of anaemia by education level

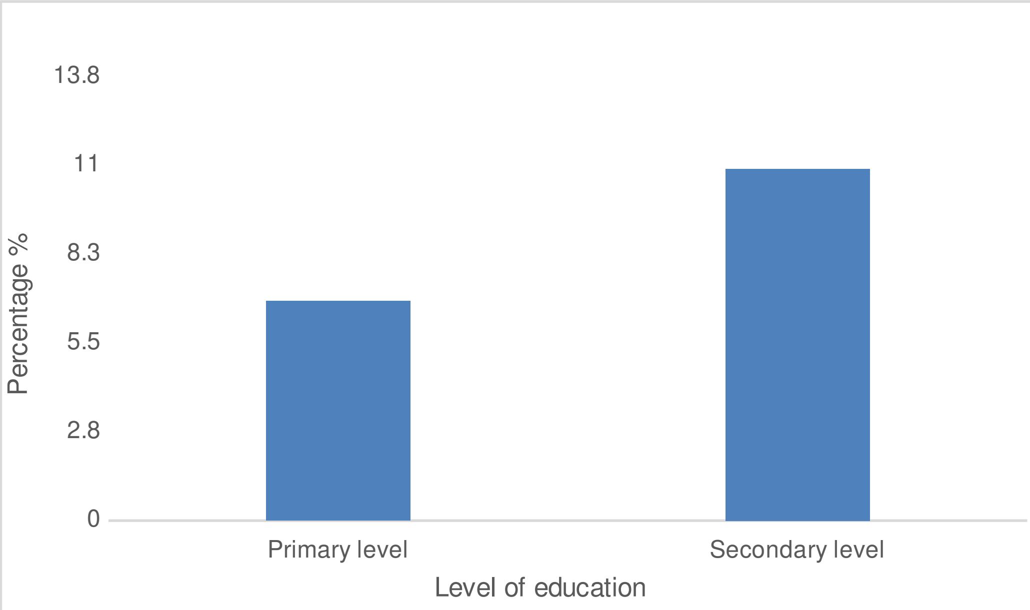

Figure 9: Prevalence of anaemia by level of education

Prevalence of anaemia was higher (10.9%) among adolescents in secondary level compared with adolescents in primary level (6.8%).

4.5 Knowledge on anaemia

Table 6: Knowledge on Anaemia and Iron rich foods

Characteristic	Girls N=212 n(%)	Boys N=199 n(%)
Heard About Anaemia		
Yes	41(19.3)	24(12.1)
No	171(80.7)	175(87.9)
Know Iron rich foods		
Yes	125(59.0)	108(54.3)
No	87(41.0)	91(45.7)

Less than one fifth of the adolescents (15.8%) had heard about anaemia and 56.7% had knowledge on iron rich foods. Slightly more girls had heard about anaemia and knew iron rich foods compared with boys (19.3% vs 12.1%, 59% vs 54.3%) respectively.

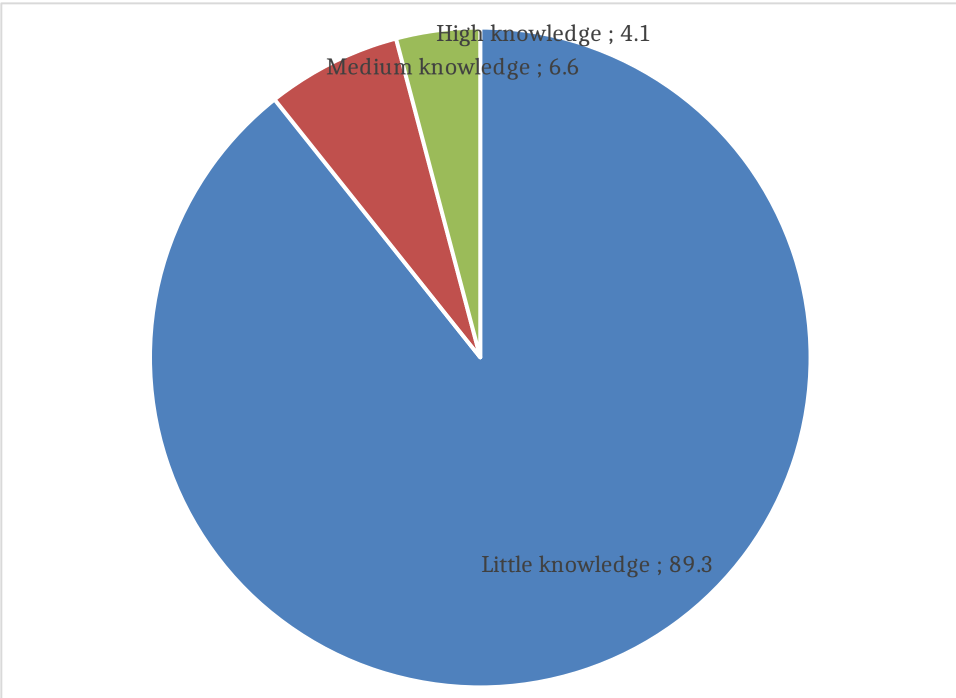

Figure 10: Knowledge levels on anaemia

The majority of the participants (89.3%) had low knowledge levels on anaemia. 6.6% and 4.1% of adolescents had medium and high knowledge respectively.

4.6 Association of adolescents' selected characteristics with adolescent anaemia

Table 7: Bivariate analysis of selected characteristics with adolescent anaemia

Background characteristic	Categories	Anaemia		OR	95% CI		P value
		Yes	No				
Gender	male	19	165	1.3	0.6	2.5	0.52
	female	16	175				
Heard about anaemia	yes	6	49	1.2	0.5	3.1	0.66
	No	29	291				
Knows Iron rich foods	Yes	20	188	1.1	0.5	2.2	0.83
	no	15	152				
Type of school	Primary	10	136	0.6	0.3	1.3	0.19
	Secondary	25	204				
Residence	Urban	7	36	2.1	0.9	5.2	0.10
	Peri Urban	28	304				
Household assets	< 4 assets excl Car/truck and animal drawn cart	14	132	0.9	0.5	1.9	0.89
	>4 assets/ animal drawn cart/Car/truck	21	208				
PICA	Yes	9	77	1.2	0.5	2.6	0.68
	No	26	263				

OR odds ratio, p value < 0.05 statistically significant

Background characteristic	Categories	Anaemia		OR	95% CI		P value
		Yes	No				
Age	10-14	16	181	0.7	0.4	1.5	0.40
	15-19	19	159				
HH head source of income	Formal	4	31	1.0	0.9	1.1	0.66
	Informal/no source	31	309				
Relationship to HH head	Parent	25	253	0.9	0.4	1.9	0.70
	Guardian	10	87				
Had Malaria in last 3 months	Yes	1	19	0.5	0.1	3.8	0.49
	No	34	321				

OR odds ratio, p value < 0.05 statistically significant

Background characteristic	Categories	Anaemia		OR	95% CI		P value
		Yes	No				
Household size	<5	17	100	2.5	1.3	5.1	0.01
	>5	18	240				
Household Uses solar or electricity	Yes	24	242	0.1	0.4	1.9	0.75
	No	11	98				
BMI-for-Age	Wasted	1	17	1.8	0.2	13.9	0.57
	Normal	34	323				
Weight-for-Age	Underweight	2	29	1.5	0.3	6.7	0.57
	Normal	33	311				
Height-for-age	Stunted	4	39	1.0	0.3	3.0	0.99
	Normal	31	301				

OR odds ratio, p value < 0.05 statistically significant

Regarding the association of anaemia and individual characteristics, household size was found to be significantly associated with anaemia on bivariate analysis. Adolescents who lived in household with < 5 members were 2.5 times more likely to be anaemic than adolescents in households with >5 members.

Table 8: Nominal logistics regression of adolescents' selected characteristics with adolescent anaemia

Back ground characteristics	B	Std. Error	Wald	df	Exp(B)	95% CI		P value
						Lower Bound	Upper Bound	
Intercept	-54.9	25.4	4.7	1.0				0.03
Age	0.5	0.3	2.9	1.0	1.7	0.9	3.0	0.09
Weight for Age cont.	0.9	1.4	0.4	1.0	2.5	0.1	42.2	0.53
BMI for Age cont.	0.6	1.2	0.3	1.0	1.9	0.2	19.0	0.59
Height for Age cont.	-0.6	0.9	0.5	1.0	0.5	0.1	3.1	0.50
Weight	-0.7	0.3	6.6	1.0	0.5	0.3	0.8	0.01
Height	0.4	0.2	5.0	1.0	1.5	1.0	2.1	0.03
BMI	1.2	0.6	3.4	1.0	3.3	0.9	11.6	0.07
Gender	0.0	0.6	0.0	1.0	1.0	0.3	3.3	0.97
Stunted	-0.1	0.9	0.0	1.0	0.9	0.2	4.8	0.87
Wasted	-0.5	1.4	0.1	1.0	0.6	0.0	8.7	0.72
Underweight	0.2	1.1	0.0	1.0	1.3	0.1	11.4	0.83

P value < 0.05 statistically significant

Back ground characteristics	B	Std. Error	Wald	df	Exp(B)	95% CI		P value
						Lower Bound	Upper Bound	
Residences	-3.0	1.2	5.9	1.0	0.0	0.0	0.6	0.02
Level of school	1.3	1.1	1.4	1.0	3.5	0.4	29.0	0.24
Type of school	-0.6	0.5	1.5	1.0	0.6	0.2	1.4	0.22
Age group	-0.2	0.7	0.1	1.0	0.8	0.2	3.2	0.77
Relationship to Head of Household	0.0	0.5	0.0	1.0	1.0	0.4	2.5	0.93
Head of Household main source of income	-0.2	0.7	0.1	1.0	0.8	0.2	3.2	0.78
Household size	-0.9	0.4	5.4	1.0	0.4	0.2	0.9	0.02
Household has electricity od solar	0.0	0.5	0.0	1.0	1.0	0.4	2.6	0.92
Household assets	0.3	0.4	0.4	1.0	1.3	0.6	3.0	0.55

P value < 0.05 statistically significant

Back ground characteristics	B	Std. Error	Wald	df	Exp(B)	95% CI	P value

						Lower Bound	Upper Bound	
Knowledge on anaemia	-0.9	0.8	1.2	1.0	0.4	0.1	1.9	0.26
Knowledge level on anaemia	0.6	0.8	0.5	1.0	1.8	0.4	8.0	0.47
Knowledge on iron rich foods	0.1	0.4	0.0	1.0	1.1	0.5	2.4	0.83

P value < 0.05 statistically significant

On multivariate analysis weight, height, residence and household size were significantly associated with anaemia among adolescents with p value <0.05. The odds of anaemia increases by 50% as height increases by 1 meter after adjusting for other factors, [OR 1.5: 95% CI (1.1, 2.1) p value = 0.03]. The odds of anaemia decreased by 50% as weight increased by 1kg [OR: 0.5 95% CI (0.3, 0.8) p value = 0.01]. After adjusting for other factors, having less than 5 household members had a 60% protective effect on anaemia compared with a household size of greater than 5 people (OR: 0.4: 95% CI 0.2-0.9) p value = 0.02. In this study living in the urban had a protective factor against anaemia of more than 90% compared with living in the peri-urban [OR: 0.0, 95% CI: (0.0-0.6) p value=0.02].

Table 9: Regression analysis of adolescents' selected characteristics with adolescent Hb level

Back ground characteristics	B	Std. Error	t	95% CI		P value
				Lower Bound	Upper Bound	
Intercept	8.7	1.4	6.1	5.9	11.5	0.00

Level of school	-0.5	0.4	-1.3	-1.2	0.3	0.21
Gender	-0.2	0.2	-1.6	-0.6	0.1	0.12
Household size	0.4	0.2	2.7	0.1	0.7	0.01
Household assets	-0.1	0.2	-0.4	-0.4	0.2	0.70
Knowledge of anaemia	-0.5	0.3	-1.5	-1.1	0.1	0.13
Knowledge of iron rich foods	-0.1	0.1	-0.9	-0.4	0.2	0.36
Pica	0.4	0.2	2.4	0.1	0.7	0.02
Level of Knowledge on anaemia	0.5	0.3	1.7	-0.1	1.0	0.08
Relationship to head of household	0.0	0.2	0.2	-0.3	0.4	0.86
Household has electricity or solar	-0.4	0.2	-2.3	-0.7	-0.0	0.02
Household head main source of income	0.1	0.3	0.5	-0.4	0.6	0.64
Type of school	0.0	0.1	0.1	-0.3	0.3	0.93

R Squared = .205 (Adjusted R Squared = .165)a

Back ground characteristics	**B**	**Std. Error**	**t**	**95% CI**		**P value**
				Lower Bound	**Upper Bound**	
Residence	1.3	0.4	3.3	0.5	2.1	0.00
Age	0.0	0.1	-0.5	-0.2	0.1	0.62

Weight	0.1	0.0	2.5	0.0	0.1	0.01
Height for age	0.0	0.2	0.1	-0.4	0.4	0.96
BMI for age	0.0	0.3	-0.1	-0.6	0.5	0.95
Weight for age	-0.3	0.4	-0.8	-1.1	0.4	0.40

R Squared = .205 (Adjusted R Squared = .165)

Computed using alpha = $.05_b$

Household size, pica, availability of electricity or solar, residence and weight were significantly associated to Hb level on linear regression analysis. Hb level increased by 0.1g/dL as weight increased by 1kg, [β= 0.1: 95% CI (0.0, 0.1) p value= 0.01]. Hb level was 0.4g/dL higher in households with <5 members compared to households with >5 members (95% CI: 0.1-0.7) p value=0.01. Hb level was 1.3g/dL higher in adolescents who lived in the urban than in adolescents who lived in the peri-urban. In this study Hb level was 0.4g/dL lower in adolescents who live in households with solar or electricity than those who live in households without [β = -0.4: 95% CI (-0.7,-0.0) p value = 0.02].

CHAPTER 5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter addresses discussion of the study findings, in comparison with findings from previous studies, to seek similarities or differences. Its main thrust is to establish whether the gathered data answered the research questions. The summary addresses the major findings against all the research objectives. Recommendations will be put forward in this chapter and implications of the study are also highlighted.

5.2 Discussion

5.2.1 Age and anaemia

Findings from the study showed no association between age and anaemia. (OR 0.7, 95% CI (0.4-1.5) p value=0.40). Similarly, a study in Lao PDR, showed that there was no statistically significant difference in occurrence of anaemia between younger and older adolescents (Kounnavong et al., 2020).

Contrarily, in South Ethiopia anaemia was higher among those in early adolescence period (10-13 years) compared to late adolescence (17-19 years) (AOR: 4.75, CI: 1.69–13.35) (Shaka et al., 2018).

5.2.2 Gender and anaemia

In this study there was no association between age and anaemia (OR 1.3, 95% CI (0.6-2.2) p=0.52). Similarly, el-Sahn et al. (2000) found out that gender differences were almost none existent in a study conducted among adolescents in Egypt.

Findings are contrary to a study in India which showed that female adolescents were more likely to be anaemic than adolescent boys (Shinde et al., 2021).

5.2.3 Anaemia and nutritional status

There was no statistically significant association between anaemia and stunting in this study, however results suggested that the odds of anaemia decrease by 10% in stunted children. [OR: 0.9: 95% CI (0.2-4.8) p value = 0.87]. Similarly, analyses using height indicated that the odds of anaemia increase by 50% as height increases by 1 meter after adjusting for other factors, [OR 1.5: 95% CI (1.0, 2.1) p value = 0.03].

Contrarily, Sungthong et al., (2002) found gains in height as Hb levels increased after iron and folic acid supplementation in a study of 397 primary school children in Thailand. A study among 893 primary school children in Vietnam found that anaemia was 2.31 times more likely in stunted children than in those not stunted [OR: 2.31; 95% CI (1.15, 4.61) p value = 0.018] (Hoang et al., 2019). Additionally, Weze et al., (2021) found that stunting and wasting frequently co-occur with anaemia in the context of poor socioeconomic conditions and endemic infections and are significant predictors of anaemia. Contradictions in this study could be due to the mild prevalence of anaemia of 9.3% observed in this study, therefore a larger sample size is required to establish associations.

This study found that the odds of anaemia may be 10% lower or more than 11 times higher as BMI increases by 1kg/m^2, though this was not statistically significant [OR: 3.3 95% CI (0.9, 11.6) p value = 0.07]. Additional analyses between Hb concentrations and BMI-for-age also showed no statistical significance [$\beta = 0$; 95% CI: (-0.6, 0.5) p value = 0.95]. In contrast, a study among 893 primary school children in Vietnam showed statistically significant association between Hb concentrations and BMI- for-age, ($\beta = 0.13$; 95% CI: 0.09, 0.18) (Hoang et al., 2019).

This study shows no significant association between anaemia and underweight [OR: 1.3 95% CI (0.1, 11.4) p value 0.83]. Nevertheless, the odds of anaemia decreased by 50% as weight increased by 1kg [OR: 0.5 95% CI (0.3, 0.8) p value = 0.01]. Hb level increased by 0.1g/dL as weight increased by 1kg, [β= 0.1: 95% CI (0.0, 0.1) p value= 0.01]. This corroborates with a study in Indonesia that revealed favourable impact on weight gain which was related to Hb gains among school going girls aged 9-13 years (P value < 0.001) (Sen et al., 2012). Iron is required for muscle mass which explains the increase in weight with increased Hb levels (Vir, 2011).

5.2.4 Household size and anaemia

After adjusting for other factors, having less than 5 household members had a 60% protective effect on anaemia compared with a household size of greater than 5 people (OR: 0.4: 95% CI 0.2-0.9) p value = 0.02. Furthermore, haemoglobin level was 0.4g/dL higher in households with <5 members compared to households with >5 members (95% CI: 0.1-0.7) p value=0.01. This result indicates that socio-economic factors affect the condition of anaemia among adolescents in Makoni district. This finding may be attributed to reduced food availability as household number increases.

These results concur to a finding which revealed that households with a family size greater than five was more than ten times likely to get anaemia than households with a family size less than five members, in South Ethiopia (AOR: 9.82, CI: 2.42–39.88), (Shaka et al.2018). The finding also corroborates with findings from a study conducted among Muslim secondary school children aged 12-18 years in Thailand which demonstrated that family members of 5-7 persons and more than 7 people were at risk of having anaemia with an odds ratio of OR: 2.71 (95% CI: 1.15-6.37), OR: 2.83 (95% CI: 1.05-7.65) respectively (Rattanawan et al., 2021).

In contrast a study done in rural Vietnam among school going children aged 6-9 years found no association between anaemia and any of the selected socio-economic factors investigated (all p value ≥ 0.08) (Hoang et al., 2019). These conflicting results may be related to the differences in ethnicity, residence or age of the studied population. This finding is important in selecting participants for targeted interventions for anaemia.

5.2.5 Residence and anaemia

In this study living in the urban had a protective factor against anaemia of 90% compared with living in the peri-urban [OR: 0.0, 95% CI: (0.0-0.6) p value=0.02]. Additionally, haemoglobin level was 1.3g/dL higher in adolescents who lived in the urban than in adolescents who lived in the peri-urban [95% CI: (0.5-2.1) p value=0.00]. This compares well with a study done in South Ethiopia which reveals that anaemia was high among adolescents from the rural areas (AOR: 4.37, CI: 1.54–12.46). This showed that adolescents from rural areas were more than 4 times at higher risk of anaemia compared to urban adolescents.

Data from the Zimbabwe Vulnerability Assessment Committee (ZimVAC) indicated that 25.2% of urban population is food insecure compared to 47.2% of the rural population (Food and Nutrition Council, 2019). This indicates that peri-urban area is more likely to be food insecure in comparison with urban settings and this can contribute to high risk of anaemia in the peri urban setting compared to the urban area.

In this study Hb level was 0.4g/dL lower in adolescents who live in households with solar or electricity than those who live in households without [β = -0.4: 95% CI (-0.7, -0.0) p value = 0.02]. This is contrary to a finding by Feranil (2005) that, living in a household with no lighting or no electricity is associated with maternal anaemia [OR: 0.75: 95% CI (0.67, 0.85) p value = 0.0000]. The study by Feranil in the Philippines used availability of electricity as a proxy of low socioeconomic status. In this study however, the majority of adolescents (72.3%) lived in households with electricity or solar and the results show that availability of electricity or solar offers no protection against low Hb levels. This could be because electricity might not be used for cooking fuel even in households with electricity. A study of 924 children under five years in Lesotho found that cooking with solid fuels increased the odds of anaemia among children under five years (Letuka & Frade, 2020). This finding is important in selecting participants for targeted interventions for anaemia.

5.2.6 Knowledge of anaemia and anaemia

The study showed that only 15.8% of the adolescents had heard of anaemia and the majority (89.3%) have low knowledge on anaemia. The finding does not corroborate with results obtained by Agustina et al, (2021) which revealed that more than 60% of the adolescent girls had heard about anaemia. This could be attributed to lack of nutrition health promotion among adolescents to raise awareness on anaemia in the district.

There was no statistically significant association between knowledge of anaemia or iron rich foods and being anaemic. [OR: 0.4: 95% CI: (0.1, 1.9) p value = 0.26], [OR: 1.1: 95% CI: (0.5, 2.4) p value = 0.83] respectively. This is similar to a finding in Indonesia, by Agustina et al. (2021) where none of the individual knowledge, attitudes and practices variables were associated with anaemia prevalence after adjusting for the covariates. This could be attributed to lack of support networks that encourage adolescents to translate knowledge into positive behaviour change.

5.3 Limitations to the study

In this study Hb concerntrations analysed were estimated using the hemocue analyser which is well known for over estimating Hb levels.

5.4 Study Conclusions

There was no significant association between anaemia and age, but prevalence of anaemia was higher in boys compared with girls. Prevalence of underweight and stunting was also higher in adolescent boys compared with girls. Adolescents with lower weight, household size of > 5 members, living in the peri urban and who were taller had a tendency to be anaemic. Stunting, wasting and underweight were not predictors of anaemia among adolescents.

The results also showed that availability of electricity or solar in a household offers no protection against low Hb levels. There is a huge knowledge gap on anaemia among adolescents that requires immediate attention

5.5 Implications to practise

The findings of this study show a mild public health concern of anaemia in adolescents in Makoni district. If the recommendations brought up by this study were to be implemented functional consequences of anaemia such as impaired physical growth, weakened cognitive development, reduced physical and work performance/capacity and diminished concentration in daily tasks and school performance, loss of appetite resulting in reduced food intake as well as irregular menstruation would be prevented. In turn, quality of life will be improved and our health system will not be burdened.

5.6 Recommendations

To Ministry of Health and Child Care, Provincial Medical Director.

- To administer iron and folic acid supplements in underweight adolescents, from food insecure wards and households size of > 5 members in the district.
- To integrate health education on anaemia with all programs targeting adolescents in Makoni district.

To MOPSE Makoni District.

- To increase awareness of anaemia and promote consumption of iron rich foods through various platforms including school health clubs.
- To strengthen home grown school feedings programs in in secondary schools.
- To provide weight scales and height meters in schools for constant monitoring of learners' nutritional status.

To researchers

Further studies to:

- Include variables such as: tendency to rely on farming or food purchasing, daily meal frequency and dietary diversity among adolescents.
- Explore association between anaemia and use of electricity and solid cooking fuels.
- To use more sensitive methods of estimating Hb concentrations like the cyanmethemoglobin method.

5.7 Dissemination of results and any action taken in response to the findings

The study findings were disseminated to the Provincial Health Executive, and District Health Executive in one of their meetings in the first week of May 2022. The investigator wishes to publish these findings in a reputable journal and a copy of this work will be kept in the Africa University library for other students to make reference to. In response to the findings of this study the nutrition department is making efforts to integrate messages on anaemia prevention in current activities carried out by school health clubs.

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Appendix 1: Permission to use MOHCC data

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Reference:

MINISTRY OF HEALTH AND
CHILD CARE
Rusape General Hospital
P.O. Box 10
RUSAPE
MAKONI DISTRICT
MANICALAND
ZIMBABWE

01 December 2021

TO: LORINE NDANGANA (MPH STUDENT, AFRICA UNIVERSITY)

Re: APPROVAL TO CONDUCT ACADEMIC RESEARCH IN MAKONI DISTRICT)

This letter serves to inform you that permission has been granted for you to conduct academic research under the Africa University Masters in Public Health Programme.

Permission is hereby granted to use data collected in the Makoni Iron and Folic Acid Supplementation program baseline survey and cohort study group.

You can proceed with your research studies, and best wishes.

Thank you

DISTRICT MEDICAL OFFICER
RUSAPE GENERAL HOSPITAL
Dr Maringe
RUSAPE
Tel (025) 2363

A/DISTRICT MEDICAL OFFICER- MAKONI