Dietary quality and its impact on anaemia prevalence among 12–19-year-old adolescent girls in Dar es Salaam: A cross sectional study

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Abstract

Background – Anaemia is a significant public health concern among adolescents in Dar es Salaam. Anaemia has adverse effects on maternal and child health, as well as intergenerational health. Adolescent girls are particularly vulnerable to anaemia due to blood loss during menarche and consumption of poor-quality diets. Poor diet quality is one of the major risk factors for anaemia, yet proper nutrition and early dietary supplements can correct anaemia before it causes detrimental effects. Despite the fact that adolescence provides a good window of opportunity for addressing nutritional problems, adolescents remain an under researched group and this study will add to the limited literature available on the association between dietary quality and anaemia in a low-income setting.

Aim – To examine association between dietary quality and anaemia among 12–19-year-old adolescent girls in Dar es Salaam.

Methods – A cross-sectional household survey was conducted among 540 adolescents aged between 12 and 19 in Dar es Salaam, Tanzania. Data from 282 girls was analysed in this study. Dietary quality was assessed using the Global Dietary Quality Score (GDQS). Dietary intake was collected using a 7-day food frequency questionnaire amended by the authors using widely consumed foods in Tanzania. Sociodemographic information and self-reported health status were also collected. Data cleaning and analysis was done using Stata version 18. Modified Poisson regression and ordinal logistic regression were used for the analyses.

Results - The prevalence of anaemia in this study was 45.4%, and 44.7% of the adolescent girls were at high risk of poor diet quality. Among the anaemic girls, 22% of them had a high risk of poor diet quality. Menarche was associated with increased risk of being anaemic (ARR 1.69, 95% CI 1.14, 2.50 p-value 0.009). Adolescents who were attending the secondary/higher level of education had a higher risk of poor dietary quality compared to those in primary school (ARR 1.19 CI 1.04, 1.37, p-value 0.096). Adolescents who came from households with 5 or more people had a 10% increased risk of poor dietary quality (95% CI 1.01, 1.19, p-value 0.022) after adjusting for confounders compared to those from smaller households. Adolescents who consumed legumes 2-4 times a week had reduced odds of being anaemic compared to those who had them 0-1 times a week (AOR 0.40, CI 0.19, 0.83 p-value 0.014) while those who consumed sweets and ice cream 2-4 times a week had increased odds of being anaemic (AOR 2.97, 95% CI 1.55, 5.69 p-value 0.001)

Conclusion – Our findings highlight a high prevalence of anaemia and poor diet quality among adolescent girls in Dar es Salaam. Interventions aimed at improving dietary diversity, nutrient intake and access to micronutrient rich foods are essential for improving the overall diet quality and associated health outcomes like anaemia in this vulnerable population.

Contents

Acronyms and abbreviations

FFQ   Food Frequency questionnaire

GDQS   Global Dietary Quality Score

Hb   Haemoglobin

IFA   Iron and Folic Acid

LMIC   Low- and middle-income countries

NIMR   National Institute of Health Research

ODK   Open Data Kit

REC   Regional Ethical Committee

WASH   Water and Sanitation Hygiene

List of tables

List of figures

List of Annexes

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Conflict of Interest

I declare that there is no conflict of interest regarding the publication of this thesis. The views and findings presented in this thesis are solely those of the author and do not necessarily reflect the views of any organization or entity associated with the author.

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1.1 Introduction

Adolescence, according to the World Health Organization (WHO) is defined as a period of life that ranges from 10-19 years which is a transition from childhood to adulthood characterized by major physiological and social changes. Adolescents constitute 1.2 billion (18%) of the world population, 90% of whom live in low- and middle-income countries (1). This makes adolescents a critical segment of the global population whose health needs are important for sustainable development. In Tanzania, adolescents constitute about 23% of the total population (2).

Adolescence is characterized by rapid growth and development where 45% of skeletal growth takes place and 15 – 25% of adult height is achieved (3). As a result of the increased nutritional needs to allow growth and development, poor dietary diversity and dietary inadequacies are major threats to adolescents due to poor eating habits and their specific psychosocial factors(4). Iron needs, for example increase in adolescent girls owing to menarche and menstrual blood loss. Consumption of high-quality diets is therefore essential for adolescents to cater for the increased needs as well as to build a good foundation for good adult health.

In this era of fast demographic, epidemiological and nutritional transitions, adolescents especially in low- and middle- income countries are experiencing a complex triple burden of malnutrition (5). Whereas micronutrient deficiencies, stunting and underweight remain prevalent, overweight and obesity are increasing in low- and middle-income countries (5). Poor dietary quality and diversity is one of the major causes of all forms of malnutrition throughout life. Lack of dietary diversity is a severe problem among poor and vulnerable populations in the developing countries because their diets are predominantly based on starch staples, with little or no intake of animal products and fresh fruits and vegetables (6). These plant-based diets are low in essential micronutrients and the ones that they have are usually in a form that is not easily absorbed.

Anaemia is a significant public health problem which affects an estimated 1.93 billion people in worldwide (7). The majority of affected individuals reside in low and middle income countries with children and women bearing the greatest burden (8). There are about 273 million children, 32 million pregnant women and 496 million non-pregnant women threatened by anaemia globally and the majority of these live in low- and middle income countries (8). Iron deficiency anaemia is the most common form of anaemia at the start of adolescence, attributed

to increased nutritional requirements due to the accelerated growth spurt and the onset of menstruation (9).

Adolescence provides a good window of opportunity for addressing nutrition related global health problems as this developmental stage is characterized by rapid growth and development. Designing effective intervention plans tailored to the specific needs of adolescents requires a deep understanding of their dietary patterns, food preferences and daily eating habits. While anaemia has some of its root causes in the adolescent period, most studies have been focusing on the prevalence of anaemia and suggested interventions among pregnant women (10).

Population-wide interventions like iron supplements are given to pregnant women when there is a possibility that anaemia can be prevented during adolescence with more cost-effective population-wide interventions if clear factors associated with it are known (11). The few studies that have been conducted amongst adolescents have mainly focused on school going adolescents, inadvertently leaving out those adolescents who are out of school. This gap in research leaves an important segment of the adolescent population underserved and overlooked in terms of nutritional interventions and health promotion efforts.

Adolescence serves as a crucial preparatory phase for motherhood especially in developing countries where approximately 25% of women have their first child at the age of 19 and below, and many more pregnancies during the following years. (12). Given the unpredictable timing of pregnancies, it is important to equip adolescent girls with the necessary knowledge and resources to mitigate the potential risk factors of adverse maternal and child health outcomes like anaemia. Interventions must address the multifaceted yet preventable risk factors of anaemia like nutritional intake, malaria and parasitic infections.

Limited data are available on the burden of anaemia amongst adolescent girls in Tanzania. A 2023 school based survey conducted in Dar es Salaam among 10-14 year adolescent boys and girls found that 58% of them had anaemia (13). Anaemia accounts for about 14% of the indirect causes of maternal deaths in Tanzania according to a hospital based retrospective study that was conducted in 2019 in Tanzanian government hospitals. (14). The burden of maternal mortality can be attributed to the unprecedented burden of anaemia during the pre-pregnancy and pregnancy periods, which is commonly associated with inadequate dietary diversity and inadequate dietary intake (14). This study therefore aimed to examine the dietary quality of adolescent girls in Dar es Salaam, Tanzania and its impact on the prevalence of anaemia.

2.1 Literature Review

2.1.1 Anaemia aetiology and epidemiology

Anaemia can be defined as a condition in which the total count of red blood cells in circulation and their ability to carry oxygen is inadequate to fulfil physiological requirements (15). WHO defines adolescent girls as anaemic if their haemoglobin levels are below 12 mg/dl (16). Cut offs for anaemia haemoglobin concentration vary with gender, age, and pregnancy status. Haemoglobin concentration is the predominant haematological assessment method utilized to define anaemia. Hb levels naturally vary based on factors such as age, gender, pregnancy status, genetic makeup and environmental influences (15).

Biologically, anaemia arises from an imbalance between loss and production of red blood cells. The imbalance can be a result of nutritional deficiencies, inflammation, genetic haemoglobin disorders or excessive erythrocyte loss due to haemolysis or blood loss (15). Sex variation in Hb concentrations emerge during puberty due to the impact of menstruation on iron reserves, consequently leading to differences in anaemia prevalence and these differences persist throughout the reproductive years.

Common causes of anaemia include iron deficiency, heavy menstrual bleeding, hookworm infection, schistosomiasis, malaria, Hb disorders like sickle cell, and vitamin A, B12 and folate deficiency (15). Nutritional anaemia occurs when hematopoietic nutrients which are essential for the production and maintenance of red blood cells are inadequate to fulfil the body's requirements (17). Nutrient deficiency is caused by inadequate dietary intake, increased nutrient loss, for example through heavy menstrual blood loss and impaired absorption of nutrients. Iron deficiency is considered the most common nutritional deficiency leading to anaemia (18).

2.1.2 Anaemia among adolescents

Anaemia is estimated to be the greatest nutritional problem during adolescence (10 – 19 years) (19). Anaemia in adolescence can have long lasting negative effects on adolescents' cognitive function and growth. Anaemia has been associated with increased maternal morbidity and mortality and if pregnancy occurs during adolescence, anaemia increases the incidence of poor birth outcomes in the infant (for example low birthweight) (19). Adolescence is a period of intense growth secondary only to infancy, and during adolescence overall nutrient needs are in high demand to support growth and resulting physiological changes.

3

Iron is one of the most essential nutrients that is required during adolescence to support physiological processes such as haemoglobin production and enzyme function (19). The body needs more iron when it is growing rapidly and when frequent blood loss occurs, for example during menstruation. Adolescent girls are therefore more vulnerable to anaemia than their male counterparts and the negative effects of anaemia among adolescent girls justifies robust public health interventions targeted towards them (20). Unfortunately, initiatives to prevent anaemia commonly target young children and pregnant and lactating women, leaving out adolescents.

2.1.3 Prevalence of anaemia among adolescents and associated causes

The prevalence of anaemia among adolescents is 27% in developing countries and 6% in developed countries (21). Anaemia affects 30% of all female adolescents and 20% of male adolescents in low-and middle- income countries. In 2019, the World Health Organization estimated that the prevalence of anaemia among women of reproductive age was 30% globally (22). Among the women of reproductive age, the prevalence of anaemia was highest among girls aged 15-19 years.

A 2022 systematic review and meta-analysis in Ethiopia found that the pooled prevalence for anaemia among adolescent girls was 23% and it was associated with low dietary diversity, illiterate mothers, household greater than 5, food insecure household and menstrual blood flow for more than 5 days (23). A study conducted in the United Kingdom in a school attended by children from diverse ethnic and socio-economic backgrounds found that vegetarian diets from ethnic minorities were associated with low haemoglobin levels (24). However, due to the low response rate of people from ethnic minorities in this study which the authors attributed to a questionnaire that asked sensitive questions, the prevalence was not so reliable.

A 2019 cross sectional study conducted on adolescent girls in rural India found a 48% prevalence of anaemia, which was mainly associated with socioeconomic status (25). Anaemia was more prevalent among late adolescent girls and adolescents with low socioeconomic status than their respective counterparts. Females who had started menstruation had higher odds of having moderate and severe anaemia demonstrating the likely impact of blood loss on haemoglobin levels (26). During late adolescents, girls tend to be more concerned about their body image and this can cause uniformed dietary choices that result in micronutrient deficiencies. This study however did not assess the nutritional status and dietary habits of the adolescents. Many studies have found associations between poor socioeconomic status and

anaemia among adolescents highlighting the need to introduce policies and interventions that curb socioeconomic disparities.

In Zanzibar, a survey found a 53% prevalence of anaemia in 2023 (27). Adolescents who shared toilets had higher odds of moderate or severe anaemia compared to those who used private toilets. Poor sanitation and hygiene practices were associated with anaemia, supporting the idea that in order to address anaemia, it is important to focus on the cycle between infectious disease, inflammation and anaemia (27). Inflammation and anaemia are both directly related to sanitation and hygiene and improved access to decent sanitation services can help address anaemia.

A cross sectional study in Turkey on the prevalence and risk factors of anaemia found that the odds of being anaemic were higher in girls compared to their male counterparts (28). Anaemia was associated with socio-economic status of the family, traditional eating habits, fear of gaining weight and irregular eating habits. Parents, peers and mass media are some of the major influencing factors of adolescents' eating habits with peer pressure more likely to outweigh parental guidance (29).

A 2023 school based study conducted among 10-14 year adolescents in Ethiopia, Sudan and Tanzania on the burden and determinants of anaemia found a 58% anaemia prevalence in Tanzania (13). Poor dietary quality, poor sanitation practices and household food insecurity were associated with anaemia. Contrary to many studies globally, this study found that being a boy was associated with a greater risk of being anaemic. While this might be because many adolescents in this study had not reached menarche, a study in Ethiopia suggested that girls commonly spend more time at home therefore they may have better access to meals pointing g out to the potential importance of socio-cultural practices (30).

2.1.4 Consequences of anaemia for adolescent girls

Iron deficiency is a major public health problem in many developing countries which contributes significantly to reduced work productivity and economic output as well as to increased morbidity and mortality (31). Low levels of haemoglobin, as a result of anaemia hinder the transport of oxygen in the blood, leading to diminished physical and mental capabilities, as well as increased susceptibility to various health hazards among adolescents (32). Anaemia interferes with the growth of adolescents, their quality of life, physical productivity and cognitive performance. Micronutrient deficiency among women is one of the

primary causes of low birthweight and poor growth amongst babies which is a significant contributor to child mortality and growth retardation throughout childhood, adolescence and adulthood for the babies that survive (33). Sustainable development therefore requires that attention be paid to the health of adolescent girls to help them reach their full potential and achieve gender equality as well as to ensure better health of the offsprings.

Biological differences between adolescent girls and boys during puberty, for example menstrual blood loss imply different nutritional requirements (34). Owing to menarche, the female adolescent body requires more iron and it also loses more iron during this period (20). While all adolescents are at risk of malnutrition, adolescent girls are more vulnerable to iron deficiency which is the most common form of nutritional anaemia (35). In adolescent girls, the intentions to maintain a satisfactory body image might push them to have unhealthy eating patterns like skipping meals or deliberately avoiding nutritional foods. In addition, the onset of menstruation increases the iron requirements of adolescent girls. Tackling the current and intergenerational burden of malnutrition therefore requires us to look at the quality of the diet for this group and the possible associations with malnutrition.

2.1.5 Dietary Intake of adolescents in sub-Saharan Africa

Poor diet quality is a known risk factor for malnutrition. In low income countries, poor functioning economic and food systems contribute to the provision of inadequately nutritious diets (36). This results in limited access to food with essential micronutrients such as fruits, vegetables, nuts and animal source food like dairy, particularly impacting adolescents. The global transition in food systems has also contributed to an increased consumption of unhealthy foods among adolescents, including refined, processed and fast foods as well as sugar-sweetened beverages by adolescents (37).

A study conducted in Brazil found that 97% of the adolescents studied had inadequate diet and the quality of diet was inversely associated with age (38). Fruits, milk and dairy products consumption had the lowest mean contribution to the dietary quality score in this study. Adolescents who were more physically active had higher mean Healthy Eating Index scores (38). Troiano et al, in the National Health and Nutrition Surveys III reported that milk consumption had decreased due to increased intake of soft drinks (39).

A cross sectional study conducted in Dar es Salaam in 2023 found that only 27% of adolescents had a low risk of poor diet quality (36). Vegetable consumption was low while the consumption

of fried foods away from home and refined grains and baked goods was high. Adolescent girls worldwide are known to be at high risk of poor diet quality. A systematic review on dietary intake and practices among adolescent girls in LMICs showed that 30% of the girls consumed fruits daily, 50% consumed carbonated soft drinks at least 2-3 times a week while 78% of the, ate salty, fried or sweet food 4-6 times a week(35). The same study showed that 50% of the girls did not consume three meals per day (35). These unhealthy eating practices put adolescent girls at high risk of nutritional inadequacy, increasing the prevalence of the triple burden of malnutrition among this group.

Another cross-sectional study conducted in Zanzibar, in 2023 found that diet quality among adolescents was mainly characterized by low animal-sourced foods and high intake of fried foods and sweetened beverages (40). This was consistent with another study conducted among 16-19 year old adolescents in Kilimanjaro region, Tanzania, where 51% of the study respondents reported consumption of meat 1-2 times a week and the authors attributed this to the monotonous diet available at boarding schools (41).

2.1.6 Factors influencing dietary intake.

A systematic review on the determinants of dietary behaviour among women of reproductive age in sub-Saharan Africa found a wide range of qualitative data on the factors influencing dietary behaviour (42). The determinants were categorized into a socio-ecological framework with institutional factors, community level factors, interpersonal factors and intrapersonal factors.

2.1.6.1 Institutional Factors

Institutional factors encompassed religious dietary restrictions and food deserts. The term food deserts refers to the differential accessibility and availability of nutritious and affordable food across socioeconomically privileged and underprivileged areas (43). Studies have found that areas with people of low socio-economic status are usually underserved by food retailers (43). Dietary choices are influenced by the dietary advice from churches and information exposure during school life (42). This review found that dietary advice from religious institutions had high influence on dietary decisions made by people. Food deserts and the availability of high energy dense nutrient poor foods in schools, workplaces and other institutions where people spend much time in were also found to have an influence on their dietary choices and decisions.

2.1.6.2 Community Factors

Community level factors include cultural beliefs and physical environment. Several cultural beliefs influence dietary behaviours. Body image was reported to have an impact on dietary intake, where being overweight is associated with health and wealth while weight loss is a source of stigma (42). Additional cultural beliefs reported included assigning a low social status to fruit, vegetable and legume consumption while eating out and eating unhealthy fast food was associated with being rich. Physical environment encompasses accessibility of unhealthy foods, virtual environment, social networking opportunities as well as climate related barriers. Food choices were reported to be influenced by readily available and cheap unhealthy food and energy-dense nutrient poor street food. Nutrition information shared through media outlets was also reported to influence food choices (42).

2.1.6.3 Inter-personal factors

Interpersonal level factors include household factors, social environment and role models. The presence of a housewife was associated with reduced frequency of eating out and large household sizes prioritized satiety-inducing carbohydrates over other food groups (42). Dietary decisions were reported to be mediated by family and friends. Peer influence was also reported to be associated with increased consumption of energy-dense street/fast-food in a study conducted in Johannesburg, South Africa (44). At household level, the determinants were parental education and occupation, household size and income and socioeconomic status (45).

2.1.6.4 Intra-individual determinants

Intra-individual determinants of dietary behaviours that were identified in this review include food and nutrition knowledge, food attitude, psychological and physiological factors, time and financial barriers, food skills, food habits, age and socio-economic status (42). Studies reported a positive attitude towards unhealthy energy dense foods as they were perceived to taste better, requiring minimal preparation time. Financial difficulties determined low fruit and vegetable intake and it was reported that a balanced diet was difficult to sustain owing to financial constraints. A low-income status was found to be a predictor of high consumption of unhealthy foods in Ghana, Kenya and South Africa while, in contrast, a high income status was a predictor of high consumption of unhealthy foods in Tanzania (42).

A cross sectional study conducted in Ecuador on individual environmental factors influencing adolescents and dietary behaviour found that vegetable intake and unhealthy snacking were associated with individual adolescent factors (perceived benefits) (46). Adolescents who

consumed vegetables more perceived them as vital to healthful eating. Breakfast and sugary drink consumption in this study were associated with socio-environmental factors (school support and parental permissiveness). Individual factors related to dietary behaviour in this study were perceived benefits and barriers, self-efficacy, and a better understanding of healthy food. Common unhealthy eating habits among adolescents include meal skipping, eating away from home, fast food consumption and snacking (47). Adolescents adopt eating habits during this stage of life where they start making independent decisions. They may take poor eating habits to adulthood influencing their nutritional status and those of the next generations later in life (48).

2.1.6.5 Socio-environmental and economic factors

A systematic narrative review on socio-cultural and economic determinants and consequences of adolescent undernutrition and micronutrient deficiencies in LMICs showed that significant determinants of undernutrition at individual level were age, sex, educational and literacy level, working status and religion (45). Environmental factors were physical environment, accessibility to healthy food, social environment, parental permissiveness, and school support (46). Schools that promote healthy dietary choices need to be complemented by individual appreciation of health benefits, parental support and access to healthy foods as well as limited access to unhealthy food.

A school based survey conducted in Ethiopia, in 2020 found that early adolescent age, a food insecure household, low dietary diversity score, high peer pressure on eating and body concern were significantly associated with micronutrient inadequacies among adolescent girls (49). Low consumption of major sources of micronutrients like animal-based foods, fruits and vegetables among adolescents contributes significantly to nutrient inadequacy and malnutrition. Poor economic status might be a barrier to accessing micronutrient rich foods since these are normally expensive in sub-Saharan Africa (49). Other reasons highlighted by the authors in this Ethiopian survey were lack of parental education and the lack of awareness of adolescents themselves on micronutrients needs and associated benefits to their health (49). Education increases parental knowledge on nutrition, helping parents dive their adolescents' dietary choices from sugary foods to high quality micronutrient rich food sources.

2.1.7 Dietary quality and anaemia

Poor diet quality is a risk factor for anaemia, underweight, overweight and obesity among adolescent girls. Undernutrition is a major public health problem amongst women and girls in low- and middle income countries, prevention of intergenerational malnutrition requires interventions targeted towards girls that go beyond the conventional maternal and child health care (50). Insufficient intake of vitamins, dietary iron, and high-quality protein can disrupt the stability of red blood cell membranes, leading to different types of anaemia (51). Iron deficiency anaemia is the most common form of anaemia therefore improving dietary quality can go a long way in reducing the burden of anaemia.

Meal patterning is a critical component of dietary quality, a cross sectional survey conducted on school going 12-19 year old adolescent girls found that eating occasions of 3-4 times or more were associated with greater odds of developing anaemia compared to eating occasions of less than 3 times a day (52). Girls who skipped dinner were less likely to be anaemic compared to those did not skip dinner and the authors attributed this to the fact that starchy foods may inhibit iron absorption due to phytate content (52). Frequent consumption of low diversity meals may contribute to low protein and micronutrient intake, both of which play an important role as a carrier and enhancer of iron absorption and eating frequency may influence energy intake along with nutrient density of iron folic acid (53).

In an Australian survey it was revealed that children less than 2 years of age and girls aged 12-15 had the least iron intake among all population groups (54). Adolescent girls had the greatest risk of iron deficiency because 65% of them had an iron intake less than the age specific recommended dietary intake (RDI) at a time in their development that coincided with menarche and puberty growth spurt. In a community based cross-sectional study conducted in slums in South India in 2006, meat consumption was associated with higher haemoglobin levels.

Significant associations were observed between anaemia and infrequent or non-consumption of meat (55). A significant number of studies have also reported an association between estimated absorbable iron intakes and iron deficiency. A 2007 Benin study found that among the 100 school girls who participated, 73% met the recommended iron intake but only 27% had estimated absorbable iron intake, 97% of the iron intake was non-heme iron and as a result 43% of the subjects were anaemic (56). It was therefore recommended that efforts of reducing the prevalence of anaemia should focus on increasing the heme content of the diet and the

bioavailability of iron by promoting consumption of affordable local foods rich in iron and iron absorption promoters like vitamin C and meat.

Dietary diversity is a key element of overall diet quality. A cross sectional study conducted in Ethiopia in 2018 on the prevalence of anaemia and the associated risk factors highlighted that low dietary intake of nutrient dense foods like meat, eggs and milk is usually associated with a higher prevalence of anaemia. Lack of dietary diversity is a proxy indicator of poor micronutrient intake which exposes adolescents to anaemia and other micronutrient deficiencies. In the study conducted on the burden and determinants of anaemia among in school young adolescent boys and girls in Ethiopia, Sudan and Tanzania, 80% of the adolescents had poor dietary diversity and 70% of them had low/moderate dietary quality (57). Adolescents with moderate/low dietary quality scores were more likely to be moderately or severely anaemic after adjusting for confounders. Dietary diversity and food insecurity also had significant associations with anaemia in this study. A higher dietary quality score was associated with higher haemoglobin score in the cross sectional survey in Indonesia (52).

Common unhealthy eating habits among adolescents include meal skipping, eating away from home, fast food consumption and snacking (47). Adolescents adopt eating habits during this stage of life where they start making independent decisions and they may take these to adulthood influencing their nutritional status and those of the next generations later in life. The mushrooming of fast food outlets and the paradigm shift towards industrialization and cultural changes globally has the potential to significantly compromise healthy eating practices and the quality of diets in developing countries where information on healthy diets and the money to afford it can be limited (47).

2.2 Conceptual Framework

The conceptual framework developed here is rooted in the extensive literature review conducted on anaemia prevalence, its determinants and the dietary patterns among adolescent girls. By synthesizing findings from various studies, the conceptual framework explains the interplay between individual, socio-environmental, economic and institutional factors that influence dietary behaviours and nutritional status among adolescent girls. This framework serves as a theoretical lens to understand the multifaceted nature of anaemia and dietary quality among adolescents and the underlying determinants guiding the design and interpretation of the present study.

We explored the underlying determinants of both anaemia and dietary quality as shown in **Error! Reference source not found.**. Additionally, the list of food groups from the GDQS was used to find associations between dietary intake and anaemia. By grounding our research in this framework, we aimed to explore the associations between dietary quality, socio-environmental factors and anaemia prevalence among 12–19-year-old girls in Dar es Salaam, Tanzania.
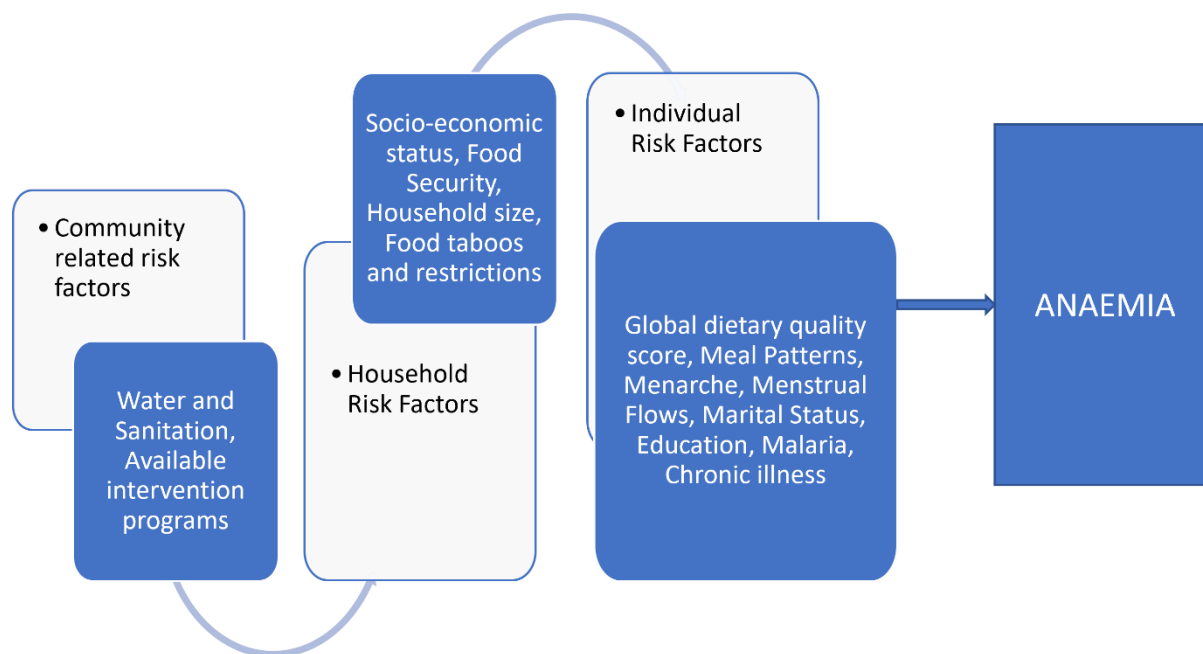
Figure 1: Study conceptual framework developed from literature review

2.3 Study Rationale

Anaemia poses a significant public health threat among adolescents in many low- and middle-income countries. It affects their physical and cognitive development resulting in decreased academic performance, fatigue and reduced productivity (17). Adolescent girls are vulnerable to anaemia due to menstrual blood loss coupled with poor dietary habits and increased nutritional demands. Anaemia during adolescence can have long term health complications including risk of chronic diseases in adulthood, maternal complications, maternal mortality. Anaemia during pregnancy is associated with adverse effects on the mother and health outcomes of the baby, contributing to maternal and perinatal mortality. Disparities in anaemia prevalence exist based on socioeconomic status. Diet quality is an important modifiable risk factor for anaemia, access to nutritious food however can be affected by socioeconomic status, knowledge and education. Research therefore should aim to identify and address these disparities to ensure equitable access to healthcare. Adolescence provides a good window of opportunity for addressing global health and intergenerational health problems. Understanding the risk factors of anaemia and tailoring suitable interventions is essential in reducing the overall burden of anaemia and promoting the health and well-being of adolescents.

2.4 Problem Statement

Despite the recognized importance of addressing anaemia among adolescents and the importance of diet in reducing the burden, there is lack of comprehensive research focusing on the dietary intake and prevalence and aetiology of anaemia among adolescents who are in and out of school in Dar es Salaam. Research and interventions on anaemia have primarily focused on pregnant women and a few studies have focused on adolescent girls. Interventions like iron supplements and deworming have resulted in small but significant declines in the prevalence of anaemia among vulnerable populations in Tanzania (14). Cost effective interventions targeted at adolescent girls can go a long way in reducing the burden of anaemia and the adverse effects it has on the health of women and children. Many risk factors of anaemia can be prevented by understanding the eating habits of adolescent girls during this stage of their life. The few studies on adolescents in Tanzania have targeted adolescents of both sexes who are in school. This leaves out a considerable proportion of adolescents who are not attending school, who carry a greater risk of getting pregnant early and might lack the basic knowledge of which foods they should consume to aid micronutrient uptake. Understanding dietary patterns of adolescent girls, their consumption of iron rich foods and the safety of the food that they consume from parasitic

infections can open room to design interventions that will reduce the burden of anaemia pre-pregnancy and during pregnancy. This study therefore aims to examine the association between dietary quality and anaemia among adolescent girls in Dar es Salaam, Tanzania.

2.5 Research Questions

2.5.1 Main Question

What is the burden of anaemia among adolescent girls in Dar es Salaam and how is associated with the quality of the diet consumed by adolescents.

2.5.2 Specific Research Questions

1. What is the burden of anaemia among adolescent girls in Dar es Salaam Tanzania?
2. What is the quality of the diet being consumed by the adolescents in Dar es Salaam?
3. What is the association between dietary quality and anaemia amongst adolescent girls in Dar es Salaam?

2.6 Research Objectives

2.6.1 Main Objective

To examine the prevalence of anaemia among adolescent girls in Dar es Salaam and how it is associated with the quality of the diet consumed by adolescents.

2.6.2 Specific Objectives

1. To examine the burden of anaemia among adolescent girls in Dar es Salaam, Tanzania
2. To examine the dietary intake of female adolescents in Dar es Salaam in Tanzania
3. To explore the association between dietary quality and the burden of anaemia among adolescent girls in Dar es Salaam, Tanzania

3. Methodology

3.1 Study design

This study was a cross-sectional household survey conducted in Dar es Salaam from August to September 2023.

3.2 Study setting

The study is part of a bigger project titled 'The triple burden of malnutrition among adolescents in Dar es Salaam, Tanzania, what is the magnitude and associated factors?'. Three master theses have been produced from the bigger study. The study presented in this thesis is focusing on dietary quality and association with anaemia among adolescent girls, another study is focusing on the double burden of malnutrition, looking into co-existing anaemia and overweight/obesity among adolescent girls and boys while the third one is focusing on undernutrition and associated factors among adolescent boys and girls.

Tanzania has a young population and it is home to 12 million adolescents according to the UNICEF (58). Dar es Salaam is Tanzania's biggest city with a total population of 13.383,362 (59). Dar es Salaam has a land area of 1,393 square kilometres and a population density of 3,100 people per square kilometre and it is reported to be one of the fastest growing cities in the world, ranking third in Africa and ninth in the world (59). This study was conducted in Dar es Salaam city. Dar es Salaam city is one administrative unit in the Dar es Salaam region, with a total population of 1,649,912 according to the 2022 census (60).

3.3 Sampling and sample size

The original sample size of this study was 540. This was calculated by a statistician based on the objectives of the three master theses in this study. The biggest sample size was needed to estimate the prevalence of overweight/obesity. With a baseline prevalence of 9.9% from a study conducted in Dar es Salaam (36), 528 adolescents were needed to estimate the prevalence of overweight and obesity with 80% power, a probability of 95%, a design effect of 1.2 and assuming a 10% non-response rate. Since the other two theses were studying both male and female adolescents, the study was conducted with the assumption that half of the participants would be girls, which would be enough for this particular thesis.

For this particular study, sample size of 194 adolescent girls was required to estimate the prevalence of anaemia to within ± 10% with probability of 95% and a baseline estimate of 50%. With a design effect of 1.2 to adjust for clustering, a sample size 233 was required and with the assumption of a 10% non-response rate, 260 was the target. The most recent estimate of the prevalence of anaemia among adolescent girls in Dar es Salaam was 47% at the time of the study (13). The sample size is shown in Figure 2.

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┌──────────────────────┐
│ Original sample size │
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           │              ┌──────────────────────┐
           ├─────────────▶│ 17 households did     │
           │              │ not consent.          │
           ▼              └──────────────────────┘
┌──────────────────────┐
│ 523 consenting       │
│ households           │
└──────────┬───────────┘
           │              ┌──────────────────────┐
           ├─────────────▶│ 258 boys excluded.    │
           │              └──────────────────────┘
           ▼
┌──────────────────────┐
│ Final sample size    │
└──────────────────────┘
```
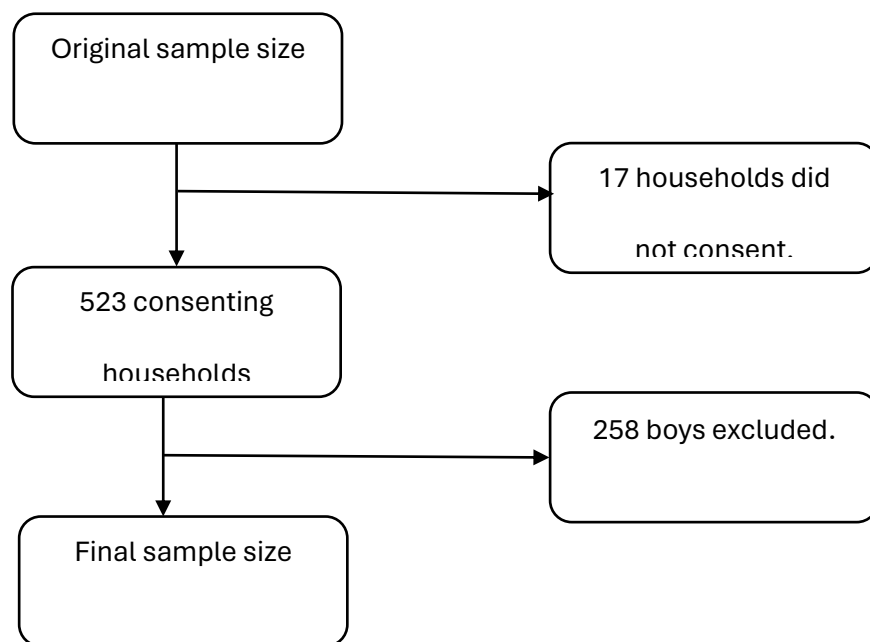
Figure 2: Sample size flow chart.

Multistage cluster sampling was used in this study. The 2022 administrative units population distribution report from the Ministry of Finance and Planning and the National Bureau of Statistics in Tanzania was used to get the population and household information in Dar es Salaam City. Probability proportional to size sampling was used to select 45 clusters (enumeration areas) in the 36 councils of Dar es Salaam city. A systematic random walk was the used to randomly select 12 households in each of the 45 clusters to give a total sample size of 540 adolescents. Data collectors would select a starting point in a central location of the cluster then randomly throw a pen to get the starting direction. Where there was more than one adolescent in a household, an adolescent was randomly selected to participate in the study.

3.4 Study population

The study was conducted among adolescents aged 12 to 19 years in Dar es Salaam. This study only analysed results from adolescent girls. Adolescent girls who were in and out of school were included in the study through a household survey. None of the adolescent girls interviewed in this study was four months or less postpartum or visibly pregnant. This was set as an exclusion criterion to prevent biased anthropometric measurements and haemoglobin status since it has different cut off points for pregnant versus non-pregnant women. Household members for this study were defined as people who were living in the household for more than six months at the time of the study.

3.5 Data Collection

Data was collected electronically using Open Data Kit (ODK) to ensure good data quality and avoid incomplete responses. A validated questionnaire (see Annex 5) was used to collect data on household characteristics, household food insecurity, individual demographic information, sedentary habits, physical activity, food environment, health status, behaviour practices and girls' information on menarche and dietary habits. A 7-day food frequency questionnaire was used to assess dietary intake of the adolescents. The FFQ was standardized and modified according to local foods in the Tanzania food composition tables. Careful amendments were done to the FFQ during the data collection training to minimize the response burden on the adolescents and ensure key food groups were represented. The questionnaire was translated to Swahili and pre-tested by the research assistants in order to improve its validity.

Data was collected by 16 trained data collectors. These were mostly nutritionists and nurses who had experience in nutrition research. The data collectors and supervisors were trained for three days to have consensus and same understanding of what each question in the questionnaire intended to measure and have a standard way of taking anthropometric and haemoglobin measurements. The training was done by the team of master students in the project – me, Christina J Kimaryo and Josephine E Massawe with help and support from our academic supervisors. We developed a training manual and a copy of standard operating procedures which is attached in Annex 7.

Data collectors reported to their supervisors Josephine and Christina who were Swahili speakers while Nancy facilitated the logistics and daily data quality checks. Data quality checks included ensuring that data was collected within the boundaries of given clusters, all questions were answered and information was entered correctly. If anything was clear, the data collectors would clarify on the given day and all matters were addressed before the following day. We developed tracking forms and cluster control sheets to ensure that all household codes were entered correctly. Data collectors had paper copies of the questionnaires as back up in the event of gadget malfunction, none of the interviews was conducted using a paper questionnaire.

3.7 Diet Quality Assessment

Dietary assessment was done using a 7-day food frequency questionnaire. We amended the questionnaire by using foods that are widely consumed in Tanzania. The list of foods was found in the Tanzania Food and Nutrition Composition tables (61) Dietary quality was measured using the Global Diet Quality Score (GDQS). GDQS is a novel measure for dietary quality which is used to assess the consumption of healthy and unhealthy food groups that have been associated with diet related chronic diseases and poor pregnancy outcomes (36). The GDQS groups food into sixteen healthy food groups which are dark leafy vegetables, deep orange vegetables, deep orange tubers, cruciferous vegetables, other vegetables, citrus fruits, other fruits, legumes, nuts and seeds, poultry, fish, whole grains, liquids and oils, low fat dairy and eggs. The eight unhealthy groups are white root tubers, red meat, processed meat, refined grains and baked foods, sugar sweetened beverages, sweets and ice-creams, juices, high fat dairy, and purchased deep fried foods. In this study, we categorised red meat as healthy because of its high heme-iron content that is beneficial for people with iron deficiency anaemia and those at risk of developing it.

For this study, the dietary quality assessment using GDQS was adopted and modified from a 2023 study by Madzorera et al on the status and influencing factors for dietary intake and quality for young adolescents in Sub-Saharan African countries. (36). The GDQS incorporates the diversity of nutritionally important foods consumed across the low- and middle- income countries and has been validated in Sub Saharan Africa including in Tanzania (62). It has also been validated for associations with higher micronutrient adequacy and lower risk of poor nutrition outcomes including anaemia and underweight in multiple sites.

GDQS was computed using frequencies rather than amounts per day because a food frequency questionnaire was used to collect dietary intake. No amounts were collected; thus, frequencies were used for the scoring and analysis. Frequency of consumption was recorded as a) never, b) once per week, c) 2-4 days a week, d) 5-6 days a week and e) daily. Both low and high fat dairy were classified as healthy as dairy is an important source of nutrients for adolescents. High consumption of red meat got the highest number of points in this study because red meat is the main source of heme iron (63).

Scoring was done as shown in Table 1.

Table 1: GDQS food groups score allocation.

Food type	Number of days per week	Points allocated
Dark green vegetables, legumes, nuts and seeds	0-1 days per week	0 points
	2-4 days per week	2 points
	≥ 5 days per week	4 points
Cruciferous vegetables, deep orange vegetables, deep orange tubers and other vegetables	0-1 days per week	0 points
	2-4 days per week	0.25 points
	≥ 5 days per week	0.5 points
Red Meat	0-1 days per week	0 points
	2-4 days per week	1 points
	≥ 5 days per week	2 points
Unhealthy food groups	0-1 days per week	2 points
	2-4 days per week	1 point
	≥ 5 days per week	0 points
Dairy	Any servings	2 points

All adolescents were assigned a low intake of low-fat dairy because low fat dairy consumption is difficult to get in Tanzania and difficult to ascertain for adolescents. Dairy is also important for their growth during adolescents thus whoever consumed dairy was assigned 2 points (36).

3.8 Haemoglobin measurements

Haemoglobin concentration was measured using portable HemoCue machines. A capillary blood sample was collected from the fingertip of each participant using an aseptic technique through sterile single use disposable lancets and disinfectants. The blood samples were taken by

trained data collectors and were disposed in the presence of the participant after the haemoglobin was measured and recorded.

3.9 Data management and analysis

Cleaning, coding and analysis of data was done using the statistical package STATA version 18. Descriptive analysis was carried out to present frequency distributions for socio-demographic characteristics, dietary intakes, and prevalence of anaemia. To compare the prevalence of anaemia according to respondents' characteristics, a chi-square test for independence was conducted. Modified Poisson regression was used for the univariate and multivariate analysis of the associations between anaemia and predictor variables and GDQS and predictor variables. Ordinal logistic regression was used to analyse the associations between anaemia and global dietary quality score. Ordinal logistic regression was used in this case because three categories of anaemia were used, no anaemia, mild anaemia and moderate/severe anaemia.

Data was stored safely in the Secure server for research data at the University of Bergen (SAFE) which has two factor authentication. Traffic in and out of the server is logged and it does not allow exportation of data files with personal data. Only personal data that is relevant for answering the research questions was collected and data will be stored for as long as it is necessary for the project.

3.10 Ethical Considerations

Ethical approval was received from the Regional Ethical Committee (REC) in Norway in line with the General Data Protection Regulation (see **Error! Reference source not found.**) and from the National Institute for Health Research (NIMR) in Tanzania (

Annex **2**). The project was explained to all participants including how their data was going to be used before they agree to participate. For adolescents less than 16, written parental informed consent and adolescent assent was sought before one was enrolled into the study. Written consent was also received from household respondents and adolescents above 16 years of age. Consent and assent forms are attached in Annex 6. Participants were informed that they were free to withdraw at any time during the study. The project was also approved by local authorities (Annex 4) who played an important role in introducing the data collectors in every cluster.

The participants were also notified that sampled blood will only be used to assess haemoglobin levels in their presence. After measuring and recording the result, the sample was immediately discarded into a disposal safety box. Maintenance of confidentiality and anonymity of the participants was ensured throughout the study. Adolescents with severe anaemia were given referral letters to health care facilities to get medical attention. Participation in the study was entirely optional, and individuals were under no obligation to take part.

4. Results

A total of 523 adolescents and their respective household representatives participated in this study with a response rate of 97%. In this study, data only from girls was analysed which were 282 out of 523 (54% of the total study population). Table 2 shows the characteristics of the study population. The mean ± SD age of the study participants was 15 ± 2.2 where 127 (45%) of the were aged between 12 and 14 years. As shown in Table 2, 223 (79%) of the adolescents were currently attending school. Most of the adolescents, 278 (99%) were not married.

On self-reported health status, 205 girls (72%) rated their health as good. Quite a few adolescents 42 (14%) reported to be living with a chronic health condition or disability. Notably, 95 (33%) adolescents reported that they had been diagnosed with malaria in the past 6 months. More than half of the adolescents 171 (60%) reported that they had some cultural or religious food restrictions. Most of the participants, 203 (72%) had reached menarche at the time of data collection and only 4 (2%) of the girls had ever been pregnant.

Table 2: Sociodemographic and health characteristics of 12-19 years adolescent girls in Dar es Salaam

Variables	Categories	N	%
Sociodemographic			
Age of adolescent (n=282)	12 – 14 years	127	45.0
	15 – 19 years	155	55.0
Education Status (n=282)	Never attended school	1	0.3
	Currently attending school	223	79.1
	Former attended school	58	20.6
Adolescent marital status (n=282)	Single	278	98.6
	Married	4	1.4
Adolescent health characteristics			
Self-rated health status (n=278)	Poor	18	6.5
	Fair	29	10.4
	Good	205	73.7
	Excellent	26	9.4
Chronic Health Condition (n=281)	Yes	42	14.9
Malaria diagnosis in 6 months or less (n=282)	Yes	95	33.7
Cultural or religious food restrictions (n=279)	Yes	171	61.3
Menarche (n=282)	Yes	203	72.0
Self-rated menstrual flows (n=195	Heavy Bleeding	12	6.1
	Moderate Bleeding	169	86.7
	Light Bleeding	14	7.2
Ever been pregnant	Yes	4	2.0

4.1 Household Characteristics

As shown in Table 3, 196 (69%) household heads in the study were self-employed. A small number, 30 (10%) of the household heads were reported to have higher or tertiary education while 9 (3%) did not have any form of formal education. Many households, 218 (77%) were using a flush toilet system and 272 (96%) of the households were using a protected water source. Notably 84 (29%) of the households were food secure.

Table 3 : Household Characteristics of 12–19-year-old adolescent girls in Dar es Salaam

Variables	Categories	N	%
Household size (n=282)	<5	139	49.3
	≥ 5	143	50.7
Household Head Occupation (n=280)	Formal Employment	27	9.6
	Seasonal Employment	14	5.0
	Self Employed	196	70.0
	Unemployed	43	15.4
Household Head Education (n=277)	No formal education	9	3.3
	Primary Education	157	56.7
	Secondary Education	81	29.2
	Higher/Tertiary Education	30	10.8
Toilet facility (n=282)	Improved toilet	231	81.9
	Unimproved toilet	51	18.1
Improved water source (n=282)	Yes	272	96.5
Household food security (n=273)	Food Secure	84	30.8
	Mildly Food Insecure	28	10.3
	Moderately Food Insecure	73	26.7
	Severely Food Insecure	88	32.2

4.2 Prevalence of anaemia and global dietary quality scores for adolescent girls

Anaemia prevalence was 45.4% (128/282). Among the anaemic girls,7 (2%) of them were severely anaemic and they were given hospital referrals by the data collectors. The maximum possible global dietary quality score was 38.5. Amongst the participants, the maximum score was 30.75 while the minimum score was 9.0. The mean ± standard deviation global dietary quality score was 15.5 ± 4.4. 138 (44%) participants had high risk of poor dietary quality, characterised by a global dietary quality score of less than 15. As shown in Table 4, only 23 (9%) of the adolescents had a low risk of poor diet quality.

Table 4: Anemia prevalence and Global Dietary Scores (N = 282)

Variable	Categories	N	%
Anemia	No anemia (Hb ≥ 12 g/dl)	154	54.6
	Mild anemia (Hb 11-11.9 g/dl)	76	27.0
	Moderate anemia (Hb 8-10.9 g/dl)	45	16.0
	Severe anemia (Hb < 8 g/dl)	7	2.4
Global Dietary Quality Score	Low risk of nutrient inadequacy (≥23)	23	9.5
	Moderate risk of nutrient inadequacy (≥15 < 23)	126	45.8
	High risk of nutrient inadequacy (< 15)	123	44.7

4.3 Anaemia and associated factors

The overall mean + SD and median haemoglobin concentration among the 282 participants were 11.9 ± 1.6 g/dl and 12.1 g/dl respectively. Anaemia was categorised as 12 g/dl and above not anaemic, 11 – 11.9 g/dl mildly anaemic, 8 – 10.9 g/dl moderately anaemic and less than 8 g/dl severely anaemic. The 7 adolescents with severe anaemia were excluded from the analysis because the haemoglobin levels got to as low as 4 g/dl which could indicate serious underlying medical conditions or some other things that could distort the association between dietary quality and anaemia.

4.3.1 Chi-square test of anaemia and background factors

A chi-square test of independence was conducted for anaemia and background factors. Predicted factors were age, malaria diagnosis in 6 months, main activity during the day (school/work), global dietary quality score, self-reported symptoms of anaemia, household size, source of water, toilet status and household food security.

As shown in Table 5, only self- reported anaemia symptoms had a significant association with anaemia (p-value 0.035).

	Anaemia categories				
	No anaemia	Mild anaemia	Moderate anaemia	Total	p-value
	n (%)	n (%)	n (%)	n	
Adolescent age category (n=275)					
12-14	71 (56.8)	38 (30.4)	16 (12.8)	125	0.296
15-19	83 (55.3)	38 (25.3)	29 (19.3)	150	
Working for a living (n=275)					
No	136 (54.4)	73 (29.2)	41 (16.4)	250	0.158
Yes	18 (72.0)	3 (12.0)	4 (16.0)	25	
Adolescent education status (n=275)					
Primary education	45 (57.7)	19 (24.4)	14 (17.9)	78	0.082
Secondary/higher	72 (51.8)	48 (34.5)	19 (13.7)	139	
Not going to school	37 (63.8)	9 (15.5)	12 (20.7)	58	
Chronic health condition/Disability (n=275)					
No	133 (56.4)	67 (28.4)	36 (15.3)	236	0.442
Yes	21 (53.8)	9 (23.1)	9 (23.1)	39	
Malaria diagnosis in 6 months (n=275)					
No	103 (56.6)	53 (29.1)	26 (14.3)	182	0.39
Yes	51 (54.8)	23 (24.7)	19 (20.4)	93	
Fever in the past 7 days (n=275)					
No	107 (53.2)	57 (28.4)	37 (18.4)	201	0.216
Yes	47 (63.5)	19 (25.7)	8 (10.8)	74	
Menarche (n =275)					
No	50 (65.8)	18 (23.7)	8 (10.5)	76	0.101
Yes	104 (52.3)	58 (29.1)	37 (18.6)	199	
Self-reported anaemia symptoms (n=275)					
No	119 (59.5)	55 (27.5)	26 (13.0)	200	0.035
Yes	154 (56.0	76 (27.6)	45 (16.4)	275	
HH size group (n=275)					
<5	78 (57.8)	30 (22.2)	27 (20.0)	135	0.078
>=5	76 (54.3)	46 (32.9)	18 (12.9)	140	
Categorized sources of water (n=275)					
Improved source	149 (56.0)	72 (27.1)	45 (16.9)	266	0.29
Unimproved source	5 (55.6)	4 (44.4)	0 (0.0)	9	
Toilet facility status (n=275)					
Unimproved	22 (46.8)	13 (27.7)	12 (25.5)	47	0.152
Improved	132 (57.9)	63 (27.6)	33 (14.5)	228	
HFIAS food insecurity status (n =266)					
Food Secure	51 (60.7)	20 (23.8)	13 (15.5)	84	0.434
Food Insecure	96 (52.7)	56 (30.8)	30 (16.5)	182	

Table 5: Chi-square test of anaemia and background factors

4.3.2 Univariate and multivariate analysis of anaemia and associated factors

Modified Poisson regression was conducted on anaemia and the background factors. Univariate analysis was conducted and then multivariate analysis to control for confounders as presented in Table 6. Adolescents who reported to have had experienced symptoms of anaemia like fatigue, weakness and pale skin were 37% more likely to be anaemic (95% CI 1.06, 1.77, p-value 0.016) and 34% more likely to be anaemic after adjusting for confounders (95% CI 1.02, 1.76, p-value 0.034) compared to those who had not. Adolescents from households with improved toilets had a 25% reduced risk of being anaemic in the univariate analysis (95% CI 0.57, 1.00, p-value 0.049) and 22% reduced risk of being anaemic after adjusting for confounders compared to those with unimproved toilets but the effect was not statistically significant (95% CI 0.57, 1.08, p-value 0.131).

Older adolescents had a 15% reduced risk of being anaemic in the multivariate analysis compared to the younger adolescents, but this association was not statistically significant (95% CI 0.59, 1.21 p-value 0.358). Adolescents who had reached menarche had a 40% increased risk of being anaemic compared to those who had not (95% CI 0.99, 1.97 p-value 0.058). This risk increased to 69% after adjusting for confounders (95% CI 1.14, 2.50 p-value 0.009).

Table 6: Univariate and multivariate association of anaemia and background factors

Variable	Crude RR	95% CI		p-value	Adjusted RR	95% CI		p-value
Adolescent age category								
12-14	1				1			
15-19	1.03	0.79	1.35	0.808	0.85	0.59	1.21	0.358
Adolescent education status								
Primary education	1				1			
Secondary/higher	1.14	0.83	1.56	0.412	0.89	0.61	1.31	0.553
Not attending school	0.86	0.56	1.32	0.477	0.70	0.42	1.17	0.172
Chronic health condition/Disability								
No	1				1			
Yes	1.06	0.73	1.53	0.767	0.96	0.64	1.45	0.854
Malaria diagnosis in the past 6 months								
No	1				1			
Yes	1.04	0.79	1.38	0.781	1.00	0.73	1.35	0.978
Fever in the past 7 days								
No	1				1			
Yes	0.78	0.56	1.09	0.147	0.73	0.52	1.02	0.066
Menarche								
No	1				1			
Yes	1.40	0.99	1.97	0.058	1.69	1.14	2.50	**0.009**
Self-reported anemia symptoms								
No	1				1			
Yes	1.37	1.06	1.77	**0.016**	1.34	1.02	1.76	**0.034**
Household size								
<5	1				1			
>=5	1.08	0.83	1.42	0.561	1.02	0.78	1.34	0.868
Toilet facility status								
Unimproved	1				1			
Improved	0.75	0.57	1.00	**0.049**	0.78	0.57	1.08	0.131
Household food security								
Food Secure	1				1			
Food Insecure	1.20	0.88	1.64	0.239	1.14	0.83	1.55	0.418
Intercept					0.40	0.24	0.68	0.001

4.4 Dietary Quality

Table 7 shows the frequency of consumption of key food groups. Consumption of dark green vegetables was relatively low, with 103 (37.5%) of the adolescents reporting that they had consumed them 0-1 times in 7 days. Legume consumption was also low, with 98 (35.6%) of the adolescents reporting 0-1 times per week. Most adolescents, 251 (91.3%) reported to have consumed citrus fruits 0-1 times in the previous 7 days. Root vegetable consumption was high, with 156 (56.7%) of the adolescents reporting to have taken them 5 or more days in the previous 7 days. Consumption of eggs and dairy was also low, with about 74% of the adolescents reporting to have consumed them 0-1 times a week.

Red meat consumption was low, 146 (53.1%) participants reported that they had consumed it 0-1 times in the previous 7 days. Many participants, 210 (77.4%) reported that they had consumed refined and baked goods at least 5 times in the previous 7 days. Consumption of sweets and ice cream was relatively low, with 141 (50.0%) of the participants reporting that they had consumed them 0-1 times in the previous 7 days. Processed meat consumption was very low in this study, with 98% of the adolescents reporting that they had consumed it 0-1 times a week.

Table 7: Frequency of consumption of key food groups in the previous 7 days among 12–19-year adolescent girls in Dar es Salaam (n=275)

Food Group	0-1 times	2-4 times	≥ 5 times
Healthy food groups	*n (%)*	n (%)	n (%)
Dark Green Vegetables	103 (37.5)	71 (25.8)	101 (36.7)
Legumes	98 (35.6)	75 (27.3)	102 (37.1)
Cruciferous vegetables	218 (79.3)	45 (16.4)	12 (4.3)
Deep orange vegetables	273 (99.3)	2 (0.7)	0 (0.0)
Roots	62 (22.6)	57 (20.7)	156 (56.7)
Deep orange tubers	200 (72.7)	51 (18.5)	24 (8.7)
Other vegetables	93 (33.8)	145 (52.7)	37 (13.5)
Citrus Fruits	251 (91.3)	23 (8.4)	1 (0.3)
Other fruits	116 (42.2)	71 (25.8)	88 (32.0)
Poultry	175 (63.6)	71 (25.8)	29 (10.6)
Fish	106 (38.5)	102 (37.1)	67 (24.4)
Whole grains	149 (54.2)	81 (29.4)	45 (16.4)
Eggs	204 (74.2)	53 (19.3)	18 (6.5)
Dairy	204 (74.2)	51 (18.5)	20 (7.3)
Red meat	146 (53.1)	84 (30.5)	45 (16.4)
Unhealthy food groups			
Processed meat	271 (98.6)	3 (1.1)	1 (0.3)
Refined grain and baked goods	4 (1.4)	61 (22.2)	210 (77.4)
Sweets and ice cream	137 (49.8)	94 (34.2)	44 (16.0)
Sweetened beverages	89 (32.4)	105 (38.2)	81 (29.4)
White roots and tubers	113 (41.1)	92 (33.4)	70 (25.5)
Fried foods	90 (32.7)	102 (37.1)	83 (30.2)

4.4.1 Chi-square test of GDQS and background variables

A chi square test of independence was conducted on the global dietary quality scores and background variables. As shown in Table 8, the only significant association found was between education status and dietary quality (p = 0.008). All the other variables had statistically insignificant associations (p > 0.05). Further statistical tests were conducted with modified Poisson regression.

Table 8: Chi square test of GDQS and background variables

| | **Risk of poor diet quality** | | | | |
Variable	**High risk** n (%)	**Moderate risk** n (%)	**Low risk** n (%)	**Total** n	p-value
Adolescent age category (n=275)					
12-14	53 (42.4)	54 (43.2)	18 (14.4)	125	0.262
15-19	62 (41.3)	75 (50.0)	13 (8.7)	150	
Working for a living (n=275)					
No	108 (43.2)	116 (46.4)	26 (10.4)	250	0.195
Yes	7 (28.0)	13 (52.0)	5 (20.0)	25	
Adolescent education status (n= 275)					
Primary education	29 (37.2)	34 (43.6)	15 (19.2)	78	**0.008**
Secondary/higher	64 (46.0)	69 (49.6)	6 (4.4)	139	
Not attending school	22 (37.9)	26 (44.8)	10 (17.3)	58	
Cultural/Religious food restrictions (n=272)					
No	40 (38.5)	53 (51.0)	11 (10.5)	104	0.539
Yes	74 (44.0)	74 (44.0)	20 (12.0)	168	
Peer-peer food restrictions (n=275)					
No	106 (42.2)	117 (46.6)	28 (11.2)	251	0.902
Yes	9 (37.5)	12 (50.0)	3 (12.5)	24	
Chronic health condition/Disability (n=275)					
No	97 (41.1)	114 (48.3)	25 (10.6)	236	0.454
Yes	18 (46.2)	15 (38.5)	6 (15.4)	39	
Purposeful weight loss habits (n=275)					
No	107 (42.3)	118 (46.6)	28 (11.1)	253	0.845
Yes	8 (36.4)	11 (50.0)	3 (13.6)	22	
Household size (n=275)					
<5	53 (39.3)	62 (45.9)	20 (14.8)	135	0.181
>=5	62 (44.3)	67 (47.9)	11 (7.8)	140	
Categorized sources of water (n=275)					
Improved source	113 (42.5)	123 (46.2)	30 (11.3)	266	0.443
Unimproved source	2 (22.2)	6 (66.7)	1 (11.1)	9	
Toilet facility status (n=275)					
Unimproved	22 (46.8)	18 (38.3)	7 (14.9)	47	0.388
Improved	93 (40.8)	111 (48.7)	24 (10.5)	228	
Household food insecurity (n=266)					
Food Secure	31 (36.9)	44 (52.4)	9 (10.7)	84	0.438
Food Insecure	80 (44.0)	80 (44.0)	22 (12.0)	182	

4.4.2 Univariate and multivariate analyses of GDQS and background factors

Modified Poisson regression was used to assess the associations between dietary quality and background factors. Univariate analysis was conducted to identify the factors with statistically significant associations with high risk of dietary inadequacy. Multivariate modified Poisson regression was then used to get adjusted estimates after controlling for the effect of confounders. The results are presented in Table 9.

Adolescents who were attending the secondary/higher level of education had an 11% higher risk of poor dietary quality (95% CI 1.01, 1.23, p-value 0.029) and a 19% increased risk in the multivariate analysis (CI 1.04, 1.37, p-value 0.013) compared to those who were in the primary level. Adolescents who came from households with 5 or more people had a 9% increased risk of poor dietary quality (95% CI 1.01, 1.18, p-value 0.034) and this risk increased to 10% (95% CI

1.01, 1.19 p-value 0.022) after adjusting for confounders, compared to those from smaller households.

Table 9: Univariate and multivariate analyses of GDQS and background factors

	Crude RR	95% CI		p-value	Adjusted RR	95% CI		p-value
Adolescent age category								
12-14	1				1			
15-19	1.05	0.97	1.14	0.2	1.03	0.94	1.13	0.508
Adolescent education status								
Primary education	1				1			
Secondary/higher	1.11	1.01	1.23	**0.029**	1.19	1.04	1.37	0.013
No education	0.98	0.85	1.13	0.819	0.94	0.78	1.13	0.531
Cultural food restrictions								
no	1				1			
yes	0.97	0.90	1.04	0.393	0.95	0.87	1.03	0.199
Peer to peer food restrictions								
no	1				1			
yes	0.96	0.82	1.13	0.639	0.95	0.80	1.14	0.594
Chronic health condition/Disability								
no	1				1			
yes	0.96	0.84	1.09	0.497	0.99	0.86	1.13	0.847
Purposeful weight loss habits								
no	1				1			
yes	1	0.87	1.15	0.951	0.99	0.86	1.13	0.864
Household size group								
<5	1				1			
>=5	1.09	1.01	1.18	**0.034**	1.10	1.01	1.19	**0.022**
Toilet facility status								
Unimproved	1				1			
Improved	1.08	0.95	1.22	0.248	1.09	0.97	1.23	0.147
Household food security								
Food Secure	1				1			
Food Insecure	1.02	0.93	1.11	0.733	1.01	0.93	1.10	0.779
Intercept					0.78	0.66	0.92	0.003

4.5 Dietary Quality and its association with anaemia

Univariate ordinal logistic regression was used to examine the relationship between dietary quality and anaemia. Three categories of anaemia were used in the analysis, no anaemia, mild anaemia and moderate anaemia. GDQS and consumption of key food groups were ran in the model with anaemia as the dependant variable. Multivariate ordinal logistic regression was done to control for potential confounders. The results are presented in Table 10. Age, chronic health condition, reporting fever in the previous 7 days, self-reported anaemia symptoms, toilet status and household food insecurity were considered as potential confounders.

Adolescents with moderate risk of poor diet quality had 0.74 times the odds of being anaemic compared to those with high risk of poor diet quality, although this did not have a significant association (95% CI 0.40, 1.07, p-value 0.09). Adolescents who consumed legumes 2-4 times a week had 0.47 times the odds of being anaemic (95% CI 0.26, 0.86 p-value 0.014) and 0.45 times the odds of being anaemic (95% CI 0.20, 0.97, p-value 0.034) compared to those who consumed them 0-1 times after adjusting for confounders.

Adolescents who consumed sweets and ice cream 2-4 times a week had 1.77 times the odds of being anaemic (95% 1.06, 2.95, CI p-value 0.029) and 2.97 times the odds of being anaemic after adjusting for confounders (95% CI 1.55, 5.69, p-value 0.001) compared to those who had consumed them 0-1 times a week.

As shown in Table 7, cruciferous vegetables, dark orange vegetables, citrus fruits, eggs and dairy were poorly consumed in this study. Almost all adolescents consumed refined grains and baked goods more than 5 days a week. These food groups were therefore removed from the regression analysis.

Table 10 : Ordinal logistic regression of anaemia and diet quality

	Crude OR	95% CI		p-value	Adjusted OR	95% CI		p-value
Risk of poor diet quality								
High risk	1				1			
Moderate risk	0.74	0.40	1.07	0.090	0.86	0.35	2.08	0.733
Low risk	1.03	0.47	2.28	0.933	1.36	0.27	6.85	0.709
Dark green vegetables								
0-1 times a week	1				1			
2-4 times a week	0.94	0.52	1.67	0.825	0.85	0.40	1.80	0.666
5-7 times a week	0.94	0.55	1.61	0.825	1.1	0.46	2.63	0.831
Legumes								
0-1 times a week	1				1			
2-4 times a week	0.47	0.26	0.86	**0.014**	0.45	0.20	0.97	**0.034**
5-7 times a week	0.64	0.37	1.09	0.097	0.53	0.25	1.15	0.109
Roots								
0-1 times a week	1				1			
2-4 times a week	1.1	0.55	2.21	0.781	0.89	0.39	2.02	0.775
5-7 times a week	0.91	0.52	1.61	0.751	1.13	0.56	2.29	0.739
Deep orange tubers								
0-1 times a week	1				1			
2-4 times a week	1.12	0.62	2.01	0.708	1.38	0.68	2.81	0.368
5-7 times a week	1.11	0.48	2.60	0.807	2.4	0.85	6.74	0.097
Other vegetables								
0-1 times a week	1				1			
2-4 times a week	1.15	0.69	1.92	0.587	1.12	0.60	2.11	0.725
5-7 times a week	1.4	0.68	2.88	0.359	1.26	0.50	3.18	0.625
Other fruit								
0-1 times a week	1				1			
2-4 times a week	0.86	0.48	1.53	0.61	0.83	0.42	1.66	0.602
5-7 times a week	0.81	0.47	1.38	0.44	0.69	0.32	1.48	0.340
Poultry								
0-1 times a week	1				1			
2-4 times a week	0.84	0.49	1.44	0.516	0.9	0.46	1.75	0.764
5-7 times a week	1.05	0.50	2.20	0.902	0.6	0.22	1.62	0.313
Fish								
0-1 times a week	1				1			
2-4 times a week	1.24	0.73	2.10	0.422	1.38	0.72	2.63	0.336
5-7 times a week	1.08	0.60	1.97	0.796	1.01	0.47	2.20	0.975
Whole grains								
0-1 times a week	1				1			
2-4 times a week	1.29	0.77	2.18	0.339	1.35	0.72	2.54	0.355
5-7 times a week	1.09	0.58	2.06	0.783	1.34	0.57	3.14	0.497
Red meat								
0-1 times a week	1				1			
2-4 times a week	1.39	0.61	3.19	0.437	1.25	0.42	3.75	0.688
5-7 times a week	0.91	0.56	1.49	0.713	0.79	0.42	1.48	0.461
Sweets and ice cream								
0-1 times a week	1				1			
2-4 times a week	1.77	1.06	2.95	**0.029**	2.97	1.55	5.69	**0.001**
5-7 times a week	1.11	0.58	2.15	0.749	1.55	0.66	3.65	0.314
Sweetened beverages								
0-1 times a week	1				1			
2-4 times a week	0.96	0.55	1.66	0.874	0.67	0.35	1.29	0.232
5-7 times a week	0.99	0.55	1.76	0.96	0.72	0.34	1.55	0.405
White roots and tubers								
0-1 times a week	1				1			
2-4 times a week	1.2	0.71	2.03	0.485	1.32	0.69	2.52	0.407
5-7 times a week	0.55	0.30	1.02	0.057	0.54	0.26	1.14	0.105
Fried foods								
0-1 times a week	1				1			
2-4 times a week	0.92	0.53	1.60	0.766	0.84	0.44	1.62	0.609
5-7 times a week	1.23	0.69	2.17	0.481	1.18	0.56	2.46	0.662

5. Discussion

Adolescents possess distinct health and developmental requirements, with many of them encountering obstacles that impede their overall welfare. This is particularly notable among adolescent girls, who may experience adverse reproductive outcomes, pregnancy complications, and issues related to birth weight (3). Adolescents however remain an under-researched group in LMICs, with many studies and interventions targeting children under 5 and women of reproductive health. Anemia poses a significant threat to the health of millions of women and children worldwide, imposing substantial health and economic burdens, particularly in developing countries (17). Poor diet quality is one of the modifiable risk factors of anaemia, this study therefore aimed to assess dietary quality and its association with anaemia among adolescent girls in Dar es Salaam, Tanzania.

Interpretation of findings

Our study revealed that the prevalence of anaemia was 45.4%, while 44.7% of the adolescents had a high risk of poor diet quality. Our analysis demostrated that girls with moderate risk of poor diet quality were less likely to be anemic compared to those with high risk of poor dietary quality even though the association was not statistically significant. Our FFQ missed 4 out of the 25 food groups required to calculate the GDQS. The missing food groups were deep orange tubers, nuts and seeds, liquids and oils and juices. In as much as we got an overall overview of diet quality among adolescents, the reliability of its association with anaemia is limited hence we need to interpret with caution.

Furthermore, we found that adolescents who consumed legumes 2-4 times had less odds of being anaemic compared to those who consumed them 0-1 times a week. Legumes are highly nutritious and they are a good source of minerals and fiber (64). A systematic review conducted in low- and middle- income countries found that legume consumption was associated with reduced prevalence of iron deficiency (64). Legume consuption among this population was relatively low yet legumes are considered to be the second most important food group after cereals (65). Even though legumes are relatively inexpensive, some studies have found that people avoid cooking legumes because of their prolonged cooking time and the associated costs of cooking energy like gas, electricity or firewood (65).

Adolescents had reached menarche and those who reported to have symptoms of anaemia like weakness, pale skin and fatigue were more likely to be anaemic compared to their counterparts. Iron demands increase with the onset of menstruation and blood loss without complementary iron intake can cause anemia. Adolescents coming from households with an improved toilet were more likely to be anaemic compared to those using unimproved toilets. This could be because better sanitation services might reduce the risk of parasitic infections. This study however did not look into parasitic infections and we cannot surely ascertain that those with improved toilets had less risks of parasitic infections.

On dietary quality, adolescents who were attending secondary/higher education had a higher risk of poor diet quality compared to those attending primary school. Adolescents attending secondary or higher education are more likely to be concerned about their body image leading them to adopt some uninformed nutritional patterns or behaviours that might interfere with the general quality of their diets. Literature suggests that as adolescents grow, dieting and body dissatisfaction increase (66). Our study also found that adolescents from households with more than 5 people had an increased risk of poor diet quality than those from smaller households. In low resource settings, people with bigger households likely to consider the quantity of food over its quality. This is in line with the findings from Yiga et al, 2020 where respondents from bigger households confirmed that they prioritized satiety over health when the resources are limited (42).

On unhealthy food groups, consumption of processed meat was very low. This could be because processed meat is expensive hence it was inaccessible to many of the study participants. As discussed in the literature review, a sytematic review of dietary patterns in Kenya, Ghana, South Africa and Tanzania found that low income status was a predictor of unhealthy eating habits in all these countries except for Tanzania (67). Refined and baked goods were widely consumed and this could be attributed to the nutrition transition and also the affordability of refined foods. Refined foods can also be easy to prepare and they have shorter preparation times, justifying the excessive consumption of them in this study.

<u>Comparison of study findings with existing literature</u>

Few studies have been conducted on the prevalence of anaemia in this particular sub-population making it difficult to compare findings. The prevalence of anaemia in our study was 45.4%

which is in line with a study conducted in Nigeria among 10-19 year old adolescents girls (68). The study, just like this one found low consumption of iron rich foods among adolescents. The prevalence of anaemia was lower than in a study conducted among girls of the same age group in Lahore, Pakistan where 68.9% of the participants were anaemic (69). In the Pakistan study, 77% of the adolescents did not have green vegetables in their diet compared to 37.5% in this study.

The prevalence of anaemia in this study was higher than in studies conducted in Dembia, Ethiopia (25.5%) (70), and in Siaya District in Kenya (26.5) (71). This could be attributed to different socioeconomic status and age groups of the participants. Adolescents in this current study also had poor intake of nutrients dense foods compared to those in Kenya and Ethiopia. Adolescents who had reached menarche had 57% increased chances of being anaemic in this study. A study conducted in 12-19 year old school girls in rural Ethiopia found that girls who had reached menarche were 2 times most likely to be anaemic compared to girls who had not reached menarche (72).

No significant association was found between dietary quality and anaemia in our study. This is in contrast to a study in Western Java where significant associations were found between anaemia and the dietary quality of school going adolescents (52). This could be because our study used a food frequency questionnaire which could be prone to recall bias unlike the other study which used a 2 day 24 hour recall on a weekend and a weekday.

A study conducted in Dar es Salaam in 2023 found that 15% of the adolescents had high risk of poor diet quality (36) which is way much lower than what we found in this current study (44.7%). This is probably because the study studies the diet quality of 10 to 15 year old boys and girls while our study assessed 12-19 year old adolescent girls only. Older adolescent girls in our study had a higher risk of poor diet quality compared to younger adolescents. Consumption of fruits, vegetables and animal source food was low in Tanzania, Ethiopia and Sudan among adolescents in sub-Saharan Africa (36). These findings were consistent with our findings where 53% of the adolescents had consumed red meat at most once in 7 days. Refined grains and fried foods were also widely consumed in Dar es Salaam as was found in Tanzania, Ethiopia and Sudan. Consumption of processed meat was low in both studies.

Findings and study conceptual framework

Our findings support the theory posed in the conceptual framework that water and sanitation are risk factors for anaemia. A small percentage of the adolescents were using an unimproved water source. However, significant associations were found between unimproved toilet facilities and anaemia among the adolescents. Our study did not look into the available anaemia intervention programs. This was overlooked in the design of the study questionnaires and therefore we could not assess the relationship between this baseline theory and our own findings.

Food security, food taboos and food restrictions did not have any significant associations with anaemia and diet quality in this study. However, among the household risk factors, a big household size was significantly associated with a higher risk of poor diet quality among the adolescents compared to smaller household size. On individual risk factors in our conceptual framework, only menarche was significantly associated with a higher risk of anaemia.

Implications of study findings on public health and policy interventions

The high prevalence of anaemia found in this study and the high risk of poor diet quality among adolescent girls have significant implications for public health policies in Dar es Salaam. Strategies to improve diet quality and promote the consumption of iron rich foods as well as strategies to reduce the burden of anaemia should be prioritized. These strategies, based on the findings of this study may include food fortification, school-based interventions, community reach out programs for nutrition education.

Consumption of iron rich foods in this study was low. This could be because of limited access or uninformed choices of dietary intake. In our study, 223 (79%) of the adolescent girls who participated were currently attending school.Inteventions like nutrition education can be extended through broadcasting channels and community reachouts so as to accommodate adolescents who are not in school. In this era where many adolescents have access to the internet, creative social media campaigns can be a cheap and effective way to promote healthy eating patterns and behaviours among adolescents. Policies to ensure accessibility and affordability of nutritious food in Dar es Salaam can go a long way in changing the dietary intake of adolescents.

In Tanzania approximately 28% of adolescent girls conceive by the age of 18 with an estimated 45% of these individuals experiencing anaemia during pregnancies (73). Improving adolescent nutrition is critical to prepare girls for motherhood, which can improve pregnancy and birth outcomes, breaking the integenerational cycle of malnutrition. Iron and folic acid (IFA) supplementation is a promising intervention to improve adolescent health in LMICs (74). Intermittent supplementation with IFA was shown to reduce anaemia by 35% in adolescents and adult women in a recent systematic review (75). In Tanzania, IFA supplementation programming is focused on pregnant women (76), no systematic attention is given to adolescent girls yet interventions at this stage can be affordable and more effective.

A study in Bangladesh found that integration of WASH, consistent adminstration of deworming and broadcasting nutrition awareness programs are effective interventions to reduce the burden of anaemia (77). In our study, we did not investigate the contribution of infections and worm infestations to the burden of anaemia yet they contribute significantly ti impared nutrient absorption and consequently, anaemia (77). Improving toilet facilities in Dae es Salaam can go a long way in reducing the burden of anaemia because better sanitation might help reduce the risk of worm infestation.

A 2024 randomized control trial of a meals, education and gardening found that school based nutritional intervention packages incorporating multiple actions may improve the diet quality of adolescents and their household members. Schools hold the power to significantly impact adolescent nutrition with initiatives such as school feeding, nutrition education and establishment of school gardens demostrating the potential to enhance the health and well-being of adolescents (78). This study found improvements in the global dietary quality scores of adolescents after introducing the intervention packages.

Strengths of the study

Our study was a household survey, which managed to capture the dietary quality of adolescents who were not going to school. This increases the generizability of the study among adolescents in similar settings. Many studies on adolescents in developing countries are conducted on school going adolescents thus our study adds another group of adolescents to the adolescent nutrition body of knowledge in low-income settings. This study was also conducted by well trained data collectors who had experience in large scale nutrition surveys improving the

reliability of the data. Data collectors were well trained and supervised daily throught the data collection process. The response rate in this study was also high, minimizing non-response bias and enhancing the representativeness of the sample.

The use of an electronic tool, ODK in tablets minimized human error and non response as the questions were set in such a way that interviewers could not go to the next question before answering the previous one. Using ordinal logistic regression to assess the association between diet quality and anaemia helped to reduce the effect of dichotomization since the three categories of anaemia were used, retaining important information (79).

Study limitations

Our study had a cross sectional design therefore we could not get causal relationships but rather risk factors of anaemia and diet quality. We used ordinal logistic regression to measure the main outcome when our prevalence was high making it difficult to interpret the results as odds ratios may not accurately the strength of associations for prevalences greater than 10% (79). The confidence intervals in Table 10 show the reduced precision of the estimates, and the high prevalence might have made it difficult to detect significant associations.

Our study used a modified version of the GDQS, where a food frequency questionnaire was used in place of a 24 hour food recall. A food frequency questionnaire has leading foods which might lead to missclassification of adolescents' scores as we could count them as not eating in a particular food group yet we did not ask for the specific food. However, this modification has been validated in many simillar settings, Dar es Salaam included (36).

Moreover, our food frequency questionnaire could not capture all the required food groups, we ended up using 21 food groups instead of 25, leaving out oils, high fat dairy, and nuts and seeds. While these food groups could add to the overall quality score, we believe the current study gave a proper assessment of what the diet quality generally looks like by capturing widely consumed foods in Tanzania. This however affected the overall diet quality score affecting the reliability of our data. Associations between diet quality and anaemia have to be interpreted cautiously. Dietary and health data was self reported which could have introduced social desirability bias. Additionally, this study was conducted in the urban part of Dar es Salaam, generizability therefore is limited to adolescents in an urban setting.

6. Conclusion

Our findings show that adolescent nutrition should be given more attention given the poor diet quality and high prevalence of anaemia among adolescent girls. Nutritional education as well as improved sanitation facilities are needed to reduce the burden of anaemia. By addressing the underlying factors contributing to diet quality, we can improve the health and well being of this vulnerable population. Programs should focus on increasing the consumption of nutrient dense foods like vegetables, fruits, poultry, eggs and fish. Future research should investigate the effectiveness of specific dietary interventions and nutrient supplementation in reducing anaemia among adolescent girls. In-depth qualitative studies are also needed to understand and appreciate the factors that influence dietary choices and behaviours among adolescent girls. More studies that comprehensively investigate the influencing factors of dietary choices, the costs and accessibility of nutritious food and the prevalence of parasitic infections might also help in decision making and policy interventions.

7. References

1.   United Nations. World population prospects 2019. Population Division. 2019.

2.   Ismail A, Darling AM, Mosha D, Fawzi W, Sudfeld C, Sando MM, et al. Prevalence and risk factors associated with malnutrition among adolescents in rural Tanzania. Tropical Medicine & International Health. 2020;25(1):89-100.

3.   Hadush G, Seid O, Wuneh AG. Assessment of nutritional status and associated factors among adolescent girls in Afar, Northeastern Ethiopia: a cross-sectional study. Journal of Health, Population and Nutrition. 2021;40(1):2.

4.   Gebregyorgis T, Tadesse T, Atenafu A. Prevalence of Thinness and Stunting and Associated Factors among Adolescent School Girls in Adwa Town, North Ethiopia. International Journal of Food Science. 2016;2016:8323982.

5.   Weiss HA, Ferrand RA. Improving adolescent health: an evidence-based call to action. The Lancet. 2019;393(10176):1073-5.

6.   Ruel M. Is dietary diversity an indicator of food security or dietary quality? 2002.

7.   Li S, Zhao L, Yu D, Ren H. Attention Should Be Paid to Adolescent Girl Anemia in China: Based on China Nutrition and Health Surveillance (2015–2017). Nutrients. 2022;14(12):2449.

8.   Stevens GA, Finucane MM, De-Regil LM, Paciorek CJ, Flaxman SR, Branca F, et al. Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data. The Lancet Global Health. 2013;1(1):e16-e25.

9.   Dreyfuss ML, Stoltzfus RJ, Shrestha JB, Pradhan EK, LeClerq SC, Khatry SK, et al. Hookworms, malaria and vitamin A deficiency contribute to anemia and iron deficiency among pregnant women in the plains of Nepal. J Nutr. 2000;130(10):2527-36.

10.   Kounnavong S, Vonglokham M, Kounnavong T, Kwadwo DD, Essink DR. Anaemia among adolescents: assessing a public health concern in Lao PDR. Glob Health Action. 2020;13(sup2):1786997.

11.   Kumar A, Goyal A, Verma N, Mahesh A. Study of anemia among adolescent schoolgirls and young adults. International Journal of Advances in Medicine. 2018.

12.   Kurz KM. Adolescent nutritional status in developing countries. Proc Nutr Soc. 1996;55(1b):321-31.

13.   Partap U, Tadesse AW, Shinde S, Sherfi H, Mank I, Mwanyika-Sando M, et al. Burden and determinants of anaemia among in-school young adolescents in Ethiopia, Sudan and Tanzania. Maternal & Child Nutrition. 2023.

14.   Sunguya BF, Ge Y, Mlunde L, Mpembeni R, Leyna G, Huang J. High burden of anemia among pregnant women in Tanzania: a call to address its determinants. Nutrition Journal. 2021;20(1).

15.   Chaparro CM, Suchdev PS. Anemia epidemiology, pathophysiology, and etiology in low- and middle-income countries. Ann N Y Acad Sci. 2019;1450(1):15-31.

16. Engidaw MT, Wassie MM, Teferra AS. Anemia and associated factors among adolescent girls living in Aw-Barre refugee camp, Somali regional state, Southeast Ethiopia. PLOS ONE. 2018;13(10):e0205381.

17. Balarajan Y, Ramakrishnan U, Özaltin E, Shankar AH, Subramanian S. Anaemia in low-income and middle-income countries. The lancet. 2011;378(9809):2123-35.

18. Warner MJ, Kamran MT. Iron Deficiency Anemia. StatPearls. Treasure Island (FL): StatPearls Publishing

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19. Chaparro CM , World Health Organization (WHO). Anemia among adolescent and young adult women in Latin America and the Caribbean: A cause for concern. Pan American Health Organization

20. Stabell N, Averina M, Flægstad T. Chronic iron deficiency and anaemia were highly prevalent in a population-based longitudinal study among adolescent girls. Acta Paediatrica. 2021;110(10):2842-9.

21. Dugdale M. Anemia. Obstetrics and gynecology clinics of North America. 2001;28(2):363-82.

22. Safiri S, Kolahi A-A, Noori M, Nejadghaderi SA, Karamzad N, Bragazzi NL, et al. Burden of anemia and its underlying causes in 204 countries and territories, 1990–2019: results from the Global Burden of Disease Study 2019. Journal of hematology & oncology. 2021;14:1-16.

23. Endale F, Woldeyohannes D, Belayneh F, Tamene A, Habte A, Gizachew A, et al. Menstrual abnormality, maternal illiteracy, and household factors as main predictors of anemia among adolescent girls in Ethiopia: Systematic review and meta-analysis. Women's Health. 2022;18:17455057221129398.

24. Nelson M, Bakaliou F, Trivedi A. Iron-deficiency anaemia and physical performance in adolescent girls from different ethnic backgrounds. British Journal of Nutrition. 1994;72(3):427-33.

25. Chandrakumari AS, Sinha P, Singaravelu S, Jaikumar S. Prevalence of Anemia Among Adolescent Girls in a Rural Area of Tamil Nadu, India. J Family Med Prim Care. 2019;8(4):1414-7.

26. Salam RA, Hooda M, Das JK, Arshad A, Lassi ZS, Middleton P, et al. Interventions to improve adolescent nutrition: a systematic review and meta-analysis. Journal of Adolescent Health. 2016;59(4):S29-S39.

27. Yusufu I, Cliffer IR, Yussuf MH, Anthony C, Mapendo F, Abdulla S, et al. Factors associated with anemia among school-going adolescents aged 10–17 years in Zanzibar, Tanzania: a cross sectional study. BMC Public Health. 2023;23(1):1814.

28. Işık Balcı Y, Karabulut A, Gürses D, Ethem Çövüt I. Prevalence and Risk Factors of Anemia among Adolescents in Denizli, Turkey. Iran J Pediatr. 2012;22(1):77-81.

29. Dalky HF, Al Momani MH, Al-Drabaah TK, Jarrah S. Eating Habits and Associated Factors Among Adolescent Students in Jordan. Clinical Nursing Research. 2017;26(4):538-52.

30.   Shaka MF, Wondimagegne YA. Anemia, a moderate public health concern among adolescents in South Ethiopia. PLOS ONE. 2018;13(7):e0191467.

31.   Yip R. Iron deficiency: contemporary scientific issues and international programmatic approaches. J Nutr. 1994;124(8 Suppl):1479s-90s.

32.   Sari P, Herawati DMD, Dhamayanti M, Hilmanto D. Anemia among Adolescent Girls in West Java, Indonesia: Related Factors and Consequences on the Quality of Life. Nutrients. 2022;14(18):3777.

33.   Saha S, Pandya A, Raval D, Saxena D, Patil MS. Malnutrition in Devbhumi Dwarka: A Situation Analysis. Cureus. 2022.

34.   Bhutta ZA, Lassi ZS, Bergeron G, Koletzko B, Salam R, Diaz A, et al. Delivering an action agenda for nutrition interventions addressing adolescent girls and young women: priorities for implementation and research. Annals of the New York Academy of Sciences. 2017;1393(1):61-71.

35.   Keats E, Rappaport A, Shah S, Oh C, Jain R, Bhutta Z. The Dietary Intake and Practices of Adolescent Girls in Low- and Middle-Income Countries: A Systematic Review. Nutrients. 2018;10(12):1978.

36.   Madzorera I, Bromage S, Mwanyika-Sando M, Vandormael A, Sherfi H, Worku A, et al. Dietary intake and quality for young adolescents in sub-Saharan Africa: Status and influencing factors. Maternal & Child Nutrition. 2023.

37.   Popkin BM, Corvalan C, Grummer-Strawn LM. Dynamics of the double burden of malnutrition and the changing nutrition reality. Lancet. 2020;395(10217):65-74.

38.   de Andrade SC, de Azevedo Barros MB, Carandina L, Goldbaum M, Cesar CL, Fisberg RM. Dietary quality index and associated factors among adolescents of the state of Sao Paulo, Brazil. J Pediatr. 2010;156(3):456-60.

39.   Troiano RP, Briefel RR, Carroll MD, Bialostosky K. Energy and fat intakes of children and adolescents in the United States: data from the national health and nutrition examination surveys. Am J Clin Nutr. 2000;72(5 Suppl):1343s-53s.

40.   Said FA, Khamis AG, Salmin AH, Msellem SN, Mdachi K, Noor R, et al. Influence of diet quality on nutritional status of school-aged children and adolescents in Zanzibar, Tanzania. PLoS One. 2023;18(10):e0293316.

41.   Nicholaus C, Martin H, Kassim N, Matemu A, Kimiywe J. Dietary Practices, Nutrient Adequacy, and Nutrition Status among Adolescents in Boarding High Schools in the Kilimanjaro Region, Tanzania. Journal of Nutrition and Metabolism. 2020;2020:1-14.

42.   Yiga P, Seghers J, Ogwok P, Matthys C. Determinants of dietary and physical activity behaviours among women of reproductive age in urban sub-Saharan Africa: a systematic review. British Journal of Nutrition. 2020;124(8):761-72.

43.   Beaulac J, Kristjansson E, Cummins S. A systematic review of food deserts, 1966-2007. Prev Chronic Dis. 2009;6(3):A105.

44.   Van Zyl M, Steyn N, Marais M. Characteristics and factors influencing fast food intake of young adult consumers in Johannesburg, South Africa. South African Journal of Clinical Nutrition. 2010;23(3):124-30.

45.	Madjdian DS, Azupogo F, Osendarp SJ, Bras H, Brouwer ID. Socio-cultural and economic determinants and consequences of adolescent undernutrition and micronutrient deficiencies in LLMICs: a systematic narrative review. Annals of the New York Academy of Sciences. 2018;1416(1):117-39.

46.	Verstraeten R, Leroy JL, Pieniak Z, Ochoa-Avilès A, Holdsworth M, Verbeke W, et al. Individual and Environmental Factors Influencing Adolescents' Dietary Behavior in Low- and Middle-Income Settings. PLoS One. 2016;11(7):e0157744.

47.	Ganasegeran K, Al-Dubai SA, Qureshi AM, Al-Abed A-AA, Am R, Aljunid SM. Social and psychological factors affecting eating habits among university students in a Malaysian medical school: a cross-sectional study. Nutrition Journal. 2012;11(1):48.

48.	Barker DJ, Osmond C. Infant mortality, childhood nutrition, and ischaemic heart disease in England and Wales. Lancet. 1986;1(8489):1077-81.

49.	Ayal BG, Demilew YM, Derseh HA, Kidie AA. Micronutrient intake and associated factors among school adolescent girls in Meshenti Town, Bahir Dar City Administration, Northwest Ethiopia, 2020. PLoS One. 2022;17(11):e0277263.

50.	Mulugeta A, Hagos F, Stoecker B, Kruseman G, Linderhof V, Abraha Z, et al. Nutritional Status of Adolescent Girls from Rural Communities of Tigray, Northern Ethiopia. Ethiopian Journal of Health Development. 2009;23(1):5-11.

51.	Mishra AS, Lakhera PC, Pandey A. Assessment of nutritional anemia on the basis of dietary pattern estimation among the population of Garhwal Himalayan region. J Family Med Prim Care. 2021;10(2):669-74.

52.	Agustina R, Nadiya K, Andini EA, Setianingsih AA, Sadariskar AA, Prafiantini E, et al. Associations of meal patterning, dietary quality and diversity with anemia and overweight-obesity among Indonesian school-going adolescent girls in West Java. PLOS ONE. 2020;15(4):e0231519.

53.	Leech RM, Worsley A, Timperio A, McNaughton SA. Understanding meal patterns: definitions, methodology and impact on nutrient intake and diet quality. Nutrition Research Reviews. 2015;28(1):1-21.

54.	Cobiac L, Baghurst K. Iron status and dietary iron intakes of Australians. 1993.

55.	Choudhary A, Moses PD, Mony P, Mathai M. Prevalence of anaemia among adolescent girls in the urban slums of Vellore, south India. Tropical Doctor. 2006;36(3):167-9.

56.	Alaofe H, Zee J, O'Brien HT. Dietary iron and iron deficiency anemia among adolescent girls from Benin. Revue D Epidemiologie Et De Sante Publique. 2007;55(3):187-96.

57.	Partap U, Tadesse AW, Shinde S, Sherfi H, Mank I, Mwanyika-Sando M, et al. Burden and determinants of anaemia among in-school young adolescents in Ethiopia, Sudan and Tanzania. Maternal & Child Nutrition.n/a(n/a):e13439.

58.	UNICEF. UNICEF; 2019 [Available from: https://www.unicef.org/tanzania/stories/tanzanias-most-vulnerable-adolescents.

59.	Review WP. World Population Review: World Population Review; 2023 [Available from: https://worldpopulationreview.com/world-cities/dar-es-salaam-population.

60.   The United Republic of Tanzania (URT) MoFaP, Tanzania, National Bureau of Statistics and President's Office - Finance and Planning Oot, Chief Government Statistician Z. The 2022 Population and Housing Census:

Administrative Units Population Distribution Report; Tanzania, December 2022. In: Ministry of Finance and Planning T, National Bureau of Statistics and President's Office - Finance and Planning Oot, Chief Government Statistician Z, editors. Tanzania2022. p. 83-8.

61.   Lukmanji Z, Hertzmark E, Mlingi N, Assey V, Ndossi G, Fawzi W. Tanzania Food ComposiTion Tables Compiled by. Dar es Salaam: Muhimbili University of Health and Allied Sciences (MUHAS)/Harvard School of Public Health (HSPH). 2008.

62.   Bromage S, Batis C, Bhupathiraju SN, Fawzi WW, Fung TT, Li Y, et al. Development and Validation of a Novel Food-Based Global Diet Quality Score (GDQS). J Nutr. 2021;151(12 Suppl 2):75s-92s.

63.   Quintana Pacheco DA, Sookthai D, Wittenbecher C, Graf ME, Schübel R, Johnson T, et al. Red meat consumption and risk of cardiovascular diseases—is increased iron load a possible link?1. The American Journal of Clinical Nutrition. 2018;107(1):113-9.

64.   Mutwiri LN, Kyallo F, Kiage B, Van der Schueren B, Matthys C. Can Improved Legume Varieties Optimize Iron Status in Low- and Middle-Income Countries? A Systematic Review. Adv Nutr. 2020;11(5):1315-24.

65.   Maphosa Y, Jideani VA. The role of legumes in human nutrition. Functional food-improve health through adequate food. 2017;1:13.

66.   Craike M, Young JA, Symons CM, Pain MD, Harvey JT, Eime RM, et al. Trends in body image of adolescent females in metropolitan and non-metropolitan regions: a longitudinal study. BMC Public Health. 2016;16:1-9.

67.   Yiga P, Seghers J, Ogwok P, Matthys C. Determinants of dietary and physical activity behaviours among women of reproductive age in urban sub-Saharan Africa: a systematic review. Br J Nutr. 2020;124(8):761-72.

68.   Olumakaiye MF. Adolescent Girls With Low Dietary Diversity Score Are Predisposed to Iron Deficiency in Southwestern Nigeria. ICAN: Infant, Child, & Adolescent Nutrition. 2013;5(2):85-91.

69.   Mazhar S. Prevalence of anemia and dietary iron intake among female adolescents (grade 8-12) in Lahore. Journal of the Dow University of Health Sciences (JDUHS). 2015;9(3):99-105.

70.   Gonete KA, Tariku A, Wami SD, Derso T. Prevalence and associated factors of anemia among adolescent girls attending high schools in Dembia District, Northwest Ethiopia, 2017. Archives of Public Health. 2018;76:1-9.

71.   Nelima D. Prevalence and determinants of Anaemia among adolescent girls in secondary schools in Yala division Siaya District, Kenya. Universal Journal of Food and Nutrition Science. 2015;3(1):1-9.

72.   Regasa RT, Haidar JA. Anemia and its determinant of in-school adolescent girls from rural Ethiopia: a school based cross-sectional study. BMC Women's Health. 2019;19(1):98.

73.   Sunguya BF, Ge Y, Mlunde L, Mpembeni R, Leyna G, Huang J. High burden of anemia among pregnant women in Tanzania: a call to address its determinants. Nutrition Journal. 2021;20(1):65.

74.   Cliffer IR, Yussuf MH, Millogo O, Mwanyika-Sando M, Barry Y, Yusufu IS, et al. Scaling-up high-impact micronutrient supplementation interventions to improve adolescents' nutrition and health in Burkina Faso and Tanzania: protocol for a cluster-randomised controlled trial. BMJ Open. 2023;13(2):e063686.

75.   Fernández-Gaxiola AC, De-Regil LM. Intermittent iron supplementation for reducing anaemia and its associated impairments in adolescent and adult menstruating women. Cochrane Database Syst Rev. 2019;1(1):Cd009218.

76.   Bahati Y, Nyanza EC, Asori M, Mutayoba R, Thomas DSK. Influence of intermittent iron and folic acid supplementation on cognitive abilities among adolescent girls in northwestern Tanzania. PLOS Glob Public Health. 2023;3(10):e0002079.

77.   Jolly SP, Roy Chowdhury T, Sarker TT, Afsana K. Water, sanitation and hygiene (WASH) practices and deworming improve nutritional status and anemia of unmarried adolescent girls in rural Bangladesh. Journal of Health, Population and Nutrition. 2023;42(1):127.

78.   Wang D, Katalambula LK, Modest AR, Ismail A, Malero A, Bray D, et al. Meals, Education, and Gardens for In-School Adolescents: A Cluster Randomized Trial of an Adolescent Nutrition Intervention Package in Tanzania. Journal of Adolescent Health. 2024.

79.   Javali SB, Pandit PV. A comparison of ordinal regression models in an analysis of factors associated with periodontal disease. J Indian Soc Periodontol. 2010;14(3):155-9.

ANNEXES

Annex 1: REK Ethical Approval

Anne Hatløy

Prosjektsøknad: Ernæring blant ungdom i Dar es Salaam, Tanzania
Søknadsnummer: 614998
Forskningsansvarlig institusjon: Universitetet i Bergen

Prosjektsøknad godkjennes

Søkers beskrivelse

The goal of this project is to assess the prevalence and determinants of malnutrition among adolescents in Dar-es-Salaam, Tanzania. Adolescents are a critical age group for nutrition interventions, as they experience rapid growth and development that increases their nutritional needs. However, they are often overlooked in nutrition programs and policies in Tanzania, where the focus is primarily on maternal and child nutrition. This study will use an analytical cross-sectional design to collect data on adolescents' health, and dietary practices, and measure their weight, height, and Hemoglobin levels to assess anaemia through a fingerpick blood test. All blood samples will be discarded after the tests. The findings from this study will inform the development of targeted nutritional interventions to improve the growth and nutrition of adolescents in urban areas of Tanzania, which is essential for their future well-being.

Vi viser til tilbakemelding mottatt 05.07.2023, i forbindelse med ovennevnte forskningsprosjekt. Tilbakemeldingen er behandlet av leder for REK vest på delegert fullmakt fra komiteen, med hjemmel i forskningsetikkforskriften § 7, første ledd, tredje punktum. Vurderingen er gjort med hjemmel i helseforskningsloven § 10.

REKs vurdering
Ønsket tilbakemelding:
REK vest ba om tilbakemelding på følgende:

- Hvordan vil prosjektgruppen håndtere opplysninger om daglig inntak av alkohol og /eller *khat*?
- Hvordan vil prosjektgruppen håndtere forespørsel fra foreldrene om innsyn i sensitive selvrapporterte opplysninger fra ungdommen?
- Lokal etisk godkjenning må ettersendes så snart den foreligger.
- Et eget samtykkeskriv til ungdommer over 16 år som kan samtykke selv må utarbeides.

Tilbakemelding:
Prosjektleder har gitt tilbakemelding på alle ovennevnte punkter. Lokal etikkgodkjenning er også mottatt per e-post den 12.07.2023.

Vurdering:
REK vest har ingen ytterligere merknader til søknaden. Prosjektet er forsvarlig organisert i sin nåværende form.

Vedtak
REK vest godkjenner prosjektet i samsvar med forelagt søknad og tilbakemelding, med hjemmel i helseforskningsloven § 10.

Sluttmelding
Prosjektleder skal sende sluttmelding til REK på eget skjema via REK-portalen senest 6 måneder etter sluttdato 31.12.2025, jf. helseforskningsloven § 12. Dersom prosjektet ikke starter opp eller gjennomføres meldes dette også via skjemaet for sluttmelding.

Søknad om endring
Dersom man ønsker å foreta vesentlige endringer i formål, metode, tidsløp eller organisering må prosjektleder sende søknad om endring via portalen på eget skjema til REK, jf. helseforskningsloven § 11.

Klageadgang
Du kan klage på REKs vedtak, jf. forvaltningsloven § 28 flg. Klagen sendes på eget skjema via REK portalen. Klagefristen er tre uker fra du mottar dette brevet. Dersom REK opprettholder vedtaket, sender REK klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag (NEM) for endelig vurdering, jf. forskningsetikkloven § 10 og helseforskningsloven § 10.

Med vennlig hilsen
Nina Langeland
Prof. dr. med.
Komiteleder

Fredrik Rongved
seniorrådgiver

Kopi til:
Universitetet i Bergen
Anne Berit Kolmannskog, Josephine Efraim Massawe, Nancy Njenge, Christina Judathadei Kimaryo, Nancy Njenge

Annex 2 : NIMR Ethical Approval

THE UNITED REPUBLIC
OF TANZANIA

National Institute for Medical Research
3 Barack Obama Drive
P.O. Box 9653
11101 Dar es Salaam
Tel: 255 22 2121400
Fax: 255 22 2121360
E-mail: ethics@nimr.or.tz

NIMR/HQ/R.8a/Vol.IX/4415

Ms. Josephine Efraim Massawe
Muhimbili University of Health and Allied Sciences
P O Box 65001
Dar es Salaam

Permanent Secretary
Ministry of Health
Government City Mtumba
Health Road
P.O. Box 743
40478 Dodoma

31 August 2023

RE: ETHICAL CLEARANCE CERTIFICATE FOR CONDUCTING
MEDICAL RESEARCH IN TANZANIA

This is to certify that the research protocol entitled "**The triple burden of malnutrition among adolescents in Dar es Salaam, Tanzania. What is the magnitude and associated factors?**" (Massawe, J. *et al*) has been granted ethical clearance to be conducted in Tanzania.

The Principal Investigator of the study must ensure that the following conditions are fulfilled:

1. Progress reports are submitted to the Ministry of Health and the National Institute for Medical Research, Regional and District Medical Officers after every six months.
2. Permission to publish the results is obtained from the National Institute for Medical Research.
3. Copies of final publications are made available to the Ministry of Health and the National Institute for Medical Research.
4. Any researcher, who contravenes or fails to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine as per NIMR Act No. 23 of 1979, PART III Section 10(2).
5. Sites: Dar es Salaam region.

Approval is valid for one year: 31 August 2023 to 30 August 2024

Name: **Prof. Said S. Aboud**

Signature
**CHAIRPERSON
MEDICAL RESEARCH
COORDINATING COMMITTEE**

c.c: Director, Health Services-TAMISEMI, Dodoma.
    RMO of Dar es Salaam region.
    DMOs/DEDs of respective districts.

Name: **Prof. Tumaini J. Nagu**

Signature
**CHIEF MEDICAL OFFICER
MINISTRY OF HEALTH**

49

Annex 3 : MUHAS Ethical Approval

UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

OFFICE OF THE DIRECTOR – RESEARCH, PUBLICATIONS

AND INNOVATION

Ref. No.DA.282/298/01.C/1790   Date: 07/07/2023

MUHAS-REC-07-2023-1790
ANNE HALTØY
SCHOOL OF PUBLIC HEALTH AND SOCIAL SCIENCES
MUHAS

RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED:
TRIPLEBURDEN OF MALNUTRITION AND ASSOCIATED FACTORS AMONG
ADOLESCENTS IN DAR-ES-SALAAM TANZANIA

Reference is made to the above heading,

I am pleased to inform you that the Chairperson has on behalf of the University
Senate, approved ethical clearance of the above-mentioned study, on
recommendations of the Senate Research and Publications Committee meeting
accordance with MUHAS research policy and Tanzania regulations governing
human and animal subjects research.

APPROVAL DATE: 07/07/2023
EXPIRATION DATE OF APPROVAL: 07/07/2024

STUDY DESCRIPTION:
Purpose:
The purpose of this cross sectional study is to assess the prevalence and factors
associated with malnutrition among adolescents in Dar-es-Salaam, Tanzania.

The approved protocol and procedures for this study is attached and stamped with
this letter, and can be found in the link provided:
https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%2014835.pdf and in
the MUHAS archives.

The PI is required to:

1. Submit bi-annual progress reports and final report upon completion of the study.

2. Report to the IRB any unanticipated problem involving risks to subjects or others including adverse events where applicable.

3. Apply for renewal of approval of ethical clearance one (1) month prior its expiration if the study is not completed at the end of this ethical approval. You may not continue with any research activity beyond the expiration date without the approval of the IRB. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.

4. Obtain IRB amendment (s) approval for any changes to any aspect of this study before they can be implemented.

5. Data security is ultimately the responsibility of the investigator.

6. Apply for and obtain data transfer agreement (DTA) from NIMR if data will be transferred to a foreign country.
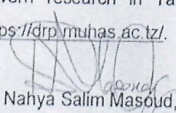
7. Apply for and obtain material transfer agreement (MTA) from NIMR, if research materials (samples) will be shipped to a foreign country,

8. Any researcher, who contravenes or fail to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine as per NIMR Act No. 23 of 1979, PART III section 10 (2)

9. The PI is required to ensure that the findings of the study are disseminated to relevant stake holders.

10. PI is required to be versed with necessary laws and regulatory policies that govern research in Tanzania. Same guidance is available on our website https://drp.muhas.ac.tz/.

Dr. Nahya Salim Masoud,

Chairperson, MUHAS Research and Ethics Committee

DIRECTOR
Research,
Publications &
Innovations
Box 65001

51

Annex 4 : Local Authorities Approval

JAMHURI YA MUUNGANO WA TANZANIA

OFISI YA RAIS
TAWALA ZA MIKOA NA SERIKALI ZA MITAA

Anuani ya Simu "TAMISEMI" DODOMA
Simu Na: +255 26 2321607
Nukushi: +255 26 2322116
Barua pepe:ps@tamisemi.go.tz

Mji wa Serikali – Mtumba,
Mtaa wa TAMISEMI,
S.L.P. 1923,
41185 DODOMA.

Unapojibu tafadhali taja:-
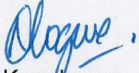
Kumb. Na. AB. 307/223/01   28/08/2023

Katibu Tawala wa Mkoa,
Ofisi ya Mkuu wa Mkoa,
S.L.P 5429,
DAR ES SALAAM.

Yah. **UTAMBULISHO WA UTAFITI UNAOTATHMINI UKUBWA NA VISABABISHI
VYA TATIZO LA UTAPIAMLO MIONGONI MWA VIJANA BALEHE WALIO
KATIKA UMRI WA MIAKA 12-19, JIJINI DAR ES SALAAM**

Tafadhali husika na somo tajwa hapo juu,

2.   Bi. Christina Kimaryo na Bi. Josephine Efraim ni wanafunzi wa Shahada ya
udhamili katika Chuo Kikuu cha Bergen, nchini Norway, ambao kama sehemu ya
ukamilishaji wa masomo yao wamepanga kufanya utafiti wenye lengo la kutathmini
ukubwa na sababu zinazochangia tatizo la utapiamlo miongoni mwa vijana walio katika
umri wa miaka 12-19, Dar es Salaam Tanzania.

3.   Utafiti huu hapa nchini utasimamiwa na Professa Bruno Sunguya kutoka Chuo
Kikuu cha afya na sayansi shirikishi Muhimbili (MUHAS). Utafiti umepata kibali Na.
MUHAS-REC-07-2023-1790 cha tarehe 07/07/2023 kitachoisha muda wake tarehe
07/07/2024 kutoka kamati ya Utafiti na Maadili ya MUHAS.

4.   Kwa barua hii, naomba kutoa taarifa ya uwepo wa utafiti huu kwa ajili ya kutoa
ushirikiano stahiki kwa watafiti ikiwa ni pamoja na kuwataarifu Wakurugenzi wa
Halmashauri zilizo chini ya mamlaka yako. Pamoja na barua hii, nimeambatisha nakala
ya cheti cha maadili tajwa hapo juu.

5.   Ninakushukuru kwa ushirikiano wako.

Dkt. N. A. Kapologwe
Kny: **KATIBU MKUU**

Nakala: Bi. Josephine Efraim,
MUHAS,
S.L.P 65001,
DAR ES SALAAM

Annex 5 : Questionnaires.

HOUSEHOLD QUESTIONAIRRE

HOUSEHOLD CHARACTERISTICS

L0. Interview date	|__|__|/|__|__|/2023
L1. Name of field interviewer	
L2. Ward name	
L3. Cluster number	
L4. Household Number	……………………………
L5. GPS	
L6. Household size ***How many adults and children are living in the household***	
DETAILS OF THE RESPONDENT **(ANY ADULT LIVING IN THE HOUSEHOLD)**	
L7. Are you the head of the household?	0. No 1. Yes
L8. Your age	
L9. Your Gender:	0. Male 1. Female
L10. Marital status	1. Single 2. Cohabit 3. Married 4. Divorced 5. Widow/Widower 6. No answer
L11. What is your relationship to the selected adolescent?	1. Parent 2. Older sibling 3. Relative 4. Adopted/non relative 5. The selected Adolescent is Head of HH 6. Housemaid
L12. What is the main economic activity of household head	1. Formal employment 2. Informal employment 3. Self-employed 4. Unemployed 5. Don't Know 6. No answer
L13. What is the highest level of education achieved by the head of the household	1. No Formal Education 2. Primary completed 3. Secondary completed. 4. College/University 5.Vocational training 8. Do not know 9. No answer
DESCRIPTION OF THE DWELLING	

A1. What is the MAIN material of the walls (in the main living area where the family spends the most time)?
    Only One Response Allowed
    Observe Main Material of The Floor of The Dwelling.
    Record Observation.
	1. Brick/cement block
	2. Traditional material/mud
	3. Wood
	4. Corrugated Iron
	5. Other (mention)

A2. What is the MAIN material of the floors (in the main living room where the family spends the most time)? ***Only One Response Allowed*** ***Observe Main Material of The Floor of The Dwelling.*** ***Record Observation.***	1. Cement 2. Carpet 3. Dung 4. Normal Wood 5. Sand/Mud 6. Plastic 7. Bamboo 8. Polished wood 9. Tiles 10. Other If other, mention
A3. What is the main material of the roof (in the main living area where the family spends the most time)? ***Only one response allowed.*** ***Observe main material of the roof of the dwelling.*** ***Record observation.***	1. No roof 2. Shrubs/Grass 3. Corrugated Iron 4. Mud 5. Bamboo 6. Normal wood 7. Polished wood 8. Cement 9. Makuti 10.Other If other mention
A4. What is the primary source of drinking water for your household? ***Should be the most commonly used source of drinking water.*** ***Record observation.***	1. Piped – Inside the house. 2. Piped – Outside but in own yard. 3. Closed well 4.Open well 5. Piped – public tap. 6. River water/dam/lake/pond 7. Tank water 8. Closed Spring surface water 9.Open Spring surface water 10. Borehole 11. Rain water 12. Tanker truck 13. Other If other mention
A5. What type of toilet facility does your household typically use? ***Only one response allowed***	1. Flush toilet inside the house 2. Flush toilet outside the house 3. Ventilated pit latrine 4. Pit latrine 5. Bucket toilet 6. Bush/veld / no toilet 7. Other (mention)
A6. Is the toilet shared with other households?	0. No 1. Yes 2. Don't know 3. No answer
A7. How many households share the toilet?	……………… households
A8. What type of fuel or energy source is most often used for cooking in the household? ***Only One Response Allowed*** ***Observe Main Material of The Floor of The Dwelling.***	1.Electricity 2. Gas 3.Charcoal 4.Wood 5.Alcohol/Ethanol

Record Observation.	6.Gasoline/Diesel 7.Kerosene/Paraffin 8.Coal/Lignite 9.Charcoal 10.Agricultural crop animal dung/ waste 11.Garbage/plastic 12.Other (go to A8a)
A8a. Specify the energy source that is most often used for cooking in the household.	_____
A9. How many rooms in this household are used for sleeping?	__|__|__|_____
A10. Does any relative send money from abroad?	0. No 1. Yes 2. Don't Know 3. No answer
Does anyone in your household have the following items (working):	
A11. Electricity	0. No 1. Yes 2. Do not Know 3. No answer
A12. Radio	0.No 1. Yes 2. Do not Know 3. No answer
A13. Television	0.No 1. Yes 2. Do not Know 3. No answer
A14. Computer	0.No 1. Yes 2. Do not Know 3. No answer
A15. Telephone (non- mobile)	0.No 1. Yes 2. Do not Know 3. No answer
A16. Refrigerator	0.No 1. Yes 2. Do not Know 3. No answer
A17. Oven	0.No 1. Yes 2. Do not Know 3. No answer
A18. Microwave	0.No 1. Yes 2. Do not Know 3. No answer
A19. Iron	0.No 1. Yes 2. Do not Know 3. No answer
A20. Watch	0.No 1. Yes 2. Do not Know 3. No answer
A21. Mobile telephone	0.No 1. Yes 2. Do not Know 3. No answer
A22. Bicycle	0.No 1. Yes 2. Do not Know 3. No answer
A23. Motorcycle	0.No 1. Yes 2. Do not Know 3. No answer
A24. Car or truck	0.No 1. Yes 2. Do not Know 3. No answer
A25. Bank Account	0.No 1. Yes 2. Do not Know 3. No answer

Household Food Insecurity Access Scale (HFIAS)→ *To be completed by adult respondent*	
B1. Over the past 30 days, were you concerned that your household might not have sufficient food?	0. No → (Skip to question B2) 1. Yes 2. Don't Know 3. No answer
B1a. How often did this occur?	1. Often (more than ten times in the past 30 days) 2. Sometimes (three to ten times in the past 30 days) 3. Rarely (once or twice in the past 30 days)
B2. In the past 30 days, were you or any household members unable to eat preferred foods due to a lack of resources?	0. No → (Skip to question B3) 1. Yes 2. Don't Know 3. No answer
B2 a. How often did this occur?	1. Often (more than ten times in the past 30 days) 2. Sometimes (three to ten times in the past 30 days) 3. Rarely (once or twice in the past 30 days)
B3. In the past 30 days, were you or any household members forced to eat a limited variety of foods due to a lack of resources?	0. No → (Skip to question B4) 1. Yes 2. Don't know 3. No answer
B3a. How often did this occur?	1. Often (more than ten times in the past 30 days) 2. Sometimes (three to ten times in the past 30 days) 3. Rarely (once or twice in the past 30 days)
B4. In the past 30 days, were you or any household members compelled to eat foods you would rather not have eaten due to a lack of resources for other food types?	0. No → (Skip to question B5) 1. Yes 2. Don't Know 3. No answer
B4 a. How often did this occur?	1. Often (more than ten times in the past 30 days) 2. Sometimes (three to ten times in the past 30 days) 3. Rarely (once or twice in the past 30 days)
B5. In the past 30 days, were you or any household members obliged to eat smaller meals than needed because there was not enough food?	0. No → (Skip to question B6) 1. Yes 2. Don't Know 3. No answer
B5a. How often did this occur?	1. Often (more than ten times in the past 30 days) 2. Sometimes (three to ten times in the past 30 days) 3. Rarely (once or twice in the past 30 days)

B6. In the past 30 days, were you or any household members forced to eat fewer meals in a day due to a lack of food?	0. No → (Skip to question B7) 1. Yes 2. Don't Know 3. No answer
B6a. How often did this occur?	1. Often (more than ten times in the past 30 days) 2. Sometimes (three to ten times in the past 30 days) 3. Rarely (once or twice in the past 30 days)
B7. In the past 30 days, was there ever no food to eat of any kind in your household because of lack of resources to get food?	0. No (Skip to question B8) 1. Yes 2. Don't know 3. No answer
B7a. How often did this occur?	1. Often (more than ten times in the past 30 days) 2. Sometimes (three to ten times in the past 30 days) 3. Rarely (once or twice in the past 30 days)
B8. In the past 30 days, did you or any household member go to sleep at night hungry because there was not enough food?	0. No → (Skip to question B9) 1. Yes 2. Don't know 3. No answer
B8a. How often did this occur?	1. Often (more than ten times in the past 30 days) 2. Sometimes (three to ten times in the past 30 days) 3. Rarely (once or twice in the past 30 days)
B9. In the past 30 days, did you or any household members go an entire day and night without eating anything because there was not enough food?	0. No (Questionnaire is finished) 1. Yes 2. Don't Know 3. No answer
B9a. How often did this occur?	1. Often (more than ten times in the past 30 days) 2. Sometimes (three to ten times in the past 30 days) 3. Rarely (once or twice in the past 30 days)

INDIVIDUAL (ADOLESCENTS 12-19 YEARS)

DEMOGRAPHIC INFORMATION

C0a. Have you read, understood, and signed the consent/assent form?	0. No (ask them to read and sign) 1. Yes
C0b Household ID number	
C1. What is your gender?	0. Male 1. Female
C2. What is your date of birth? (dd/mm/yy)	|__|__|/|__|__|/20|__|__|
C2a. What is your age in years	
C3. What is your current marital status?	1. Single 2. Cohabit 4. Married 5. Widow/widower 6. Divorced 9. No answer
C4. Do you have children?	0. No 1. Yes
C5. What is your main activity during the day?	1. School → (Skip to question C6) 2. Work → (Skip to question C6) 3. Other → (Go to question C5a.)
C5a. Specify your main activity during the day.	_____
C6. Are you working for a living?	0. No (Skip to question C10) 1. Yes
C7. How are you compensated for your work?	1. Salary (from employer) 2. Own account (payment directly from customer) 3. Paid in kind→ (skip to question C10)

C8. How much do you get paid monthly? (In TZS)	1. less than 50,000 2. 50,000 to < 100,000 3. 100,000 to < 350,000 4. 350,000 to 500,000 5. More than 500,000 8. Do not know 9. No answer
C9. Who has the primary control about how you spend your income?	1. Yourself (adolescent) 2. Parent/guardian 3. Employer 4. Siblings (brother/sister) 5. Other → (Go to question C9a)
C9a. Please specify who has primary control about how you spend your income.	_____
C10. Have you ever attended school?	0. No → (skip to question C14) 1. Yes
C11. Are you currently attending school?	0. No 1. Yes → (Skip to question C13)
C12. What was the last grade you attended before leaving school? *Skip to C14*	1. Standard one 2. Standard two 3. Standard three 4. Standard four 5. Standard five 6. Standard six 7. Standard seven 8. Form I 9. Form II 10. Form III 11. Form IV 12. High/ advanced school 13. Vocational Technical School
C13. What is your current grade level? ***All skip to FFQ***	**1.** Standard one 2. Standard two 3. Standard three 4. Standard four 5. Standard five 6. Standard six 7. Standard seven 8. Form I

	9. Form II 10. Form III 11. Form IV 12. High/ advanced school 13. Vocational Technical School
C14. What are the reasons why you are not attending school? *(Read out the options to the participant and Tick all that apply)*	1. I don't know. 2. Pregnancy 3. Parental decision 4. Lack of School Contribution 5. Lack of uniform, school supplies 6. A school full/no place 7. Death of parent/guardian 8. Marriage 9. Adult in household sick/disabled. 10. I was ill/disabled. 11. I need to work. 12. School too far 13. Other→ (Go to question C14a)
C14a. Please specify the reasons you are not attending school.	_____

FOOD FREQUENCY QUESTIONNAIRE

In this section We're interested in understanding the variety and frequency of foods you've consumed during this period. Please take some time to reflect on your meals and try to recall them as accurately as possible.

In the last 7 days, how many times have you eaten the foods listed below?

Type of Food Cereal Based Dishes	1. Never	2. Once per week	3. 2-4 times a week	4. 5-6 times a week	5. Everyday
D1. Cassava	1	2	3	4	5
D2. Ugali	1	2	3	4	5
D3. Cooking banana	1	2	3	4	5
D4. Mixed Porridge flour	1	2	3	4	5
D5. Bread Roll	1	2	3	4	5
D6. Rice	1	2	3	4	5
D7. Boiled Corn	1	2	3	4	5
D8. Sweet potatoes	1	2	3	4	5
D9. Potatoes	1	2	3	4	5
D10. Yam	1	2	3	4	5
Meat/fish	1. Never	2. Once per week	3. 2-4 times a week	4. 5-6 times a week	5. Everyday
D11. Beef	1	2	3	4	5
D12. Beef Liver	1	2	3	4	5
D13. Goat meat	1	2	3	4	5
D14. Sheep	1	2	3	4	5
D15. Pork	1	2	3	4	5
D16. Rabbit	1	2	3	4	5
D17. Chicken/poultry	1	2	3	4	5
D18. Chicken Liver	1	2	3	4	5
D19. Small Dried Fish	1	2	3	4	5
D20. Fish	1	2	3	4	5
D21. Sea food (street food)	1	2	3	4	5
D22. Other meat/fish	1	2	3	4	5

D23. Milk	1	2	3	4	5
D24. Eggs	1	2	3	4	5
Green Leafy Vegetables	**1. Never**	**2. Once per week**	**3. 2-4 times a week**	**4. 5-6 times a week**	**5. Everyday**
D25. Spinach	1	2	3	4	5
D26. Broccoli	1	2	3	4	5
D27. Pumpkin Leaf	1	2	3	4	5
D28. Hare Lettuce	1	2	3	4	5
D29. Okra	1	2	3	4	5
D30.Taro leaf	1	2	3	4	5
D31.Other green leafy vegetables	1	2	3	4	5
D32. Cabbage	1	2	3	4	5
D33. Butternut	1	2	3	4	5
D34. Carrots	1	2	3	4	5
D35. Beetroot	1	2	3	4	5
Fruits	**1. Never**	**2. Once per week**	**3. 2-4 times a week**	**4. 5-6 times a week**	**5. Everyday**
D36. Avocado	1	2	3	4	5
D37. Oranges	1	2	3	4	5
D38. Banana	1	2	3	4	5
D39. Pineapples	1	2	3	4	5
D40. Baobab	1	2	3	4	5
D41. Mango	1	2	3	4	5
Legumes	**1. Never**	**2. Once per week**	**3. 2-4 times a week**	**4. 5-7 times a week**	**5. Once a day**
D42. Beans	1	2	3	4	5
D43. Soybean	1	2	3	4	5
D44. Lentils	1	2	3	4	5
D45. Cowpeas	1	2	3	4	5

D46. Chickpeas	1	2	3	4	5
D47. Pigeon peas	1	2	3	4	5
D48. Hyacinth Beans	1	2	3	4	5
Discretionary food items	**1.** **Never**	**2.** **Once per** **week**	**3.** **2-4 times a** **week**	**4.** **5-6 times a** **week**	**5.** **Everyday**
D49. Sweetened Beverages	1	2	3	4	5
D50. Salty Snacks (e.g., samosa, kebab, plantain chips)	1	2	3	4	5
D51 Sweet Snacks (e.g., chocolates, biscuits, cakes, sweets, ice cream)	1	2	3	4	5
D52. Pizza	1	2	3	4	5
D53. Burger	1	2	3	4	5
D54. Chips	1	2	3	4	5
D55.Fried chicken	1	2	3	4	5

SECTION E - SEDENTARY HABITS:

Most questions will ask you to think only about the LAST 7 DAYS, but a few questions will ask about what you typically do (during a normal week). THERE ARE NO RIGHT OR WRONG ANSWERS SO PROVIDE HONEST ANSWERS.

SEDENTARY HABITS refer to activities such as watching TV, or playing video games, computer games, or browsing the Internet or playing hand-held games. It includes time spent using a phone to talk or text with friends, play games.

On weekdays, (Monday – Friday)	
E1. How many days last week did you watch television?	1. I did not watch → (skip to question E2) 2. 1 day 3. 2 days 4. 3 days 5. 4 days 6. 5 days
E1a. On the days you watched, how long did you typically watch television each day?	1. Less than one hour 2. 1 to 2 hours 3. More than two hours
E2. How many days last week did you play video games, use a smartphone/iPad/computer for leisure activities e.g., social media and schoolwork?	1. I did not do this → (Skip to question E3) 2. 1 day 3. 2 days 4. 3 days 5. 4 days 6. 5 days

E2a. On the days you did this, how long did you typically spend on these activities each day?	1. Less than one hour 2. 1 to 2 hours 3. More than two hours
E3. How many days last week did you spend reading, sitting idly, talking, or playing games (like chess or cards) either alone or with friends/family?	1. I did not do this→ (skip to question E4) 2. 1 day 3. 2 days 4. 3 days 5. 4 days 6. 5 days
E3a. On the days you did this, how long did you typically spend on these activities each day?	1. Less than one hour 2. 1 to 2 hours 3. More than two hours
On weekends, (Saturday and Sunday)	
E5. How long did you spend watching television over the weekend?	1. I did not do this. 2. Less than one hour 3. 1 to 2 hours 4. More than two hours
E6. How long did you spend playing video games, using a computer/smartphone/iPad for leisure activities like social media and for schoolwork activities over the weekend?	1. I did not do this. 2. Less than one hour 3. 1 to 2 hours 4. More than two hours
E7. How long did you spend reading or just sitting, or playing games (like chess or playing cards) by yourself or with friends or family?	1. I did not do this 2. Less than one hour 2. 1 to 2 hours 3. More than 2 hours
E8. How long did you do homework?	1. I did not do this 2. Less than one hour 2. 1 to 2 hours 3. More than 2 hours

PHYSICAL ACTIVITY

This section asks about physical activities that is, any play, game, sport, exercise at home/ work or school (either during recess or after school), transportation (like walking or cycling to school or work) that gets you moving and breathing harder.

F1. In the past 7 days, have you play any kind of sport like football, cycling, basketball, skipping, running or participate in physical exercise like dancing, exercise classes or swimming?	0. No 1. Yes 2. No answer
F2. In the past 7 days, how many times have you played any sport like football, cycling, basketball, skipping, running or participate in physical exercise , like dancing, exercise classes or swimming	1. 1 day 2. 2 days 3. 3 days 4. 4 days 5. 5 days 6. 6 days 7. 7 days
F3. In the past 7 days have you walked or cycled to school or work?	0. No → (Skip to question F5) 1. Yes

	2. Don't know
	3. No answer
F4. How much time have you walked or cycled to reach to school or work? Includes both going to school and returning home.	1. 5 – 15 minutes 2. 16 – 30 minutes 3. 31 minutes to 1 hour 4. More than 1 hour
F5. On weekdays, when you wake up in the morning while you are at home do you normally do physical activities such as housework, gardening, fetching water etc before going to school for at least 30 minutes?	0. No 1. Yes 2. Don't know 3. No answer

FOOD ENVIRONMENT

G1. In the past month in your house, which foods and drinks were frequently available? (Available at least 3-4 days a week) *Please select all that apply*.	1. Fast foods bought from restaurants e.g.: chicken chips, samosas, kababs, sausages etc. 2. Fresh squeezed juice from fruits (home-made) 3. Sugary drinks such as sodas, artificial/ boxed juices (Azam, Fresh, Ceres, Juice cola etc) 4. Chocolates, sweets 5. Cakes, biscuits 6. Doughnuts, mandazi, chapati 7. Vegetables 8. Fruits 9. Milk and milk products (soured milk, fresh milk, yoghurt)
G2. Think about the local area around your home; which of the following is easily accessible (a walking distance) ? **Please select all that apply.**	1. Street vendors who sell fast foods such as bajia, samosas, chips mayai 2. Markets or local sellers who sell fruits and vegetables. 3. Take away restaurants.
G3. Over the past one month, have you eaten somewhere else apart from your home?	0. No → (skip questions 4,5 and 6) 1. Yes 2. No answer
G4. Where else have you eaten at? (Select all that apply)	1. School 2. Street vendor/ mama ntilie 3. At a neighbour's/ friend's hou 4. At a relative's house (grandparents/ aunt/uncle/siblings) 5. At a fast-food outlet 6. Other → (Go to question G4a.)

65

G4a. Please mention all the other places that you eat at	
G5. How many times in a week do you eat out of your home?	1. Once a week 2. 2-3 times 3. 4-5 times 4. 6-7 times 5. More than 7 times
G6. What do you usually eat out of your home? (Tick all that applies)	1. Fruits and vegetables 2. Rice/ ugali/ cassava/ chapati 3. Fast food like fried potatoes, pizzas, burgers, samosas, kebabs, sausages 4. Sugary drinks and snacks like cakes, sweets, sodas, or processed juice 5. Meat or milk.

HEALTH STATUS

H1. In general, how do you consider your health?	1. Poor 2. Fair 3. Good 4. Excellent 8. Do not know 9. No answer
H2. Do you have any chronic health condition or disability?	0. No → (Skip to question H4) 1. Yes → (Go to question H2a) 9. No answer
H2a. Mention your chronic health condition or disability	_____
H3. Are you currently attending clinic for the chronic health conditions?	0. No 1. Yes
H4. Are you taking any medication?	0. No (Skip to question 6) 1. Yes 9. No answer
H5. What is the name of the medication that you are taking?	0. Do not know Specify_____
H6. Have you ever been diagnosed of any mental illness?	0. No 1. Yes

We ask every participant these questions about things that can affect your health and well-being. Some of the questions might not fit you. It is okay to leave some questions blank. Please answer these questions on your own, without help from your parent or friends, and be as honest as possible. Your answers are private.

S/N		0. No	1. Yes	2. Some-times	8 DK
I1.	In general, are you happy with the way things are going for you?	0	1	2	8
I2.	Do you get along with your family?	0	1	2	8
I3.	Do you have at least one adult you can really talk to?	0	1	2	8
I4.	Do you ever have a problem of feeling down, depressed, or hopeless?	0	1	2	8
I5.	Do you ever feel anxious or worried for no good reason?	0	1	2	8
I6.	Do you ever feel bad about yourself or like you are not doing well?	0	1	2	8
I7.	Do you feel safe at home?	0	1	2	8
I8.	Do you feel safe at school?	0	1	2	8
I9.	Do you feel safe in your community?	0	1	2	8
I10.	Do you think you are about the right weight height?	0	1	2	8
I11.	Do you ever skip meals, use laxatives, or diet pills, or throw up on purpose to lose weight to control your weight?	0	1	2	8

BEHAVIOUR PRACTICES

How often have you used/done the following things during the last month?

	0 =Never	1=Rarely (1/2 times)	2=Sometimes (a few times)	3=Often (Several times)	4=Always (Almost every day)
J1. Cigarettes	0. Never	1. Rarely	2. Sometimes	3. Often	4. Always
J2. Chewing tobacco or snuff, *khat*	0. Never	1. Rarely	2. Sometimes	3. Often	4. Always
J3. Local brew, beer	0. Never	1. Rarely	2. Sometimes	3. Often	4. Always
J4. Imported beer, wine, spirits	0. Never	1. Rarely	2. Sometimes	3. Often	4. Always
J5. Unprotected sex	0. Never	1. Rarely	2. Sometimes	3. Often	4. Always

K20. Have you been diagnosed with malaria in the past 6 months or less?	0. No 1. Yes
K21. Have you had a fever in the past 7 days?	0. Yes 1. No

GIRLS ONLY

K1. How many times have you skipped breakfast in the past 7 days?	1. Zero times 2. 2 times 3. 3 times 4. 4 times 5. 5 times 6. 6 times 7. Everyday
K2. How often do you drink tea or coffee?	1. Less than once a day 2. 1-2 cups a day 3. 3-4 cups a day 4. More than 4 cups a day
K3. How often do you consume calcium-rich foods such as milk, cheese, and yogurt?	1. Daily 2. 2-3 times a week 3. Once a week 4. Rarely 5. Never
K4. How many times a week do you consume iron rich foods like such as meat, poultry, fish, beans, and leafy greens?	1. Never 2. Less than once a week 3. 1-2 times a week 4. 3-4 times a week 5. 5 or more times a week
K5. Are there any foods or food groups that you avoid due to cultural, religious, or personal beliefs or practices?	0. No 1. Yes
K5a. Which kind of foods do you avoid due to cultural, religious, or personal beliefs and practices	
K6. Are there any foods or food groups that you avoid due to influence from friends?	0. No (Skip to question K7) 1. Yes
K6a. What kind of foods do you avoid due to influence from friends?	

K7. Have you begun to menstruate or get you period?	0. No (Skip to K19) 1. Yes
K8. How old were you when you first menstruated or got your period?	_____years
K9. Do you experience regular menstrual cycles	0. No 1. Yes 2. I don't know
K10. How would you rate your menstrual flows	1. Heavy Bleeding 2. Moderate Bleeding 3. Light Bleeding
K11. How many days do you menstruate?	1. Less than 3 days 2. 3 – 5 days 3. More than 5 days
K12. Do you use any contraceptive pills or injections or medicines?	0. No 1. Yes 9. No answer
K13. Have you ever been pregnant or given birth?	0. No (Skip to question K19) 1. Yes
K14. What is your baby's date of birth ?	_____
K15. Are you breastfeeding?	0. No 1. Yes
K16. Did you have a caesarean or natural birth	1. Caesarean 2. Natural
K17. If so, did you experience any complications during your pregnancy or postpartum period?	0. No (Skip to question K19) 1. Yes
K18.What kind of complications?	1. Too much bleeding 2. Feeling really tired and weak 3.Trouble making milk for baby. 4. Felling dizzy or out of breath
K19. Have you ever had symptoms of anaemia like fatigue, weakness, and pale skin	0. No 1. Yes

MEASUREMENTS

Member ID:

Measure	1st reading	2nd reading
M1 Height (cm)	M1a. |__|__|__|	M1b. |__|__|__|
M2 Weight (kg)	M2a. |__|__|. |__|	M2b. |__|__|. |__|
M3 Haemoglobin (g/dl)	M3. |__|__|.|__|	

EXPLANATION OF QUESTIONS

QUESTIONS	PART
A1 – A11	Household Characteristics
B1- B9a	Household Food Insecurity Access Scale
C0-C14a	Individual Adolescent Information
D1- D45	Food Frequency Questionnaire
E1-E7	Sedentary Habits
F1- F6	Physical Activity
G1- G6	Food Environment
H1- H6	Health Status
I1- I11	General Well being
J1- J5	Behavioural Practices
K1- K21	Girls Questions
L1-L17	Introduction
M1-M3	Measurements

CONSENT AND ASSENT FORMS

PARENTAL CONSENT FORM

Consent To Participate in Structured Interviews

INFORMATION SHEET

STUDY TITLE: The triple burden of malnutrition among adolescents in Dar-es-salaam, Tanzania. What is the magnitude and associated factors?

RESEARCHERS STATEMENT:

You are asked to participate in a research study conducted by researchers from the University of Bergen, Norway. This study is funded by the NORPART project.

The purpose of this consent form is to give you the information you need to decide whether you wish to be part of the study or not. Your participation is voluntary. You may ask any questions about the purpose of the research, what happens if you participate, possible risks and benefits, your rights as a volunteer, and anything else about the research or this form that is not clear. When we have answered all your questions, you can decide if you want to participate in the study or not. This process is called "informed consent". Please take as much time as you need to read the consent form. You will be given a copy of this form.

WHO ARE WE?

We are researchers from the University of Bergen, Norway.

WHY IS THIS STUDY BEING DONE?

Malnutrition is detrimental to adolescents' current and future health, affecting their brain growth and functional capacity and increasing the risk of non-communicable diseases (NCDs) when older.

There is a paucity of information on the factors contributing to the malnutrition burden in adolescents in Dar-es-salaam and many nutritional interventions are targeting under-five and maternal nutrition leaving out this susceptible group.

Nonetheless, studies done in Dar-es-salaam have assessed malnutrition in school-going adolescents which are not representative of the whole adolescent population. Hence this study is a household survey to assess the magnitude of the co-existence of underweight, overweight/ obesity and nutritional anemia and the factors associated with that burden.

WHY ARE YOU BEING ASKED TO TAKE PART IN THE STUDY?

You are asked to participate in this study because you are the head of the household, in a selected household for the study.

HOW MANY PEOPLE WILL TAKE PART IN THIS STUDY?

We will ask 540 adolescents and their respective heads of households to participate in this study.

WHAT WILL HAPPEN IF YOU TAKE PART IN THIS RESEARCH STUDY?

If you agree to participate, we will ask you a series of questions relating to you and your household. We will explore different aspects of food habits and lifestyle. We will also measure the adolescent's weight and height and do a finger prick to obtain blood for anaemia screening.

HOW LONG WILL YOU BE IN THE STUDY?

The interview will take about 30-45 minutes.

ARE THERE ANY RISKS IN TAKING PART IN THIS STUDY?

There may be the potential for some questions to make you feel uncomfortable or may distress you. If a question makes you feel uncomfortable, you are free to not answer that question. For the adolescent, There is a risk of pain, bleeding and infection on the finger prick site however the risk is minimized since the procedure will be done by qualified, trained and experienced fieldworkers (nurses) who will be provided with the necessary equipment to avoid contamination and possible infections.

ARE THERE ANY BENEFITS TO TAKING PART IN THIS STUDY?

There are no direct benefits to you for participating in the study. However, if we find that your child has severe anemia we would be able to assist him/her in getting help from the nearest health facility. This study does not provide and kind of treatment.

In addition, while not benefiting you directly, this study has the potential to find adolescents with malnutrition and help to suggest interventions that will benefit the community and country.

WILL YOUR INFORMATION BE KEPT CONFIDENTIAL?

2

Your information **will be kept confidential**. The data collectors have been trained to keep all the information you give them confidential, which means they will **not share your information with others outside the project.**

Your name and other identifying information will not be recorded. You will be identified only **by a unique study number** given to each person. All information will be stored in a password-protected file at the University of Bergen. If any information from this study is published or presented at meetings, no identifying information about you personally will be used. All study data will be destroyed 5 years after publication.

WHAT ARE THE COSTS OF TAKING PART IN THIS STUDY?

You will not need to pay anything to take part in this study.

WILL YOU BE PAID FOR TAKING PART IN THIS STUDY?

You will not be paid to participate in the study.

WHAT ARE YOUR RIGHTS IF YOU TAKE PART IN THIS STUDY?

Taking part in this study is your choice. If you decide not to take part in this study you may refuse right now, or if you initially agree but do not want to continue, you may leave the study at any time. If at any time there are questions which make you feel uncomfortable you may refuse to answer them. If you no longer want to participate in the study for any reason, please make this known to the fieldworkers and we will respect your right to withdraw. If you decide not to take part in this study you will not be disadvantaged in any way.

Do you have any questions ?

You have talked to Ms./Mr._____about this study and have had your questions answered.

You can talk to Christina Kimaryo or Josephine Efraim about any questions, concerns, or complaints you have about this study.

Phone: 0789568088, 0743480221

If you wish to ask questions about the study or your rights as a research participant to someone other than the researcher or if you wish to voice any problems or concerns you may have about the study, please contact the NATIONAL INSTITUTE FOR MEDICAL RESEARCH. Address:3 Barack Obama Drive, P.O.Box 9653,11101 Dar es Salaam,

Tel: +255-22-2121400, Fax: +255-22-2121360, hq@nimr.or.tz | info@nimr.or.tz

3

If you wish to participate in this study, you should sign below. Check if participant has understood the following:

- o She/he will be participating in a study called: The triple burden of malnutrition among adolescents in Dar es Salaam , Tanzania. What is the magnitude and associated factors?
- o He/She understands the purpose and procedures of the study.
- o She/he has been given an opportunity to ask questions about the study and they have been answered properly.
- o She/he understands that her participation in this study is entirely voluntary and that she may withdraw at any time without any negative consequence to him/her
- o She/he has received the telephone number of a person to contact should /he need to speak about any issues which may arise in this study.
- o She/he understands that this consent form will not be linked to his/her responses and that His/her answers will remain confidential.
- o She/he has been given a copy of this consent form to keep.

If you wish to participate in this study, you should sign below,

---

I AGREE TO PARTICIPATE IN THIS STUDY (Parent/guardian)

…………………………………   ....

 Date(dd/mm/yyyy)   Name

....

Thumb print (only for use if the participant is illiterate)

………………………………………………………….

(Signature of a trusted friend/witness if unable to sign)

CONSENT FOR THE HOUSEHOLD

I understand that I will not answer any questions about this adolescent, but I will only sign

for permission for him/her to be screened for underweight or overweight/obesity or anemia.

Relationship to the

child ……………………………………………………………………………………………

I **AGREE** TO FOR THE CHILD TO BE SCREENED for malnutrition.

Caregiver's name and signature

……………………………………   ....

 Date(dd/mm/yyyy)   Name

....

Thumb print (only for use if the participant is illiterate)

………………………………………………………….

(Signature of a trusted friend/witness if unable to sign)

STUDY STUFF

……………………………………   ....

 Date(dd/mm/yyyy)   Name

ADOLESCENTS CONSENT FORM

Consent to participate in structured interviews and measurements for adolescents above the age of 16.

INFORMATION   SHEET

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We are researchers from the University of Bergen, Norway.

WHY IS THIS STUDY BEING DONE?

Malnutrition is detrimental to adolescents' current and future health, affecting their brain growth and functional capacity and increasing the risk of non-communicable diseases (NCDs) when older.

There is a paucity of information on the factors contributing to the malnutrition burden in adolescents in Dar-es-salaam and many nutritional interventions are targeting under-five and maternal nutrition leaving out this susceptible group.

Nonetheless, studies done in Dar-es-salaam have assessed malnutrition in school-going adolescents which are not representative of the whole adolescent population. Hence this study is a household survey to assess the magnitude of the co-existence of underweight, overweight/ obesity and nutritional anemia and the factors associated with that burden.

WHY ARE YOU BEING ASKED TO TAKE PART IN THE STUDY?

6

You are asked to participate in this study because you are an adolescent above the age of 16 in a selected household for the study.

HOW MANY PEOPLE WILL TAKE PART IN THIS STUDY?

We will ask 540 adolescents and their respective heads of households to participate in this study.

WHAT WILL HAPPEN IF YOU TAKE PART IN THIS RESEARCH STUDY?

If you agree to participate, we will ask you a series of questions about yourself and what you usually eat. We will explore different aspects of food habits and lifestyle, We will also measure your weight and height and do a finger prick to obtain blood for anaemia screening. The blood sample will be disposed right away and will not be used for anything else apart from anemia assessment.

HOW LONG WILL YOU BE IN THE STUDY?

The interview and screening will take about 45 minutes to 1 hour.

ARE THERE ANY RISKS IN TAKING PART IN THIS STUDY?

There may be the potential for some questions to make you feel uncomfortable or may distress you. If a question makes you feel uncomfortable, you are free to not answer that question. There is also a risk of pain, bleeding and infection on the finger prick site however the risk is minimized since the procedure will be done by qualified, trained and experienced fieldworkers (nurses) who will be provided with the necessary equipment to avoid contamination and possible infections. If you do not wish to participate in any of the screenings you are free to opt out.

ARE THERE ANY BENEFITS TO TAKING PART IN THIS STUDY?

There are no direct benefits to you for participating in the study.   This study does not provide any kind of treatment/ intervention. However, if we find that you have severe anemia we would be able to assist you in getting help from the nearest health facility.

In addition, while not benefiting you directly, this study has the potential to find adolescents with malnutrition and help to suggest interventions that will benefit the community and country.

WILL YOUR INFORMATION BE KEPT CONFIDENTIAL?

Your information will be kept confidential. The data collectors have been trained to keep all the information you give them confidential, which means they will not share your information with others outside the project.

Your name and other identifying information will not be recorded. You will be identified only by a unique study number given to each person. All information will be stored in a password-protected file at the University of Bergen. If any information from this study is published or presented at meetings, no identifying information about you personally will be used. All study data will be destroyed 5 years after publication.

WHAT ARE THE COSTS OF TAKING PART IN THIS STUDY?

You will not need to pay anything to take part in this study.

WILL YOU BE PAID FOR TAKING PART IN THIS STUDY?

You will not be paid to participate in the study.

WHAT ARE YOUR RIGHTS IF YOU TAKE PART IN THIS STUDY?

Taking part in this study is your choice. If you decide not to take part in this study you may refuse right now, or if you initially agree but do not want to continue, you may leave the study at any time. If at any time there are questions which make you feel uncomfortable you may refuse to answer them. If you no longer want to participate in the study for any reason, please make this known to the fieldworkers and we will respect your right to withdraw. If you decide not to take part in this study you will not be disadvantaged in any way.

Do you have any questions? QUESTIONS

You have talked to Ms./Mr.__about this study and have had your questions answered.

You can talk to Christina Kimaryo or Josephine Efraim about any questions, concerns, or complaints you have about this study.
Phone: 0789568088, 0743480221

8

If you wish to ask questions about the study or your rights as a research participant to someone other than the researcher or if you wish to voice any problems or concerns you may have about the study, please contact the NATIONAL INSTITUTE FOR MEDICAL RESEARCH.

Address: 3 Barack Obama Drive, P.O.Box 9653,

11101 Dar es Salaam,Tanzania.

Tel: +255-22-2121400, Fax: +255-22-2121360

hq@nimr.or.tz | info@nimr.or.tz

If you wish to participate in this study, you should sign below.

Check if participant has understood the following:

- o **She/he will be participating in a** study called: The triple burden of malnutrition among adolescents in Dar es Salaam , Tanzania. What is the magnitude and associated factors?
- o He/She understands the purpose and procedures of the study.
- o She/he has been **given an opportunity to ask questions** about the study and they have been answered properly.
- o She/he understands that her participation in this study is entirely **voluntary** and that she   may withdraw at any time without any negative consequence to him/her
- o She/he has **received the telephone number of a person** to contact should /he need to speak about any issues which may arise in this study.
- o She/he understands that this **consent form will not be linked** to his/her responses and that His/ her answers will **remain confidential**.
- o She/he has been given a copy of this consent form to keep.

If you wish to participate in this study, you should sign below.

9

I AGREE TO PARTICIPATE IN THIS STUDY

Participant's name and signature

………………………   …………………………………………

Date (dd/mm/yyyy)   Name (PRINT)

……………………………………

 Thumb print (only for use if participant is illiterate)

……………………………………………………….

(Signature of a trusted friend/witness if unable to sign)

STUDY STUFF

……………………………………   ……………………

 Date(dd/mm/yyyy)   Name

1

ASSENT FORM

 A study to evaluate the magnitude and factors associated with the triple burden of malnutrition among adolescents in Dar-es-salaam Tanzania.

ASSENT FORM FOR AN ADOLESCENT TO PARTICIPATE IN A HOUSEHOLD SURVEY ON ADOLESCENT NUTRITION

This assent should be completed when an adolescent is aged below 16years. Consent will be obtained from the parent of the adolescent OR by another adult caregiver in the house (includes aunties, grandmothers or other family members who live in the house and provide care for the teenager). The adolescent must provide assent to participate by signing this form.

RESEACHERS STATEMENT

You are asked to participate in a research study conducted by researchers from the University of Bergen, Norway. This study is funded by the NORPART project.

WHO ARE WE?

We are **researchers** from the University of Bergen, Norway

WHY IS THIS STUDY BEING DONE

We are doing this study because malnutrition is detrimental to adolescents' current and future health, affecting their brain growth and functional capacity and increasing the risk of non-communicable diseases (NCDs) when older. Research on this has mainly focused on pregnant women and children under 5. We are interested in knowing the situation among adolescents in Dar es salaam by assessing the magnitude of the co-existence of underweight, overweight/ obesity and nutritional anemia and the factors associated with that burden.

WHY ARE YOU BEING ASKED TO PARTICIPATE IN THE STUDY

We are asking you because you are an adolescent below the age of 16 and you live in a community where this kind of research has never been done before.

ARE THERE ANY RISKS IN TAKING PART IN THIS STUDY?

Some questions have the potential to make you feel uncomfortable. If a question makes you feel uncomfortable, you can refuse to respond. There is also a risk of pain, bleeding,

1

and infection on the finger prick site, however the risk is minimized since the procedure will be done by qualified, trained, and experienced fieldworkers (nurses) who will be provided with the necessary equipment to avoid contamination and infections. If you do not wish to participate in any of the screenings, you are free to opt out.

RESEARCHERS CONTACT DETAILS

You have talked to Ms./Mr._____about this study and have had your questions answered.

You can talk to Christina Kimaryo or Josephine Efraim about any questions, concerns, or complaints you have about this study.

Phone: 0789568088, 0743480221

FOR THE ADOLESCENT

Now tick or color the boxes below. Tick 'Yes' if you agree and 'No' if you don't agree

I have been told about the study called. **The triple burden of malnutrition among adolescents in Dar es Salaam, Tanzania. What is the magnitude and associated factors?'**		
I understand **why the study is being done** and what will happen if I choose to participate		
I have had the chance **to ask questions** about the study and they have been answered properly.		
I understand that my participation in this study is **voluntary,** and that I may stop at any time without anything bad happening		
I have **received the telephone number of a person** to contact should I need to speak about any worries that might come up in this study.		
I understand that this **consent form will not be linked** to what I say during the discussion, and that my answers will **remain confidential**.		

1

I have been given a **copy of this consent** form to keep.		
I understand that the researchers **will explore my food habits and lifestyle**		
I understand that the researchers will also **measure my weight and height and do a finger prick** to obtain blood for anemia screening		
I have been told about **the benefits of participating** in this study		
I have been **told about the risks associated** with this study		
I understand that I am **not getting paid** for participating in this study		
I understand that I am **not paying anything** to participate in this study		
I understand that the information I will share will be **confidential and safely kept** by the researchers, not even my parents can access it		

QUESTIONS

If you wish to ask questions about the study or your rights as a research participant to someone other than the researcher or if you wish to voice any problems or concerns you may have about the study, please contact the **NATIONAL INSTITUTE FOR MEDICAL RESEARCH**. Address:3 Barack Obama Drive, P.O.Box 9653, 11101 Dar es Salaam, Tanzania.

Tel: +255-22-2121400 Fax: +255-22-2121360

hq@nimr.or.tz | info@nimr.or.tz

If you wish to participate in this study, you must sign below.

1

I AGREE TO PARTICIPATE IN THIS STUDY.

Name of adolescent and signature

……………………………………   ………………………………………

Date (*dd/mm/yyyy*)   Name

…………………………………….

Thumb print (only for use if the adolescent is illiterate)

……………………………………………………….

(Signature of a trusted friend/witness if unable to sign)

STUDY STAFF

………………………….   ………………………………………

……………………………..

Date (*dd/mm/yyyy*)   Name   Signature

1

STANDARD OPERATING PROCEDURE (SOP)

THE TRIPLE BURDEN OF MALNUTRITION AMONG ADOLESCENTS IN DAR ES SALAAM, TANZANIA. WHAT IS THE MAGNITUDE AND ASSOCIATED FACTORS?

UNIVERSITY OF BERGEN

1. **Study objective**

   The study's primary objective is to assess the magnitude and factors associated with malnutrition among adolescents in Dar-es-Salaam Tanzania.

2. **Contact persons**

   You can talk to Christina Kimaryo (0789568088) or Josephine Efraim (0743480221) regarding any questions, concerns, or complaints you have about this study.

3. **Working days/hours**

Data collection is expected to start from September 1^{st} to 19^{th}, start of the working day is at 8 am until you finish the number of interviews per day (5 interviews per day). Every morning the research team will be meeting at a chosen spot to start data collection and all the research assistants should be at the chosen site on time. At the end of the day, you will report to your supervisor who will do the data quality check before you can leave.

If you are unable to collect data for any reason on any given day you must inform Christina/ Josephine (contacts provided above) as soon as possible by a phone call so that alternative arrangements for data collection can be made. We must keep up the number of interviews and we will need to replace any person who is unable to collect data.

The tablet should always be fully charged every morning and with you. Do not leave it lying anywhere even for a short time- it may get stolen!

You should take your bag with all the supplies (informed consent, questionnaires, pens, measuring equipment) and a copy of a written local authority permit. You should wear culturally acceptable outfits and look professional.

Supervisors will randomly visit data collectors to assist with any problems, replenish supplies, collect completed consent forms, and oversee data collectors. They will not necessarily notify data collectors of their visits and should be expected at any time.

4. **Selection of households**

Households will be randomly selected from the enumerated areas of the Dar es Salaam city council; each enumerated area will have a specific number of households to be interviewed depending on the population size of that area. Hence, you will be able to move from one enumerated area to another after finishing the required number of interviews.

5. **Introducing yourself to the household**

Local leaders will be informed and asked to help introduce you to the household. In case the local leader is not available, you will introduce yourself starting with your name, and what the study is about and show a written permit from the authorities. Explain that you will need to speak to an adolescent (aged 12-19) and his/her parent or guardian. If an adolescent is the head of the household, he/she will be interviewed twice (as the head of the household and an adolescent). Only one adolescent should be chosen if the household has more than one adolescent. Adolescents can choose random papers and the one who chooses the agreed number will be interviewed.

Ask if an adolescent is pregnant or less than 4 months postpartum and exclude them by explaining that the measurements are not accurate during these periods.

6. **Eligible adolescents and head of the household**

- An adolescent is considered eligible when he/she is **12-19 years** of age and has given consent/assent to participate.
- Is residing in that household for more than 6 months prior to the survey.
- Is not pregnant or less than 4 months post-partum during the survey.

➢ The head of the household is the one that makes most of the decisions in the household including the income and expenditures.

7. **Starting an interview**

Use the following template to provide a proper introduction and information before consenting.

Good morning. My name is ... I am from the University of Bergen, Norway collaborating with Muhimbili University of Health and allied sciences, Tanzania. As I have said previously, I am in this household today to conduct research to learn about general health practices for adolescents, especially nutritional practices. I am visiting your household today because it is a randomly chosen household in this area with an adolescent. I am seeking to interview adolescents who are aged between 12-19 years. I am also seeking to interview caregivers of these adolescents. Everything you tell us about yourself will be kept completely confidential.

Screening questions

If the adolescent and the head of the household/caregiver agree you must ask the initial questions about his/her age and the date that they were born. **Open the tablet and ask the screening questions**. The tablet will then confirm that the head of the household and the adolescent are the correct age and are eligible to participate. Once these first few questions have been answered you will be prompted to do the written informed consent.

Ask and observe if there is **a private space** where you can do the consent and where you can conduct the interview.

8. The informed consent/assent

If an eligible adolescent is below 16 years of age, obtain their written assent and their caregiver's consent. If an eligible adolescent is aged 16 and above, obtain their written consent. Furthermore, obtain written consent forms from the head of the household in every interviewed household.

The following information is important when doing the consent/assent.

Informed consent/assent

- Read out the informed consent/ assent.

- Ask if she/he has any questions about the study.

- Ensure she/he understands that participation is **voluntary** and may withdraw at any time.

- Ensure she/he understands that the information given will remain **confidential** and anonymous.

- Ask if she/he is willing to participate in the study.

- If she/he agrees to participate, **give him/her the information** section of the consent form which she can keep at home with him/her.

- Get him/her to sign the consent section. Place the consent in a separate file and prepare to administer the questionnaire.

- Once the eligible adolescent or caregiver is screened and has consented to participate, give them **a tracking number, and complete the tracking form**.

- Then pick up the tablet and continue with the rest of the interview.

NB: If an adolescent/caregiver/ head of the household refuses to take part, thank them for their time. Do not try and coerce them to take part and do not be rude to them for choosing to not take part. REMEMBER it is their right to refuse an interview.

All eligible participants who refuse to take part in the study should still have their age recorded. Fill in the questionnaire on the tablet up to the point where the questionnaire asks if consent was obtained, enter "No", and then end the interview. This is to ensure we have an accurate record of the number of adolescents/heads of households who refused to participate in the study.

If an adolescent is ineligible, thank them for their time, explain why they are not eligible and end the interview.

9. **The tracking form and interview number**

   Once the informed consent is complete the tablet will prompt you to fill in the paper tracking form (see below) and then insert the CIH interview number on the tablet. The CIH interview numbers are listed on the far left-hand side of the tracking form and you need to type this number onto your tablet. Use the next interview number that is available on your list. So in the example given below, the number you would fill onto the tablet is H01003.

Fieldworker Tracking form			
District Name: KINONDONI DISTRICT (D01)			
Household Name: HOUSEHOLD (H01)			
Fieldworker Name:			
CIH interview number	**Date of Interview**	**Paper/Tablet**	**Comment**
H01001	01/09/2023	tablet	Not completed adolescent had to leave
H01002	02/09/2023	tablet	
H01003			
H01004			

Please note that it is **EXTREMELY IMPORTANT** that you fill in the tracking form directly after you have obtained the informed consent. The tablet will prompt you to fill in the tracking form. **DO NOT FILL IN THE TRACKING FORM AFTER THE INTERVIEW!!!!!**

You will also need to fill in the date of the interview, if you are doing the questionnaire on the tablet or on paper, add any comments you may have to tell us or problems you may have had on the tracking form.

Incomplete interviews

If you start an interview and fill in the tracking form and CIH interview number on the tablet and then for any reason you do not complete the interview, make a note in the comments section that this is an incomplete interview (see example above). Once the interview number has been allocated and written on the tablet the interview is recorded and should be considered an incomplete interview if it is not completed. You will use the next CIH interview number for the next interview.

After you have filled in the tracking form you can continue with the interview.

10. Conduct the interview.

The questionnaire should start before taking the measurements from an adolescent.

Completing questionnaires

- Read all the questions as they appear on the questionnaire/tablet.

- Be consistent in how you ask the questions.

- Be neutral during the interview.

    COMPLETE ALL THE QUESTIONS is the most important thing! You cannot move onto the next question until you have completed the previous question because the tablet will not open the next question until a response is given.
    If you are not sure about how to respond to any question
    •   Use your judgment to make a decision about what response to give
    •   Enter that response so you can move to the next question
    •   Make a note in the comments section of the tracking sheet or in a notebook so that you can remember clearly what the problem was.

- Send an SMS to Christina/ Josephine so she can call you and see what the problem was.

We can then sort out your problem and stop it from happening again or to other fieldworkers.

11. TAKE MEASUREMENTS

Weight

- Each day calibrate the scale with the standard weight
- Always explain the weighing procedure to the participant
- Record the weight in kilograms to one digit to the right of decimal point.

How to weight properly

- Place the scale on a hard and flat surface and in the shade or indoors.
- Push the switch located on the right side of the screen in position "1"
- The scale has also a "Start" button on the front to switch on the scale
- "SECA", "8 8 8 8 8"and [00] appear consecutively in the display and the scale is ready to use.
- Ask the adolescent to step on the scale, to stand still and to look straight ahead (ensure they are wearing light clothes)
- After the weight appears (stop flashing) record weight
- Measurer reads the weight out loud. The assistant repeats the weight out loud to confirm and records the weight.
- Thank the participant and ask them to step off the scale.

Height

- Place the board on a plane and a solid surface against a wall, a table or a tree. Ensure that the board does not move.
- Explain the height measurement procedure to the adolescent.
- Ask the adolescent to take the shoes off and to undo the node or hear style that could interfere with the height measurement.
- Make sure that their legs are straight and feet is flat and joined at the center and against the back and the base of the board.

- Tell the adolescent to look straight ahead and ensure that the vision is parallel to the ground.
- Ensure that the shoulders are at the same level, hands on the side, and the head, the shoulder blades and the buttocks are against the board.
- Lower the cursor on the adolescent's head and read the measure out loud to the nearest **0.1cm (1mm).**

Anaemia

Explain procedure:

1. Briefly explain the procedure and explain that they may experience a pain from the finger prick. Explain that the benefits to adolescents will be that their anaemia status will be known and that they will be referred to the health clinic if they are found to be severely anaemic. If the adolescent is uncomfortable with the procedure, answer any questions she/he may have. Ensure that she/ he knows that they are free to withdraw from the survey at any time and that nothing bad will happen if she/he does.
2. Prepare work station: put on a new pair of gloves and layout all the supplies to be used for the measurement on a piece of paper roll. Close the microcuvette container immediately after taking out the microcuvette.
3. Ensure correct position of the adolescent: face the adolescent, if you are right-handed, position yourself to be able to comfortably hold the adolescent's finger with your left hand while using your right hand to hold the lancet or microcuvette (reverse if you are left-handed).
4. Hold adolescent's hand: do not hold the adolescent 's hand so tightly so as to obstruct blood flow.
5. Select finger: choose the adolescent's middle or ring finger for the finger stick. The selected finger should not be swollen and should be minimally callused. Remove any rings that are on this finger because the ring might interfere with blood flow. Rings on other fingers do not have to be removed unless they are in the way of the measurer.
6. Check finger: feel the adolescent's fingers for warmth. If the fingers are cold, rub the fingers vigorously. If warm water is available, you can also warm them by washing them in the warm water.

7. Massage finger: hold the adolescent 's finger for the finger stick. Use a rolling motion to gently massage the finger from the top of knuckle towards the fingertip to increase blood flow.

8. Disinfect finger: clean the adolescent 's fingertip with the disinfectant and allow to air dry.

9. Hold finger: hold the adolescent's finger and apply gentle pressure to firm the skin so that the lancet will go deeper into the finger.

10. Place lancet: hold the lancet between two fingers and rest the thumb on the needle trigger. Place the lancet on the side of the fingertip rather than on the pad of the fingertip (this will especially help in case fingers are heavily callused).

11. Stick finger: use a rolling motion to massage the adolescent's finger even more from the top of knuckle towards the fingertip to increase blood flow. Push firmly the lancet against the adolescent's skin before triggering the needle with your thumb. Dispose of the lancet immediately after use in a biohazard waste container.

12. Initiate blood flow: apply gentle pressure to the wrist, palm and top of knuckle to initiate blood flow. Do not squeeze or rub the tip of the finger because you may dilute the blood drop with interstitial fluid.

Fill the microcuvette

13. Wipe away 1st and 2nd blood drop: using a clean dry gauze pad or tissue paper, wipe away the first two drops of blood. Do not wipe away the drops with alcohol.

14. Sample 3rd drop: sample the third drop of blood. The drop of blood should be large enough to fill the microcuvette in one touch.

15. Fill microcuvette: hold the finger in one hand. Touch the tip of the microcuvette into the middle of the blood drop and fill the microcuvette completely with a single drop of blood in one step. The microcuvette fills itself by capillary action.

16. Inspect microcuvette: inspect the microcuvette for air bubbles and check if it is completely filled by holding it up to the light.

17. If you see air bubbles or if you see that it is not completely filled, discard the microcuvette.

18. Never refill a partially filled microcuvette with the same drop of blood because the blood may have started to clot and will give an incorrect reading.

19. If a new microcuvette is needed, refill a new microcuvette from a new blood drop from the same finger puncture if feasible. Otherwise, you may have to make a new prick. If you do need to make another prick, you should use another finger.

20. Wipe off excess blood: carefully wipe off any excess blood from the flat sides of the microcuvette with a clean dry tissue paper. Make sure that no blood is sucked out of the microcuvette while wiping it.

21. Place microcuvette in holder: immediately place the filled microcuvette into the microcuvette holder and read the microcuvette within **three minutes of sampling.**

22. Slide holder: gently slide the microcuvette holder into the machine until the stop point is reached. Do not 'slam' the holder into position for reading. This may spray blood droplets, which negatively affects the reading.

23. Apply a cotton ball: while the HemoCue machine is reading the sample, apply a cotton ball to the puncture wound on the woman's finger.

24. Record reading: after a few seconds, the Hb value will appear on the display. Record this value.

25. Dispose of the microcuvette: dispose of the microcuvette immediately in the biohazard waste container after reading it.

NOTE:

Obtain the consent from the adolescent before to start

All adolescents with signs of severe anaemia (<8.0 g/dL) will be given referral form to go to the nearest health facility

Referral form ☐ 2 copies

Team copy (for Supervisor) and adolescent copy.

All blood samples and contaminated supplies should be handled with extreme care because blood is a potential source of infection with HIV, Hepatitis B and C Virus and other blood-borne pathogens.

To protect yourself and the survey population from exposure to blood:

- Wash your hands: always wash hands with soap and water at the start and end of the workday (or before and after each break).

- Cover your cuts: cover all cuts with bandages to prevent any possibility of blood from survey population coming into contact with any cuts.

- Wear gloves: always wear well-fitting disposable latex gloves when sampling blood to protect against exposure to blood. Gloves must be worn during Hb measurement until

all specimens and materials are disposed of. Gloves must be disposed of as bio hazardous waste. Gloves must be never reused! ☐ Use new pairs of gloves for each adolescent.

- Avoid penetrating injuries: although gloves can prevent blood contamination, they cannot prevent penetrating injuries caused by the instruments used for finger sticks.
- Clean up blood spills: immediately clean up any blood spills with an antiseptic so that survey workers and participants do not touch any blood.
- Disposal in biohazard waste: all materials coming in contact with blood must be placed in bio hazardous waste containers after use and disposed of according to standards. Immediately dispose of any tissue paper, gloves, used lancets, microcuvettes and other supplies that have been in contact with blood in the biohazard waste container.
- If an accident occurs: any skin surfaces or mucous membranes that come in contact with blood must be immediately and thoroughly washed with a large amount of water and soap. The supervisor is to be contacted immediately.

12. Sync to server

Sync the interview to server so that we can receive the questionnaires. Any problems experienced with the tablet, contact Josephine or Christina (contact provided above).

13. Paper questionnaires

- If the tablet is not working at any time send an SMS to Josephine/ Christina and she will phone you back and we will help you to trouble shoot the problem.
- If for some reason your tablet stops working or freezes during an interview you should apologize to the participant explain the problem and start the interview from the beginning again, using a paper questionnaire. This will prevent the participant having to wait while you sort out your tablet problem.

- Once the interview is completed send an SMS to Josephine/ Christina she will phone you back so that we are able to help you to trouble shoot the problem.
- Until the problem is sorted out you should use paper questionnaire so that no interviews are missed.
- The questions on the paper questionnaire are the same as on the tablet but, unlike the tablet, the skips are manual and you need to follow these skips carefully so that you ask

the right questions. As discussed above you need to note on your tracking form if you have had to use a paper questionnaire.

- Tracking of paper questionnaires. Write the interview number and the date on the tracking sheet for every paper questionnaire that you use. Keep all paper questionnaires in a safe place to be handed over when your supervisor visits you.

14. Data collection equipment and tools

You will need the following equipment and tools in order to undertake the study. This will give you a few day supplies so that there is time to get more supplies. So think ahead

-Bag to store all equipment

-Informed consents   Keep between 24-30 unsigned informed consents for the duration of your data collection in each ward. When you only have 10 left please inform your supervisor so she can make arrangements to supply more.

-Tablet computer

-Paper Questionnaires   Keep 15 questionnaires for the duration of your data collection in each clinic in case your tablet doesn't work. If you only have 5 left, please inform the supervisors.

-Pens   For participants to sign informed consents/ assents.

-Permissions   Laminated permissions from the authorities

Ensure that the following items are available every day:
- 1x laminated copy of local government permission letter, and ethical approvals from NIMR and MUHAS
- 1x Scripts for introduction
- Between 24-30 informed consent and assents forms for the duration of data collection in each ward
- 15 questionnaires for the duration of data collection in each ward.

Check all supplies at the beginning and end of every week. If you will run out of supplies during the week, contact Josephine/ Christina to make arrangements for supplies to be provided

All completed informed consents, screening forms and questionnaires will be collected and signed for by the study supervisor every week. You will need to provide an

informed consent and assent for every questionnaire that has been completed on the electronic tablets. This will be tracked by the study investigators.

Consent and assent forms:

COMPLETED CONSENT FORMS ARE VERY IMPORTANT!!

• You must have a signed consent and assent form for every interview otherwise we may have to discard the interviews.

• Make sure that all your completed consent and assent forms are filed in a safe place.

• Every day you should check that the number of completed consent and assent forms is equal to the number of interviews you have done.

• Every time a tracking sheet is completed, put all the consent forms together with the tracking sheet in a single file.

Paper questionnaires:

Keep all completed questionnaires filed safely with the corresponding tracking sheet.

THANK YOU