

**A COMPARATIVE ANALYSIS OF DETERMINANTS OF LOW BIRTH  
WEIGHT AND STUNTING AMONG UNDER-FIVE CHILDREN OF  
ADOLESCENT AND NON-ADOLESCENT MOTHERS USING THE 2015/16  
TANZANIA DEMOGRAPHIC AND HEALTH SURVEY**

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**A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of  
Master of Science in Public Health Research of the Nelson Mandela African Institution of  
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## ABSTRACT

In Tanzania, adolescent pregnancies increased from 23% to 27% between 2012 and 2015. The rises have been linked to poor birth outcomes, pregnancy complications, childhood malnutrition, and maternal and child deaths. Using data from the 2015 Tanzania Demographic and Health Survey, this study investigated the factors associated with low birth weight (LBW) and under-five stunting among adolescent and non-adolescent mothers. Data from 13 266 women collected as part of the Tanzania Demographic and Health Survey in 2015/2016 were re-analyzed using STATA version 14 software while taking survey design into account. The outcome variables were low birth weight and stunting. Logistic regression models were used to identify factors that contributed to LBW and stunting in children born to adolescent and non-adolescent mothers. After controlling for potential confounders, this study discovered that non-adolescent mothers had a lower risk of having LBW babies than adolescent mothers (AOR = 0.34; 95 per cent CI: 0.22-0.50). Maternal malnutrition (AOR = 2.29; 95 percent CI: 1.43–3.67), divorce, separation, or widowhood (AOR = 1.76; 95 percent CI: 1.24–2.50), and fewer than four antenatal care (ANC) visits (AOR = 0.64; 95 percent CI: 0.49–0.83) were all associated with LBW. Stunting in children was not related to maternal age. Maternal high socioeconomic status (AOR = 0.69; 95% CI: 0.57-0.84) and maternal obesity or overweight (AOR = 0.77; 95% CI: 0.64-0.92) were associated with stunting. Stunting was found to be significantly associated with birth weight, gender, and age. Maternal age predicted LBW but not stunting. To reduce poor birth outcomes, a multi-sectoral approach is required to address childhood stunting and teenage pregnancies.

## DECLARATION

I, Ramadhani H. Mtongwa, hereby declare to the Senate of the Nelson Mandela African Institution of Science and Technology that this dissertation is my original work and that it has neither been submitted nor concurrently submitted for a degree or similar award in any other institution.

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11<sup>th</sup> July 2022

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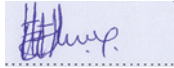
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## CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by the Senate of the Nelson Mandela African Institution of Science and Technology the dissertation entitled “*A Comparative Analysis of Determinants of Low Birth Weight and Stunting Among Under-Five Children of Adolescent and Non-Adolescent Mothers Using 2015/16 Tanzania Demographic and Health Survey*” in partial fulfilment of the requirements for the Degree of Master of Science in Public Health Research of the Nelson Mandela African Institution of Science and Technology.

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## **DEDICATION**

I would like to dedicate this work to: My wife ms Jazila for her support and encouragement. My parents Mr. and Mrs. Hashim for their encouragement and best wishes, my brothers and sisters for their unlimited support and encouragement.

## TABLE OF CONTENTS

ABSTRACT .....	i
DECLARATION.....	ii
COPYRIGHT .....	iii
CERTIFICATION .....	iv
ACKNOWLEDGEMENTS .....	v
DEDICATION .....	vi
TABLE OF CONTENTS .....	vii
LIST OF TABLES .....	x
LIST OF FIGURES.....	xi
LIST OF ABBREVIATIONS AND SYMBOLS.....	xii
CHAPTER ONE.....	1
INTRODUCTION.....	1
1.1 Background of the Study .....	1
1.2 Statement of the Problem.....	3
1.3 Rationale of the Study.....	3
1.4 Research Objectives.....	4
1.4.1 General Objectives .....	4
1.4.2 Specific Objectives.....	4
1.5 Research Questions.....	5
1.6 Significance of the Study .....	5
1.7 Delineation of the Study .....	5
CHAPTER TWO.....	6
LITERATURE REVIEW.....	6
2.1 Overview.....	6
2.2 The Association between Mother's Age (Adolescent and Non-Adolescent Mothers) and Childbirth Outcomes.....	6



2.2.1	Adolescent versus Non-Adolescent Mothers and Low Birth Weight .....	6
2.2.2	Adolescents versus Non-Adolescents and Preterm Births .....	7
2.3	The Association between Mothers' Age (Adolescent and Non-Adolescent) and Under-five Stunting Status .....	8
2.3.1	Adolescent Mothers versus Non-Adolescent Mothers and Stunting among under-five .....	8
2.4	Maternal Factors Associated with Low Birth Weight and Under-five Stunting Status among Adolescent and Non-Adolescent Mothers .....	9
2.4.1	Maternal Education Levels and Birth Outcomes .....	9
2.4.2	Maternal Occupation and Birth Outcomes .....	10
2.4.3	Maternal Place of Residence and Birth Outcomes .....	11
2.4.4	Maternal Nutrition Status and Birth Outcomes .....	11
2.4.5	Maternal Service Utilization and Birth Outcomes .....	12
2.4.6	Maternal Occupation and Child Stunting .....	13
2.4.7	Maternal Education Level Child Stunting .....	14
2.4.8	Maternal Place of Residence and Child Stunting .....	14
2.4.9	Maternal Nutrition Status and Under-five Stunting .....	15
CHAPTER THREE .....		16
MATERIALS AND METHODS .....		16
3.1	Data Source .....	16
3.2	Research Design .....	16
3.3	Target Population .....	16
3.4	Sampling Procedures .....	16
3.5	Data Management and Analysis .....	17
3.5.1	Subjects and Sample Size .....	17
3.5.2	Categorization of Variables .....	17
3.5.3	Statistical Analysis .....	17
3.6	Ethical Considerations .....	18

CHAPTER FOUR .....	20
RESULTS AND DISCUSSION .....	20
4.1 Results.....	20
4.1.1 Association between Mother’s Age (Adolescent and Non-adolescent Mothers) and Under-five stunting.....	20
4.1.2 Prevalence of Low Birth Weight in Children from Adolescent and Non-adolescent Mothers.....	24
4.1.3 Prevalence of Under-five Stunting, Wasting and Underweight .....	26
4.1.4 Prevalence of stunting among under-five children according to maternal characteristics .....	26
4.1.5 Predictors of Low Birth Weight .....	28
4.1.6 Predictors of Stunting in Under-five Children .....	29
4.2 Discussion.....	31
4.2.1 The association between Adolescent and Non-adolescent Mothers’ Characteristics and Childbirth Weight .....	31
4.2.2 The Association between Adolescent and Non-adolescent Maternal Characteristics and Stunting in Under-five Children .....	33
4.2.3 Relationship between Stunting and Child’s Birth Weight, Sex and Age .....	34
CHAPTER FIVE.....	36
CONCLUSION AND RECOMMENDATIONS.....	36
5.1 Conclusion .....	36
5.2 Recommendations .....	36
REFERENCES .....	37
RESEARCH OUTPUTS .....	50

## LIST OF TABLES

Table 1:	Household and individual interviews .....	20
Table 2:	Socio-economic and Demographic Characteristics of Mothers .....	22
Table 3:	Anthropometric and nutrition status of mothers.....	23
Table 4:	Prevalence of Low Birth Weight in children from adolescent and non-adolescent mothers by maternal characteristics (N= 6386).....	25
Table 5:	Prevalence of under-five stunting, wasting and underweight .....	26
Table 6:	Prevalence of child stunting among adolescent and non-adolescent mothers by maternal characteristics (N=8852) .....	27
Table 7:	Factors associated with Low Birth Weight (N=6385) .....	29
Table 8:	Factors associated with stunting (N=8852) .....	31

## LIST OF FIGURES

Figure 1: Maternal level of education .....	21
Figure 2: Maternal Body Mass Index (BMI) .....	23
Figure 3: Gestation age at 1 <sup>st</sup> Antenatal Care Visits .....	24
Figure 4: Low birth weight status of the study participants.....	25
Figure 5: Stunting prevalence according to maternal age .....	27

## LIST OF ABBREVIATIONS AND SYMBOLS

ABR	Average Birth Rate
AfDB	African Development Bank
ANC	Antenatal Care
AOR	Adjusted Odds Ratio
CI	Confidence Interval
BMI	Body Mass Index
EBF	Exclusive Breastfeeding
DHS	Demographic and Health Survey
LBW	Low Birth Weight
MHS	Maternal Health Services
MUAC	Mid Upper Arm Circumference
NBS	National Bureau of Statistics
PMTCT	Prevention of Mother to Child Transmission
SES	Socio Economic Status
TDHS	Tanzania Demographic and Health Survey
TNNS	Tanzania National Nutrition Survey
UN	United Nations
UNFPA	United Nations Population Fund
UNICEF	United Nations Children Fund
URT	United Republic of Tanzania
WHO	World Health Organisation
GB	Girls not Brides
GA	Global Action Report on Preterm Birth
MoH	Ministry of Health
STIs	Sexually Transmitted Infections
HIV	Human Immunodeficiency Virus,
AIDS	Acquired Immunodeficiency Syndrome
IHIRB	Ifakara Health Institute Review Board

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background of the Problem

Globally, about 1.2 billion people (out of 7.6 billion) are adolescents aged 10–19 years (World Health Organization [WHO], 2018b). Individuals aged 10–14 years are classified as early adolescent, while those aged 15–19 years are classified as a late adolescent (WHO, 2018c). Over 580 million adolescents are female worldwide. Asia is the leading continent with the highest number of adolescents in the world, and in sub-Saharan Africa, 23% of the population are adolescents aged 10–19 (United Nations Children Fund [UNICEF], 2019).

It is expected that from 2010 to 2030, the number of countries with more than 5 million adolescent girls will increase from 16 to 18 (United Nations Population Fund [UNFPA], 2013). The largest absolute national increases in adolescent girls will mostly happen in sub-Saharan Africa. Nigeria (9.2 million), the United Republic of Tanzania (3.7 million), the Democratic Republic of the Congo (3.3 million), Uganda (2.5 million), and Kenya (2.3 million) are the five countries with the highest absolute increases in adolescent population (UNFPA, 2013). The increase in the number of adolescents in these countries is associated with different health outcomes.

As per the 2018 population projection, Tanzania has a population of 60 million (National Bureau of Statistics [NBS], 2018). Out of them, 23% (approximately 12 million people) are adolescents aged 10–19 years, 16.7 million are children aged 0–9 years, and 29 million are non-adolescents (NBS, 2018). Recent efforts targeting adolescent empowerment have been made, but still, child marriage, early pregnancy, low quality of education, violence, abuse and exploitation continue to undermine some of their opportunities (United Republic of Tanzania [URT], 2011).

Almost one out of three girls in Tanzania gets married before her 18<sup>th</sup> birthday. By the age of 15, 5% of girls are married, and by the age of 18, 31% are married. Despite early marriage, one out of every three adolescent girls is anaemic and one out of every four is stunted (URT, 2020).

Approximately 15 million girls aged 15–19 years and 2.5 million girls under age 16 give birth each year in developing countries (UNFPA, 2015). The highest proportions of early childbearing are found in sub-Saharan Africa, where birth rates among adolescents reach over 102 births per 1000 girls aged 15–19 (UNICEF, 2019). This is higher compared to the global estimate of 44 births per 1000 girls aged 15–19 years (UNICEF, 2019). Adolescent birth rates are higher in rural areas than in urban areas among those with low education levels or living in poor households (Wado *et al.*,

2019). The average birth rate (ABR) among adolescents in rural areas with no education and in the poorest households is 1.8, 2.8 and 2.8 times higher than that of those who live in urban areas, have secondary or higher education, and are from the richest households, respectively (UNFPA, 2013). Policy enforcement has been weak in many African countries, creating a loophole for child marriages, which resulted in a low level of education and employment opportunities, early and unwanted pregnancies, poor offspring outcomes, increased maternal malnutrition and mortality (Girls Not brides [GNB], 2016).

Adolescent pregnancies are considered a global health problem that occurs in high-, middle-, and low-income countries. Adolescent pregnancies occur in marginalized communities, commonly driven by poverty and a lack of education and employment opportunities (WHO, 2018b). Adolescent pregnant girls face difficulties in sustaining their health status due to poor socio-economic and other demographic factors. Furthermore, girls are discriminated against and consequently face diminished opportunities and choices, are poorly educated, subjected to serious health risks, threatened by violence, and are prone to unintended pregnancies, resulting in early motherhood (United Nations [UN], 2011). Adolescent mothers face neglect from their family, school, workplace and community (Mangeli *et al.*, 2018). When compared to non-adolescent mothers in both high- and low-income countries, they frequently have insufficient resources, are less educated, and lack financial independence (Roux *et al.*, 2019). These circumstances are what cause adolescent pregnancies and deliveries to be accompanied by more risks as compared to non-adolescent mothers (Yussif *et al.*, 2017).

Young mothers compared to adult mothers are more likely to have low maternal weight gain and anemia during pregnancy due to competing needs for nutrients (Nabugoomu *et al.*, 2018). Due to poor nutrition outcomes, adolescent girls are likely to give birth to preterm or low-birth-weight babies with a high likelihood of malnutrition and death compared to mothers aged 20 years and above (Banke-Thomas *et al.*, 2017). Besides poor birth outcomes, pregnant adolescent girls are prone to hypertensive disorders, eclampsia, puerperal endometritis, systemic infections and cesarean delivery (Grønvik & Fossgard, 2018; Muche & Alene, 2018; Roos & Nickel, 2018).

Furthermore, the high rates of adolescent pregnancy contribute significantly to the high prevalence of malnutrition among adolescents themselves and their under-five children (Olodu *et al.*, 2019). Adolescent mothers are not only challenged by health risks, as described above, but are socially disadvantaged as well. The majority have to raise their babies as single parents because they are unable to complete their education and have limited capacity to secure a job and sustain a livelihood to support themselves and their children (Banke-Thomas *et al.*, 2017). Additionally, they lack

critical childcare knowledge, which contributes significantly to the raising of malnourished children and thus creating a vicious circle of malnutrition and poverty.

## **1.2 Statement of the Problem**

Adolescent pregnancy is a global phenomenon with clearly known causes and serious health, social, and economic consequences for individuals, families and communities (WHO, 2019a). It is associated with high maternal and child morbidity and mortality, which eventually affects socio-economic development (Odukogbe & Yalew, 2018; Sully & Mumah, 2019). Adolescent mothers have disproportionately high rates of poverty, food insecurity, social isolation, poor health, employment, inadequate access to health care services, and unfriendly youth service (Nabugoomu, 2018). Mustapha *et al.* (2018) noted that pregnant adolescents have difficulties accessing health services such as prenatal care, skilled attendants during birth, and prevention of mother-to-child transmission (PMTCT) services (Mustapha *et al.*, 2018).

Maternal demographic characteristics like age, education, social status, economic status, employment and living conditions have high impacts on both unborn babies and children who are under five years of age. Most of the studies done in Tanzania (Malisa, 2015; Adolf, 2014; Kiluvia, 2011; Uromi, 2014; Sik, 2015) explored an association between maternal socio-economic status and service utilization and their impacts on children's birth outcomes and nutrition status. This study intends to expand their work by exploring if the observed association is different between adolescent and non-adolescent mothers. Despite the overwhelming evidence of adolescent social and economic vulnerabilities, little is known about how maternal age contributes to low birth weight and childhood stunting in Tanzania.

## **1.3 Rationale of the Study**

Adolescent pregnancies have become a public health challenge in Tanzania. From 2012 to 2015, adolescent pregnancies have increased from 23% to 27% in the country, with those living in the poorest conditions having a much higher prevalence (42% compared to those in the highest wealth quintile (13%)) (UNICEF, 2017). The increase in teenage pregnancies has been associated with poor birth outcomes, complications during pregnancy, childhood malnutrition, and maternal and child deaths (WHO, 2019b). In Tanzania, 236 000 babies are born prematurely each year, and 11 500 children under five die due to preterm complications (Tanzania, 2017). Pregnancy during adolescence is a known risk factor for preterm birth (WHO, 2019b). Overall, it is estimated that 15% to 20% of all children born worldwide have low birth weight (LBW), representing more than 20 million births a year (WHO, 2014). The estimated prevalence of LBW in Sub-Saharan Africa is



13%, although 54% of all children are not weighed at birth (WHO, 2014). In Tanzania, the prevalence of LBW babies is 10%. Maternal age, Body Mass Index (BMI), Antenatal Care (ANC) attendances and place of residence are among the reported risk factors for LBW (Roux *et al.*, 2019; Nabugoomu *et al.*, 2018; Banke-thomas *et al.*, 2017).

On the other hand, nutrition indicators for children under five years of age in Tanzania have shown some improvement over recent years, but stunting is still widely prevalent. According to the 2015/16 Tanzania Demographic and Health Survey (TDHS) the prevalence of stunting among children under five was 34%, a decline from 42% in 2010 (TDHS, 2010), but is still unacceptably high compared to the average of middle-income countries, which is 22% (WHO, 2019). Besides, more than half of young women under the age of 19 are either pregnant or mothers. The perinatal mortality rate among young women under the age of 20 is 56 per 1000 pregnancies, which is significantly higher than the 39 per 1000 pregnancies in older women aged 20–29 years and the 32 per 1000 pregnancies in those aged 30–39 (Ministry of Health, 2015). Furthermore, the maternal mortality rate in Tanzania in 2015 was high (556 deaths per 100 000 live births), and it is likely that adolescent pregnancies contributed greatly to the burden (UNICEF, 2017). This study explored factors associated with LBW and stunting among adolescent and non-adolescent mothers using data collected as part of the Tanzania Demographic and Health Survey in 2015/2016.

## **1.4 Research Objectives**

### **1.4.1 General Objectives**

To compare the childhood stunting and low birth weight outcomes of under-five children born by adolescent and non-adolescent mothers and their association with maternal characteristics.

### **1.4.2 Specific Objectives**

- (i) To determine the association between mother's age (adolescent and non-adolescent mothers) and under-five stunting.
- (ii) To determine the association between mothers' age (adolescent and non-adolescent) and low-birth-weight.
- (iii) To determine maternal characteristics associated with under-five stunting and low birth weight.

## **1.5 Research Questions**

- (i) What is the prevalence of low birth weight outcomes among babies born by adolescent and non-adolescent mothers?
- (ii) What is the prevalence of childhood stunting of under-five children born by adolescent and non-adolescent mothers?
- (iii) What are maternal socio-economic, demographic features and uptake of care associated with under-five stunting and low birth weight among adolescent and non-adolescent mothers?

## **1.6 Significance of the Study**

This study enlightens the significance of adolescent reproductive health issues in Tanzania. The findings of this study indicated the vulnerability of adolescent mothers with respect to their health together with their born and unborn babies. For different reasons, the risk of low birth weight was found to be significantly higher among adolescent mothers as compared to non-adolescent mothers. LBW was also found to be a great risk factor for under-five stunting. As there are still many unpublished reports about the increase in adolescent pregnancy, especially during these times of the COVID-19 pandemic, this special group needs a lot of support and attention to avoid the unnecessary foreseen poor children's futures in terms of health and nutrition. We recommend the government, stakeholders, and communities as a whole hold hands together and protect this vulnerable group through offering emotional support and health education during pregnancies to improve immediate and later-life childbirth outcomes.

## **1.7 Delineation of the Study**

The study had a sample size of 13 266 women from 2015/16TDHS-MIS but contained only 2904 adolescent and 10 362 non-adolescent mothers. Unequal sample size distribution can affect the statistical power of the study. Since the study was not done in the field, some important clues concerning the causal relationship between dependent factors and outcome might be missing. For example, the study revealed that male children were more stunted than females, but the reasons behind this were incomprehensive. Variability in birth weight information may introduce some bias when comparing birth weights by maternal age since only 64% of live births were measured for their weight in the five years before the survey. This may underestimate the unrecorded LBW from home deliveries, and hence the findings may require interpretation with consideration.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Overview

This Chapter provides an overview of maternal characteristics that are associated with low birth weight and stunting in under-five children. The section is presented to cover each research objective such as: To determine the association between mother's age (adolescent and non-adolescent mothers) and child-birth weights, to determine the association between mothers' age (adolescent and non-adolescent) under-five stunting status and to determine maternal characteristics associated with low birth weight and under-five stunting status among adolescent and non-adolescent mothers

#### 2.2 The Association between Mother's Age (Adolescent and Non-Adolescent Mothers) and Childbirth Outcomes

##### 2.2.1 Adolescent versus Non-Adolescent Mothers and Low Birth Weight

A child born with a weight of less than 2500 g is considered a low birth weight regardless of the gestational age (WHO, 2012). Low birth weight is complex and includes preterm neonates (born before 37 weeks of gestation), small for gestational age neonates at term and the overlap between these two situations – preterm and small for gestational age neonates, who typically have the worst outcomes. Several studies have indicated an increased risk of low birth weight babies among adolescent girls but with limited comparison among different age groups (Demelash *et al.*, 2015; Endalamaw *et al.*, 2018; Desta *et al.*, 2020; Ratnasiri *et al.*, 2018; Awintuen *et al.*, 2018; Ngwira & Stanley, 2015; Kassa *et al.*, 2019). The increased likelihood of having a low birth weight is a result of competing growth and nutrition needs exerted during adolescent hood and pregnancy (Mahumud *et al.*, 2017).

A case-control study conducted by Demelash (2015) in Bale, Ethiopia with 129 cases (52 adolescents and 77 adult mothers) and 258 controls (56 adolescents and 202 adult mothers) found an increased chance of having LBW among adolescent mothers (AOR = 3.1; 95% CI (1.65-5.73);  $p = 0.001$ ) compared to adult mothers. Although the study provided more evidential results, it has some weaknesses, including selection bias, as it considered only hospital delivery and didn't consider other factors such as diseases, preterm births, and multiple births, which could contribute to LBW as well as measurement and memory bias (Demelash *et al.*, 2015). Another case-control study conducted in Tigray, Ethiopia with 127 cases (46 adolescent and 81 adult mothers) and 254

controls reported an increased risk of LBW among adolescent mothers (AOR = 6.42 (95% CI = 1.93–21.42) as compared to adult mothers. Other factors related to low birth weight were having a low level of education, being a rural resident, absence of antenatal care follow-up and maternal BMI of less than 18 kg/m<sup>2</sup> (Desta *et al.*, 2020). Although several findings found a positive association between low maternal age and LBW, one study conducted in South Africa and involving 1073 women (23% adolescent mothers) found an increased risk of LBW among older women, i.e., those over 20 years of age (adjusted odds ratio [AOR] 12.20, CI 3.90 to 38.02) compared to those 19 years of age (Tshotetsi *et al.*, 2019). The association found might be due to a small age gap and memory bias since the study was a case-control and did not collect information on the status of ANC attendance, which has an impact on birth weight.

Besides age, findings from most studies have shown that maternal socio-demographic factors and economic factors like wealth, age, level of education, occupation category, marital status and ANC attendance are associated with LBW. Adolescent mothers have a higher prevalence of LBW than adult mothers (Njim & Agbor, 2018; Tshotetsi *et al.*, 2019; DeMarco *et al.*, 2021).

## **2.2.2 Adolescents versus Non-Adolescents and Preterm Births**

Each year, about 15 million babies are born prematurely, representing more than one in 10 of all babies born around the world. Besides that, over 1 million children die each year due to complications of preterm birth (global action report on preterm birth [GA], 2012). Common causes of preterm birth have been mentioned as multiple pregnancies, infections and chronic conditions such as diabetes and high blood pressure. However, often no cause is identified (WHO, 2019).

In one of the multi-country, facility-based, cross-sectional studies implemented from May 2010 to December 2011 by Ganchimeg (2014), which comprised 32179 adolescent and 92267 adult deliveries, they found a higher risk of preterm birth among adolescent mothers compared to adults (AOR = 1.60; 95%CI, 1.37–1.87). This study provided the clue that adolescent mothers are at a higher risk of delivering pre-term babies compared to non-adolescent mothers. Although this study gave out important clues, it was subjected to bias. Selection bias was the biggest study weakness as only city hospitals were selected to participate, leaving small hospitals located in rural and urban areas to carry out the study, which are the ones that have the most abundant numbers of adolescent and non-adolescent mothers' deliveries. The study was also subjected to information bias from participants since some of them were more likely to provide wrong responses (Ganchimeg & Ota, 2014). Almost the same odds of delivering preterm birth were reported in a cohort study by Kassa *et al.* (2019) comprised of 374 adolescent and 760 adult mothers (AOR = 1.65; 95%CI, 1.09–2.49).

Maternal age at first pregnancy, ANC attendance and preeclampsia were mentioned as the risk factors (Kassa *et al.*, 2019).

Vivid evidence was found in a randomized control clinical trial done by Mombo-ngoma *et al.* (2016) in four countries (Gabon, Benin, Mozambique and Tanzania) with infants' delivery numbers of 1223 (adolescent mothers) and 2877 (non-adolescent mothers) that took place between September 2009 and December 2013. The study found a non-significant increase in the odds of delivering preterm infants to adolescent mothers of 20 compared to adult mothers. Factors like BMI, ANC attendance, and literacy were found to not be significantly associated with preterm birth.

However, a cross-sectional study done in Kenya by Wagura *et al.* (2018) with 34 adolescents and 229 non-adolescent mothers in December, 2013 found that the odds of delivering preterm infants were significantly lower among adolescent mothers (OR = 0.236; 95% CI (0.054–1.001)) compared to non-adolescent mothers (OR = 0.834; 95% CI (0.272–2.555)). This study has weak evidence because it involved a low number of adolescents, i.e., 34, which can result in imprecise estimates. The results might also under or over represent the reality when it comes to adolescent mothers' population and their birth outcomes. Furthermore, there is a likelihood of information and selection biases since the study was conducted in a referral hospital only (Wagura *et al.*, 2018).

## **2.3 The Association between Mothers' Age (Adolescent and Non-Adolescent) and Under-five Stunting Status**

### **2.3.1 Adolescent Mothers versus Non-Adolescent Mothers and Stunting among Under-five**

Stunting, or being too short for one's age, is defined as a height for age that is less than minus 2 standard deviations of the World Health Organization (WHO) child growth reference standards (De Onis, 2006). It is a largely irreversible outcome of inadequate nutrition and repeated bouts of infection during the first 1000 days of a child's life. Stunting has long-term effects on individuals and societies, including diminished cognitive and physical development, reduced productive capacity, poor health and an increased risk of degenerative diseases such as diabetes (WHO, 2012). Childhood stunting is one of the most significant impediments to human development globally, affecting approximately 162 million children under the age of 5 years (WHO, 2012). Maternal age has been known to influence childhood stunting, with a high prevalence among adolescent mothers as compared to non-adolescent mothers. This fact has been reported in several studies (Wemakor *et al.*, 2018; Khan *et al.*, 2019; Maravilla *et al.*, 2020; Quarshie, 2014; Nguyen *et al.*, 2014; Branson, 2016). In a case–control study by Wemakor *et al.* (2018) involving 300 children aged 6–59 months born to teenage (n = 150) and adult (n = 150) mothers in Tamale Metropolis, Ghana, carried out

from April to June 2017, it was revealed that the children of teenage mothers, compared to those of adult mothers, were 8 times more likely to be stunted [Adjusted Odds Ratio (AOR) = 7.56; 95% confidence interval (CI) 4.20–13.63]. Although the study provided some light for further studies, it was subjected to anthropometric measurements and information bias. Also, this study failed to show a cause-effect relationship between nutrition outcomes and children's voices (Wemakor *et al.*, 2018).

According to Maravilla *et al.* (2020) the ongoing nutritional requirements of adolescent mothers due to puberty may deplete fetal nutrition, causing low birthweight, which they also found is strongly associated with stunting (Maravilla *et al.*, 2020). Like other studies discussed above, the study by Nguyen *et al.* (2014), which used the Bangladesh Demographic and Health Survey (1996–2014) and a sample size of 30 331 children, reported that children born to adolescent mothers had lower z-scores for height-for-age (mean difference: 0.64 SD), weight-for-age (0.45 SD), and a higher prevalence of stunting (18 percentage points [pp]) and underweight (12 pp) than children born to adult mothers. Adolescent mothers are at an age where they still need to provide for their growth and developmental needs. These mothers are also at risk of inadequately breastfeeding their infants due to low milk supply, which results in undernourished children (Khan *et al.*, 2019). Other maternal contributors to stunting include short stature, short birth spacing, and adolescent pregnancy, which interfere with nutrient availability to the fetus (owing to the competing demands of ongoing maternal growth) (WHO, 2012).

## **2.4 Maternal Factors Associated with Low Birth Weight and Under-five Stunting Status among Adolescent and Non-Adolescent Mothers**

### **2.4.1 Maternal Education Levels and Birth Outcomes**

Education enables women to make independent decisions and have good access to household resources that are important for better nutrition (Gizaw & Gebremedhin, 2018). Adolescent mothers may represent a particularly disadvantaged risk group characterized by low socioeconomic status, income, and level of education (Mekonnen *et al.*, 2019). Adolescents with high education expectations are likely to delay sexual experience and childbearing to meet those expectations. As a result, they enter into sexual affairs at an advanced age after they have gained enough knowledge and their reproductive systems are fully matured to prevent the likelihood of undesirable birth outcomes. Maternal education and parity are distal socioeconomic and reproductive factors associated with adverse pregnancy outcomes (Althabe *et al.*, 2015).

A strong association was found in a retrospective cross-sectional study done in Ghana which involved 78 adolescent mothers and 853 non-adolescent mothers by Mohammed *et al.* (2019) and assessed the relationship between the maternal level of education and the prevalence of LBW. The study revealed that mothers who attended or completed their secondary or higher education were 63% (95% CI 0.20–0.78) less likely to give birth to LBW infants when compared with uneducated mothers. However, this study recruited participants from the hospital, hence creating a likelihood of selection bias and less generalizability of the obtained findings (Mohammed *et al.*, 2019). Unlike the study conducted in Ghana, an institutional-based study conducted in East Gojjam Zone, Northwest Ethiopia with a total of 374 adolescents (15–19 years) and 760 adults (20–34 years) women, education was not a significant factor for LBW. The study revealed the rate of LBW was higher among adolescent mothers (AOR 2.14; 95% CI 1.36, 3.36,  $p = 0.001$ ) as compared to non-adolescent mothers. Considering that only institutional women were involved in the study, this might have caused study bias because if those delivering outside of institutional settings were also taken into account, they could have influenced the results either positively or negatively (Kassa *et al.*, 2019).

#### **2.4.2 Maternal Occupation and Birth Outcomes**

The majority of developing countries are grappling with the growing challenge of an increasing number of women entering the labor force while balancing maternal roles (Ngwira & Mkandawire, 2003). On the other hand, there is a close link between maternal occupation and economic status. Women with good income tend to widen their food and decision choices, which in turn influences their health status and their families (Pampel *et al.*, 2010).

Different studies have reported the association between maternal occupation and low birth weight among adolescent and non-adolescent mothers. In a systematic review of a total of 30 studies having 55 085 participants by Endalamaw *et al.* (2018), it was reported that LBW among teenage mothers was due to a lack of fair jobs, which contributed to unplanned and/or unwanted pregnancies and less attention to nutritional value and healthcare services utilization as a result of low economic power. Endalamaw *et al.* (2018) found that the risk of infants born to mothers whose age was 20 years to have LBW was two times greater compared to those who were born to non-adolescent mothers. However, a case-control study conducted by Demelash *et al.* (2015), which consisted of 52 adolescent and 77 non-adolescent mothers, revealed that occupational status was not associated with LBW. Nevertheless, the study found that the odds of LBW (AOR = 3.1; 95% CI = 1.65–5.73) were higher among adolescent mothers as compared to non-adolescent mothers (Demelash *et al.*, 2015). In another study, it was reported that the wealthier group of adolescents were better engaged

in maternity care compared to the coalescent ones (Gebremedhin *et al.*, 2015). Good socioeconomic status is an important factor for improving maternal health and the prevention of poor birth outcomes.

### **2.4.3 Maternal Place of Residence and Birth Outcomes**

Maternal place of residence is one of the social determinants that influences the health status of mothers in many ways. Living in a place where there is adequate access to different social and environmental services does influence the health of mothers and their children. A study by Kassa *et al.* (2019) which comprised 374 adolescent mothers and 760 older mothers found an increased risk of low birth weight (LBW) among adolescents than in adult women (AOR 2.14; 95% CI, 1.36, 3.36,  $p = 0.001$ ). The study further revealed that 29 (13.7%) of low-birth-weight babies were born to adolescent women from rural areas, while 10.7% were from adolescent women from urban areas, although the difference was not significant (Kassa *et al.*, 2019). Difficulties in accessing services like medical, health and nutrition information could be the key factors that are associated with poor birth outcomes. Inadequate antenatal care follow-ups and less use of health services are common challenges among adolescents living far from facilities (Kimario *et al.*, 2020).

### **2.4.4 Maternal Nutrition Status and Birth Outcomes**

Overall, 10% of Tanzanian women of reproductive age (15–49 years) are considered undernourished, with a body mass index (BMI) of less than 18.5, with rural women being more affected than urban women (Ministry of Health [MoH], 2015). The proportion of pregnant women of reproductive age who were malnourished [mid-upper arm circumference (MUAC) 220 mm] was higher among adolescent girls aged 15 to 19 years than older women (Tanzania National Nutrition Survey [TNNS], 2018). The Tanzania Demographic and Health Survey also reported an increased prevalence of overweight/obesity among women of age 15–19 years, from 9% in 2010 to 11% in 2015. The triple burden of malnutrition (undernutrition, hidden hunger, and being overweight) has greater negative impacts on birth outcomes. Poor maternal nutrition is a risk factor for poor infant birth, health, and nutrition outcomes (URT, 2011). Several studies have reported the link between low maternal BMI and low birth weight among adolescent mothers compared to adult mothers living in low- and middle-income countries (Sananpanichkul *et al.*, 2015; Kurniati, 2019; Gebregzabihherher *et al.*, 2017; Bililign *et al.*, 2018; Togoobaatar & Ota, 2014; Nesara, 2018; Veghari, 2016; Dharmalingam & Navaneetham, 2009; Seid *et al.*, 2019).

A study conducted in Ethiopia by Kassa *et al.* (2019) with a total of 374 adolescents (15–19 years) and 760 adult women (20–34 years) reported an increased odd (2.14 times) of LBW among



adolescent women due to the low pregnancy weight gain (Kassa *et al.*, 2019). Inadequate weight gain during pregnancy is a risk factor for the delivery of LBW due to competing nutrients between mothers and unborn infants, and this is predominant among adolescent mothers (Gedefaw *et al.*, 2020; Mahumud *et al.*, 2017; Maravilla *et al.*, 2020; Togoobaatar & Ota, 2014).

However, a retrospective study by Sananpanichkul *et al.* (2015), which comprised 371 adolescents and 1641 non-adolescent mothers, conducted between January and June 2013 in Pakistan, found that low maternal BMI and teenage pregnancy were not significantly associated with LBW (Sananpanichkul & Rujirabanjerd, 2015).

#### **2.4.5 Maternal Service Utilization and Birth Outcomes**

Access to maternal services is a greater obstacle for young women aged 15–19 in Tanzania than for their older counterparts. It has been reported that the major barriers perceived by adolescents in accessing delivery health services include lack of money (40%), long distance to health facilities (38%), lack of transport (37%) and unfriendly services (14%) (MoH, 2015). Utilization of maternal health services (MHS) across the continuum of care, that is, antenatal, intrapartum (by skilled birth attendants) and postpartum care, is critical in reducing pregnancy-related morbidities, decreasing maternal mortality of adolescent mothers and improving birth outcomes, survival, quality of life and health of their babies (Banke-Thomas *et al.*, 2017). Unawareness of young women aged 15–19 about where to access health services has been reported as a barrier to utilization (MoH, 2015). According to Tanzania Demographic and Health Survey (TDHS, 2015), antenatal care becomes effective in the prevention of adverse pregnancy outcomes during early pregnancy and continues throughout (TDHS, 2015). A study by Carmo *et al.* (2019) reported that the use of ANC services and health facilities was positively associated with birth outcomes (Carmo *et al.*, 2019). However, an important observation from the study is the lack of equity in accessing these services.

One of the cross-sectional studies conducted by Atunyambe *et al.* (2008) with a total of 762 women (442 adolescents and 320 non-adolescents) found that adolescent mothers were significantly more disadvantaged in terms of health care seeking reproductive health services and faced more challenges during pregnancy and early motherhood compared to non-adolescent mothers. The study further reported that the mean number of times adolescent and adult mothers attended ANC was nearly the same (4.1 and 4.3, respectively) and found a strong association between adolescent mothers and less than four ANC attendances (OR = 1.52, 95% CI: 1.12–2.07). Contrary to this, the study by Tshotetsi *et al.* (2019) contained a sample of 1073 adolescent and non-adolescent mothers and found women who had fewer than 5 ANC visits were strongly associated with LBW (AOR

1.30, CI 1.06 to 1.61) as compared to non-adolescent mothers. This could be possible due to a lack of necessary care, information, and intervention that prevent the likely adverse birth outcome. Due to lack of adherence and unfriendly antenatal care, poor hospitality among health providers has been cited to be among the causes of adverse birth outcomes among adolescents.

A study by Mekonnen *et al.* (2019) reported that unfriendly maternal care contributes to poor utilization of maternal services and that the economic status of the adolescent mother is positively associated with the use of maternal health care. The study further showed that adolescents in the wealthier group were more engaged with maternity care services compared to the poor ones. The use of maternity care is critical given that young women are at higher risk of experiencing complications during pregnancy, childbirth, and the postpartum period, which may lead to an increased risk of maternal and child mortality or poor lifetime health outcomes. It has also been highlighted that the kind of adolescent women's interaction with health care providers may have either positive or negative effects on their experience of accessing maternity care (Mekonnen *et al.*, 2019). For example, in Tanzania, women aged 15–19 years who completed the full phase of antenatal care from 2013 to 2018 had a 48% completion rate (WHO, 2019). Some of the reasons behind feeling shy are poor income and unfriendly health services from healthcare providers.

#### **2.4.6 Maternal Occupation and Child Stunting**

Maternal employment empowers women economically and socially and is in line with Sustainable Development Goal 8, which aims to promote economic growth and productive employment for all. Adolescent pregnancy is associated with increased school dropout rates and decreased educational achievement. Almost half of childbearing mothers fail to complete their high school education, thus increasing the probability of persistent economic and social disadvantage (Barnet *et al.*, 2004). Adolescent mothers who drop out of school and do not pursue higher education are limited in their opportunities (Mohr *et al.*, 2019).

Additionally, adolescent mothers were more likely to be involved in manual work than formal ones as they are less likely to complete secondary and high levels of education (Nguyen *et al.*, 2016). Female employment tends to increase total household income and also the part of the income that is controlled by women has a positive effect on child nutrition and health (Bethelhem, 2019). Mothers who do not work have a higher risk of stunted children compared to mothers who work due to having less time to care for their children. Adolescent mothers are less able to guarantee their children adequate food, access to safe water, and sanitary conditions, which in turn affects child growth (Wemakor *et al.*, 2018).

#### **2.4.7 Maternal Education Level Child Stunting**

Maternal education is a strong predictor of child stunting with some minimal attenuation of the association by other factors (Abuya *et al.*, 2012). Childhood stunting is more likely among mothers with no education or less than a secondary education than among mothers with at least a secondary education (Abuya *et al.*, 2012).

Most teenagers are unlikely to complete their secondary education due to early pregnancy. A study which recruited 30 331 women aged 15–49 by Phuong *et al.* (2020) highlighted that a low level of education among adolescent mothers was significantly associated with a high stunting rate among their under-five children ( $p=0.05$ ) compared to adult mothers (Phuong *et al.*, 2020). The association between mothers' low level of education and an increased risk of child stunting was also reported by several others (Assefa *et al.*, 2013; Chirande *et al.*, 2015; Semali *et al.*, 2015). Educated mothers are more likely to be employed in a variety of fields, have more options, and have consistent food security in their home. However, a study by Agedew & Chane (2015) conducted in Ethiopia, comprised of 97 adolescents and 465 non-adolescent mothers, reported that having no formal education for mothers is negatively associated with the nutritional status of children (Agedew & Chane, 2015).

#### **2.4.8 Maternal Place of Residence and Child Stunting**

A residential area is one of the significant determinants of child undernutrition (Roux *et al.*, 2019). A study conducted in Tanzania found that children living in urban areas were less likely to be stunted compared to their counterparts living in rural areas (AOR = 0.56, 95%CI = 0.50–0.62,  $P=0.001$ ) (Sunguya *et al.*, 2019). This could be due to the fact that children whose mothers reside in urban settings have more access to nutrition information, which enables them to feed their children properly compared to their counterparts. Children whose parents live in rural areas are more likely to be short than those whose parents live in cities (Agedew & Chane, 2015). Possible explanations may be due to better-equipped urban healthcare systems and high access to nutritional information and healthcare services (Gebru *et al.*, 2019). In addition, a cross-sectional study that utilized the Rwanda demographic and health survey found stunting to be higher in rural settings than in urban settings (Habimana & Biracyaza, 2019). The study also found that children whose mothers were in the middle age group (25–34) were more likely to be stunted than those whose mothers were younger (under 25) (Habimana & Biracyaza, 2019). In Zambia, a study which utilized demographic and health survey data by Mzumara *et al.* (2018) found that stunting was more prevalent in children living in urban areas than those in rural areas. The contributing factors that

were stated include decreased maternal-child contact time due to work schedules, short periods of breastfeeding, early cessation of breastfeeding and improper complementary foods, which have a negative effect on children's growth (Mzumara *et al.*, 2018).

#### **2.4.9 Maternal Nutrition Status and Under-five Stunting**

Maternal nutrition and health status are critical factors in early child development (Sarma *et al.*, 2017). Inadequate maternal weight gain and poor dietary intake during pregnancy may result in intrauterine growth retardation, which has an impact on the nutrition status of a child in later life (Gaccioli & Lager, 2016). According to the WHO, the nutritional status of adolescents is of great importance to the health of their mothers and children (WHO, 2018d). In Tanzania, 3.4% of adolescents are wasted (MUAC 220 mm) (TNNS, 2018). Several studies have found a link between maternal nutrition status and child nutrition outcome (Berhe *et al.*, 2019; Hall *et al.*, 2020; Xun, 2019; Black *et al.*, 2008). A cross-sectional study conducted in Ethiopia among 1104 under-five children and 1911 women aged 15–49 years reported an increased risk of stunting in children born from mothers who were less than 155 cm. Children whose mothers' height was less than 155 cm were two times more likely to be stunted (AOR = 2.37) and wasted (AOR = 2.17) compared to those whose height was above 155 cm. Maternal stature is a combined indicator of both genetic and environmental stress during early life and adolescence (Hall *et al.*, 2020). Another study conducted by Dessie *et al.* (2019) with 7452 participants found children whose mothers were underweight had 1.20 times (AOR = 1.20; 95%CI: 1.06, 1.35) chances of being stunted as compared to children of mothers with normal nutritional status (Dessie *et al.*, 2019). Low maternal body-mass index is associated with intrauterine growth restriction (Black *et al.*, 2008) and poor nutritional status in pregnant women results in a reduced supply of nutrients to the fetus, thereby disrupting the process of organogenesis, growth and development (Fitriani *et al.*, 2020).

## **CHAPTER THREE**

### **MATERIALS AND METHODS**

#### **3.1 Data Source**

This study utilized the 2015-16 Tanzania Demographic and Health Survey and Malaria Indicator Survey (2015-16 TDHS-MIS). The TDHS-MIS is a national survey done every five years to monitor and evaluate the population's health and nutrition programs. Specifically, the survey aims to provide up-to-date information on fertility and childhood mortality levels; fertility preferences; awareness, approval, and use of family planning methods; maternal and child health; and knowledge and attitudes toward HIV/AIDS and other sexually transmitted infections (STIs).

The TDHS-MIS 2015-16 is the most recent data with a sufficient sample of adolescent and non-adolescent mothers together with their children's information. It allows assessment of the association between mothers (adolescent and non-adolescent) with social-economic status, child health, and nutrition outcomes.

#### **3.2 Research Design**

The study used secondary data collected from the countrywide cross-sectional survey on population health and nutrition indicators, maternal characteristics, feeding practices, health care seeking behaviours, and child anthropometric measurements.

#### **3.3 Target Population**

The study used data for adolescents 15-19 and non-adolescent mothers aged 20-49 years and their corresponding children 0-59 months all over the country.

#### **3.4 Sampling Procedures**

The 2015 TDHS-MIS uses a two-stage stratified sampling design (TDHS, 2015). The urban and rural areas of each region formed a sampling stratum. A total of 59 sampling strata were created with each sample selected independently. Implicit stratification and proportional allocation were done at each lower-level administrative unit. The detailed sampling procedure has been documented in the 2015 DHS report (TDHS, 2015).

### **3.5 Data Management and Analysis**

The 2015/2016 TDHS dataset was downloaded from the Demographic and Health Survey (DHS) website after completing the registration and fulfilment of the conditions related to the protection of sensitive data. Analysis was conducted in a sample of women who had a live birth five years preceding the survey using STATA version 14 software accounting for survey design.

#### **3.5.1 Subjects and Sample Size**

A total of 13 634 eligible women were identified from 1782 households sampled. Of interviewed women, 27% (2904) were adolescents aged 15-19 years and 73% (10 730) were non-adolescent mothers. Child anthropometric measurements were available in a total of 8852 women (600 adolescents and 8252 non-adolescent) and childbirth weight data was available in a total of 6386 women (459 adolescents and 5927 non-adolescent).

#### **3.5.2 Categorization of Variables**

Variables were categorized as per DHS guidelines with the normative category used as a reference group in regression analysis (De Onis, 2006). Maternal nutritional status was assessed using the BMI and classified as undernutrition (BMI < 18.5), normal (> 18.5 BMI < 25), overweight (> 25 BMI < 30) and obese (BMI > 30). Stunting and childbirth weight of under-five children born by adolescents (15–19 years) and non-adolescent mothers (19–49 years) were considered primary and secondary outcomes, respectively. Manyeh *et al.* (2016) used the 2006 World Health Organization (WHO) growth standards reference points based on z-scores and 2 standard deviations (Manyeh *et al.*, 2016). A child weighed at birth below 2500 grams was termed a "low birth weight baby." Adolescent (15–19 years) and non-adolescent (20–29, 30-39 and 40–49 years) maternal ages were used. The household wealth index was developed based on the household's asset ownership using principal component analysis. The five equal categories (highest, fourth, middle, second, and lower wealth quintiles) used in the TDHS reports were further categorized into two groups (high and low socioeconomic status), with the first three being in the low socioeconomic status to reflect the actual Tanzanian condition.

#### **3.5.3 Statistical Analysis**

Frequencies and percentages were used to present results from descriptive analysis stratified by outcome variables. Univariate logistic regression models were fitted independently with stunting and birth weight as outcome variables while adjusting for socioeconomic and demographic

characteristics such as age, height, weight (for both mother and child), maternal characteristics (education, place of residence), and uptake of maternal care. As anticipated, logistic regression analysis was not done separately for each maternal age group (adolescent and adult mothers) due to the small sample size, particularly in the adolescent population. A pooled analysis was done instead for each outcome variable, with maternal age as the main exposure. A forward selection procedure was applied during modelling, with variable selection based on the change in the exposure effect estimate. The procedure involved four main steps:

- (i) Descriptive analysis and preliminary investigations into the relationship between variables, with a focus on effect sizes and *p-values* at a 95% significant level.
- (ii) Selecting one variable at a time from a list of candidate variables (socioeconomic and demographic characteristics such as age, height, weight (for both mother and child), maternal characteristics (education, place of residence), and use of maternal care). From univariate analysis were then included in the model with and without adjustment of forced variables to help understand the effect of forced variables. The choice of the “best” predictor to be included in the model was then decided based on the change in the exposure effect estimate. Each time a new variable was added to the model, evidence of confounding and multicollinearity was assessed by comparing the effect estimates and standard errors between the “univariate” and “multivariate” models.
- (iii) Multivariable models were fitted by adding explanatory variables (socioeconomic and demographic characteristics such as age, height, weight (for both mother and child), maternal characteristics (education, place of residence), and uptake of maternal care) that were removed from the models in step “b” one at a time to help explore their effect when added to the model. Variables that resulted in positive changes in the mean square error were then included in the model. The process was repeated until all variables that provided precise estimates of exposure variables were selected.

### **3.6 Ethical Considerations**

The protocol, study procedures, and questionnaires for DHS surveys were reviewed and approved by the international Institutional Review Board (IRB) and by the National Institute of Medical Research committee prior to the 2015 data collection. Before the interviews, written informed consent was obtained from all participants. A parent or guardian provided consent for the child or adolescent to be involved in the study. Interviews were performed as privately as possible with each eligible respondent interviewed in the absence of another person. A comparative analysis of

determinants of low birth weight and stunting among under-five children of adolescent and non-adolescent mothers using the 2015/16 Tanzania demographic and health survey was again approved by the Ifakara Health Institute review board (IHI/IRB/No: 24/2020).



## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.1 Results

##### 4.1.1 Association between Mother's Age (Adolescent and Non-adolescent Mothers) and Under-five stunting

###### (i) Household Characteristics

A total of 13 360 and 1782 households in Tanzania and Zanzibar were selected for the interviews. The response rate for the interviewed households was very similar in both rural and urban residency (Table 1).

A total number of 13 634 (unweighted sample) eligible women were identified for individual interviews. Interviews were completed with 13 266 women, yielding a response rate of 97%, the number of eligible women interviewed with age 20-49 years was 10 362 and 2904 with age 15-19 years (weighed sub-sample).

**Table 1: Household and individual interviews**

Results	Tanzania Mainland			Zanzibar	Tanzania
	Urban	Rural	Total		
Household interviews					
Household selected	3570	8008	11 578	1782	13 360
Household occupied	3364	7639	11 003	1764	12 767
Household interviewed	3265	7543	10 808	1755	12 563
Household response rate	97.1	98.7	98.2	99.5	98.4
Interviews with women age 15-19	1053	1755	2808	97	2904
Interview with women age 20-49	3622	6432	10 055	307	10 362

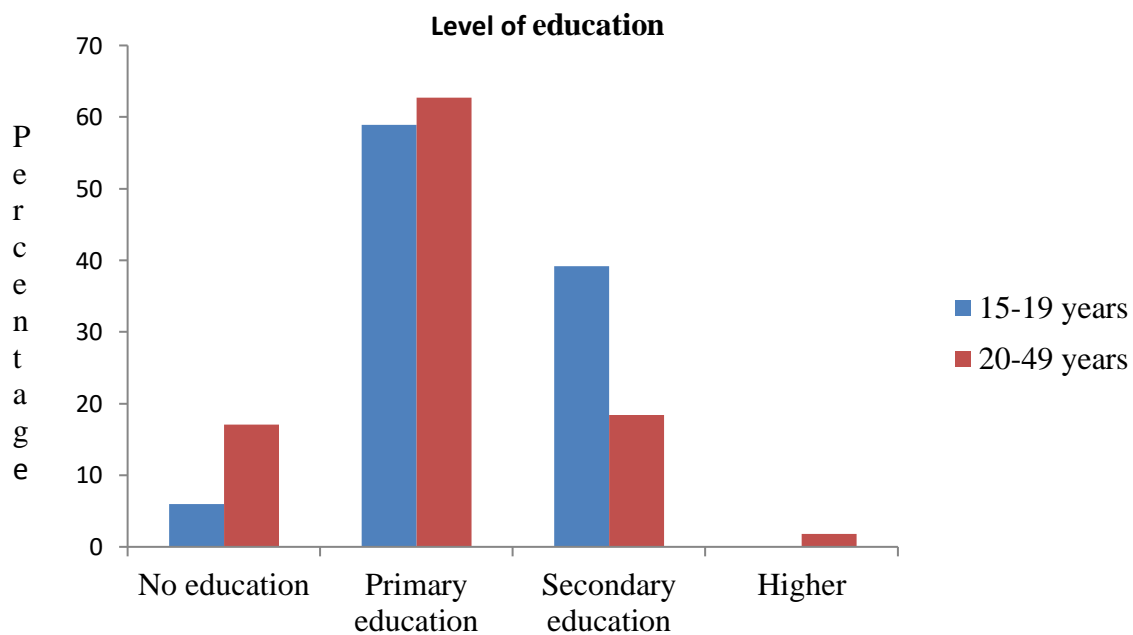
This table obtained from the DHS-MIS explain the distribution of interviews conducted per Tanzania mainland and Zanzibar

###### (ii) Maternal background characteristics

This study is aimed at identifying the association between maternal characteristics that influence birth outcome and under-five stunting. Factors like maternal level of education, occupation, marital

status, wealth quintile, place of residence, service utilization and radio exposure were analyzed to determine their association with under-five birthweight and nutrition status.

About 59% of the adolescent and 63% of the non-adolescent mothers had attained primary education. Only 0.1% of the adolescent mothers and 1.8% of the non-adolescent mothers attained a higher learning education (college or university) (Fig.1). The proportion of women employed in the agriculture sector was 59% (age 15-19 years) and 55% (age 20-49), and the corresponding proportions of those working in unskilled manual labour were 18.2% and (22.6%), respectively. Few of them were employed in clerical and professional/technical/managerial work. The proportion of the study participants in the highest wealth quintile was 29.7% for adolescents and 26.4% for non-adolescent mothers. About 75% of adolescent mothers and 11.4% of non-adolescent mothers were never married. Some of them (2.3% of adolescents and 15.9% of older mothers) were divorced, separated or widowed. Only a few adolescent mothers (23.0% compared to 72.8% of non-adolescent mothers) were married or living with their partners. Most of the respondents (43.2% of teen mothers and 45.1% of older mothers) had access to listening to the radio at least once per week. However, 21.3% and 22.3% of adolescent and non-adolescent mothers, respectively, were not listening to the radio at all.



**Figure 1: Maternal level of education**

**Table 2: Socio-economic and Demographic Characteristics of Mothers**

Parameter	Maternal Age	
	15 – 19 years N=2904 n (%)	20 years and above N=10 362 n (%)
<b>Level of education</b>		
No education	174 (6.0)	1773 (17.1)
Primary education	1711 (58.9)	6500 (62.7)
Secondary education	1017 (39.15)	1908 (18.4)
higher	2 (0.1)	181 (1.8)
<b>Occupation</b>		
Professional/technical/managerial	12 (1.0)	414 (4.8)
Clerical	3 (0.1)	75 (1.0)
Agricultural - self employed	835 (59.0)	4741 (55.0)
Domestic services	173 (12.2)	581 (6.7)
Sales and services	66 (4.7)	481 (5.6)
skilled manual	69 (4.9)	386 (4.5)
unskilled manual	257 (18.2)	1951 (22.6)
<b>Wealth quintile</b>		
Low SES	1433 (49.4)	5415 (52.3)
High SES	1471 (50.7)	4947 (47.7)
<b>Place of residence</b>		
Urban	1083 (37.3)	3728 (36.0)
Rural	1821 (62.7)	6636 (64.0)
<b>Marital status</b>		
Never married	2170 (74.7)	1183 (11.4)
Married or living together	668 (23.0)	7543 (72.8)
Divorced/ Separated/ Widowed	66 (2.3)	1636 (15.8)
<b>Radio exposure</b>		
not at all	619 (21.3)	2313 (22.3)
less than once a week	1031 (35.5)	3381 (32.6)
at least once a week	1254 (43.2)	4667 (45.1)

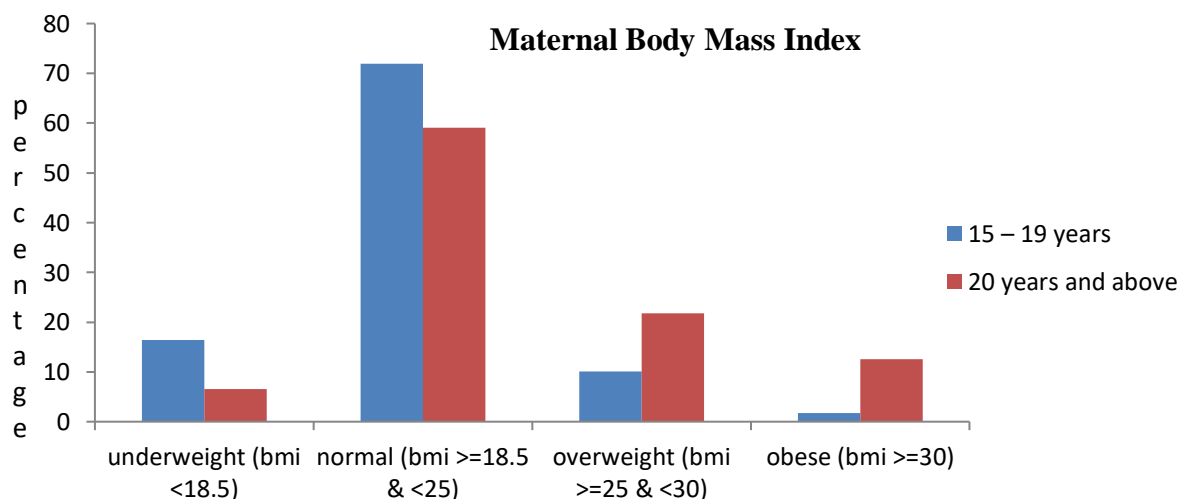
### (iii) Anthropometric and Nutrition Status of Mothers

The study participants have an average weight of 57.5 kg for adolescent mothers and 66.3 kg for non-adolescent mothers with a mean height of 155.7cm and 156.8 cm respectively (Table 3).

**Table 3: Anthropometric and nutrition status of mothers**

Parameter	Maternal Age 15 – 19 years		Difference Effect 20 years and above	
	Mean	95% CI	Mean	95% CI
Weight (kg)	57.5	54.6-60.3	66.3	64.3-68.3
Height (cm)	155.7	155.4-156.0	156.8	156.6-157.0

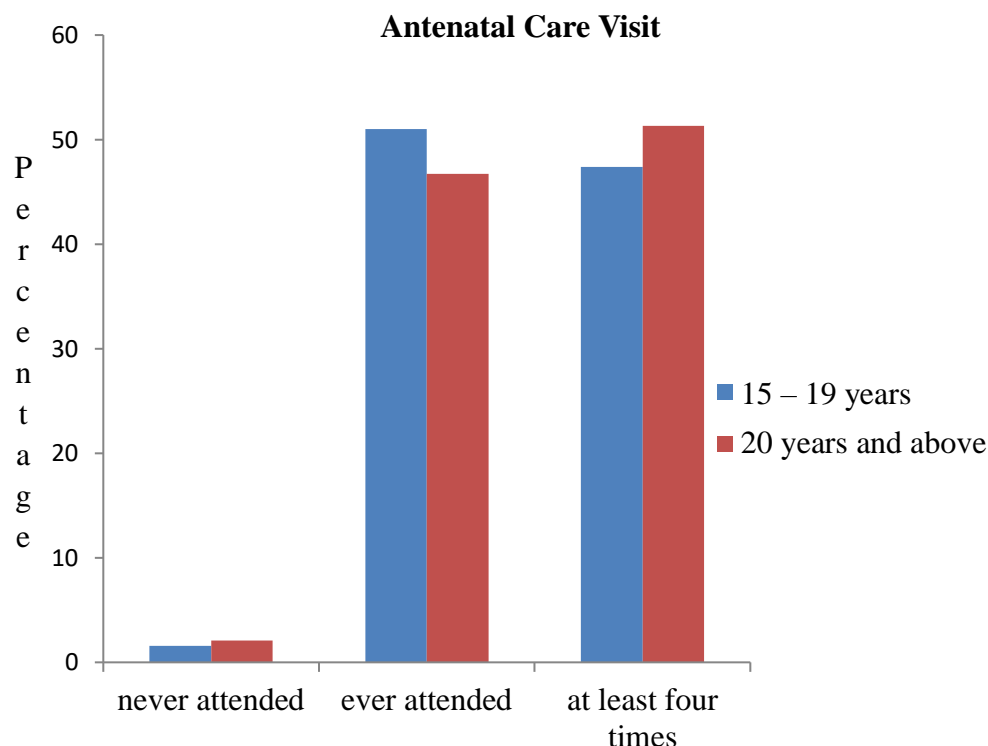
With regard to BMI, more adolescent mothers seemed to be underweight (16.4% CI 14.9–18.1) compared to non-adolescent mothers (6.5% C.I 5.9–7.1). The majority of the participants (71.9% of adolescents and 59.1% of non-adolescent mothers) had normal BMI. However, non-adolescent mothers were significantly affected by overweight and obesity compared to adolescent mothers (Fig. 2).



**Figure 2: Maternal Body Mass Index (BMI)**

#### *Antenatal Care attendance*

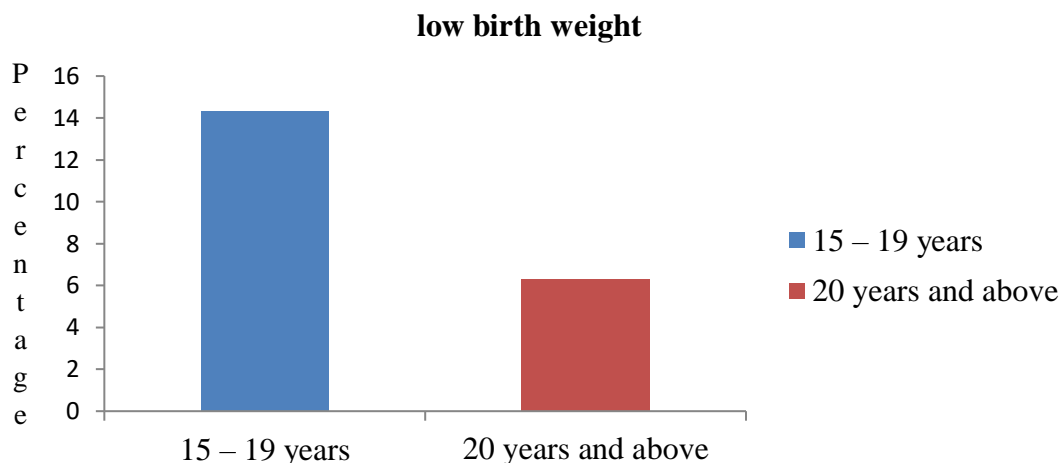
Fifty-one per cent of the adolescent and 48% of non-adolescent mothers were found to attend Antenatal Care attendance (ANC) whereby 47.4% and 51.3% respectively had at least four visits. Few of them (1.6% of adolescents and 2.1 of non-adolescent mothers) did not attend ANC visits (Fig. 3).



**Figure 3: Gestation age at 1<sup>st</sup> Antenatal Care Visits**

#### **4.1.2 Prevalence of Low Birth Weight in Children from Adolescent and Non-adolescent Mothers**

Overall, 14.3% of adolescents and 6.3% of non-adolescent mothers gave birth to low-birth-weight babies (Table 4). Nineteen per cent of the adolescent mothers with no education had low-birth-weight babies, compared to 7.1% of the non-adolescent mothers. The urban community appears to have a higher proportion of mothers who gave birth to LBW babies, with 15.5% for adolescent mothers and 6.9% for non-adolescent mothers, when compared to those located in rural settings (13.7% and 6.0%). Twenty-two per cent of divorced, separated or widowed adolescent mothers gave birth to LBW babies, compared to 9.5% of non-adolescent mothers. Twenty-four per cent of the undernourished adolescent mothers gave birth to LBW babies, as compared to 10.4% of undernourished adult mothers (Fig. 4).



**Figure 4: Low birth weight status of the study participants**

**Table 4: Prevalence of Low Birth Weight in children from adolescent and non-adolescent mothers by maternal characteristics (N= 6386)**

Variable	Adolescent mothers (15-19 years.)		Non-Adolescent mothers (20+ years)	
	N	LBW children n (%)	N	LBW children n (%)
<b>Overall</b>	459	66 (14.3)	5927	376 (6.3)
<b>Level of education</b>				
No education	34	6 (19.1)	831	59 (7.1)
Primary education	353	52 (14.9)	3867	241 (6.2)
Secondary education or higher	71	7 (0.9)	1229	76 (6.2)
<b>Wealth quintile</b>				
Low SES	275	40 (14.4)	3016	186 (6.2)
High SES	184	26 (14.1)	2910	190 (6.5)
<b>Place of residence</b>				
Urban	148	23 (15.5)	2255	156 (6.9)
Rural	312	43 (13.7)	3672	220 (6.0)
<b>Marital status</b>				
Never married	128	19 (14.9)	330	25 (7.6)
Married or living together	287	37 (12.9)	4842	279 (5.8)
Divorced/ Separated/ Widowed	45	10 (22.0)	755	72 (9.5)
<b>Maternal BMI</b>				
Undernutrition	43	10 (23.9)	309	32 (10.4)
Normal	363	46 (12.7)	3646	232 (6.4)
Overweight or obese	52	9 (18.0)	1936	110 (5.7)
<b>ANC visits</b>				
Ever attended	200	31 (15.7)	1837	124 (6.7)
Attended at least four visits	218	31 (14.3)	2500	106 (4.3)

SES= Socio-economic status, BMI= Body Mass Index, ANC=Antenatal care, LBW =Low Birth Weight  
N=Total number of children with birth weight data, n= Number of children with Low Birth Weight

### 4.1.3 Prevalence of Under-five Stunting, Wasting and Underweight

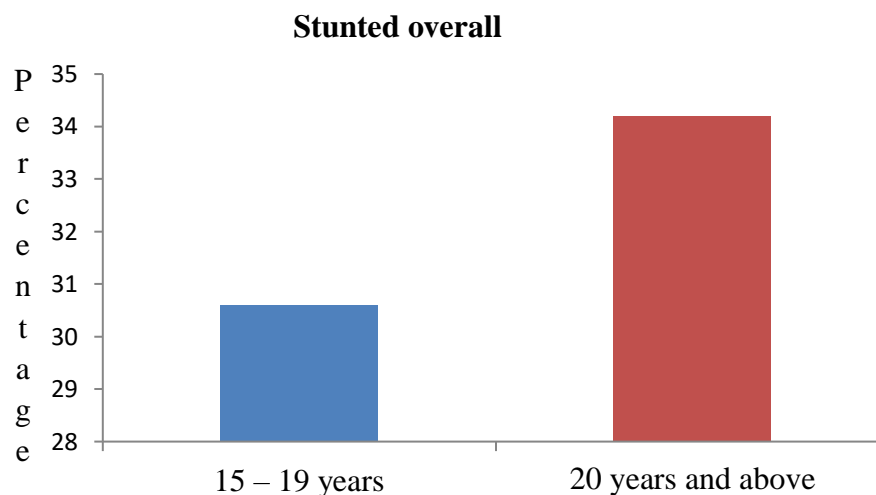
Generally, 31% of stunted and 10% of the severely stunted children under five years old were from adolescent mothers, while the corresponding proportions of the children from non-adolescent mothers were 34.2% and 11.5%, respectively. As with acute malnutrition, the proportion of wasting among children under five was very small in children of both adolescent (7.0%) and non-adolescent mothers (4.6%). Eleven per cent of the adolescent mother's children were underweight, as compared to 13.8% of the adult mother's children (Table 5). The table above gives a broad picture of under-five nutrition outcomes, but our study focused on stunting status among adolescent and non-adolescent mothers, where the difference between them is not significant.

**Table 5: Prevalence of under-five stunting, wasting and underweight**

Parameter	Maternal Age			
	15 – 19 years		20 years and above	
	n	%(95% CI)	N	%(95%CI)
<b>Child Nutrition Status</b>				
<b>Stunted</b>				
Overall	183	30.6 (26.6-34.9)	2820	34.2 (32.6-35.8)
Severe	59	9.9 (7.6-12.7)	945	11.5 (10.5-12.3)
<b>Wasted</b>				
Overall	42	7.0 (4.9-9.9)	376	4.6 (4.1-5.1)
Severe	13	2.2 (1.2-4.1)	97	1.2 (1.0-1.5)
<b>Underweight</b>				
Overall	65	10.9 (8.3-14.1)	1138	13.8 (12.7-14.9)
Severe	16	2.7 (1.5-4.6)	224	2.7 (2.3-3.2)

### 4.1.4 Prevalence of stunting among under-five children according to maternal characteristics

Thirty-eight per cent of under-five children born by women who have not been to school or have a primary level of education were stunted. Over 30% of children born to mothers living in rural areas or in lower socioeconomic groups were stunted. The proportion of stunted children by marital status was very similar, ranging from 25.8% among children born to divorced or separated adolescent women to 32.3%. For non-adolescent women, it ranges from 32.2% among those never married to 39.4% among divorced or separated women. Thirty-four per cent of the under-five stunted children were born to adolescent mothers who were overweight or obese, as compared to 26.6% of adult mothers. Adult mothers who ever attended ANC visits had a high percentage (33.9%) of stunted children as compared to adolescent mothers (22.87%) as presented in Table 6.



**Figure 5: Stunting prevalence according to maternal age**

**Table 6: Prevalence of child stunting among adolescent and non-adolescent mothers by maternal characteristics (N=8852)**

Variable	Adolescent mothers (15-19 years)		Non-Adolescent mothers (20+ years)	
	N	Stunted children n (%)	N	Stunted children n (%)
<b>Overall</b>	600	183 (30.6)	8252	2820 (34.2)
<b>Level of education</b>				
No education	79	30 (38.0)	1820	709 (38.9)
Primary education	455	139 (30.6)	5258	1839 (35.0)
Secondary education or higher	66	14 (21.5)	1174	272 (23.2)
<b>Wealth quintile</b>				
Low SES	419	137 (32.8)	5403	2124 (39.3)
High SES	182	46 (25.4)	2849	695 (24.4)
<b>Place of residence</b>				
Urban	141	36 (25.8)	2148	532 (24.8)
Rural	459	147 (32.0)	6104	2287 (37.5)
<b>Marital status</b>				
Never married	141	38 (26.9)	333	107 (32.2)
Married or living together	416	134 (32.3)	7042	2367 (33.6)
Divorced/ Separated/ Widowed	43	11 (25.8)	878	345 (39.4)
<b>Nutrition Status (BMI)</b>				
Undernutrition	53	16 (30.0)	552	220 (39.9)
Normal	481	145 (30.2)	5528	2024 (36.6)
Overweight or obese	65	22 (34.3)	2155	573 (26.6)
<b>ANC visits</b>				
Ever attended	284	81 (28.7)	2914	989 (33.9)
Attended at least four	260	76 (29.1)	3001	913 (30.4)

SES= Socio-economic status, BMI= Body Mass Index, ANC=Antenatal care, N=Total number of children with anthropometric measurement, n= Number of stunted children



#### **4.1.5 Predictors of Low Birth Weight**

This analysis was conducted on a sample of 6385 women that had a live birth five years preceding the survey and weight data for their most recent child. Maternal age (adolescent and non-adolescent mothers) was considered the main exposure as explained in the method section. Overall, non-adolescent mothers have a reduced odds of giving birth to LBW babies when compared to adolescent mothers in both univariate and multivariate analyses. The odds of delivering LBW babies decreased from 0.41 (95% CI: 0.29–0.57) in crude analysis to 0.34 (95% CI: 0.22-0.50) in adjusted analysis (Table 3). Maternal BMI, marital status, and attending at least four ANC visits were significantly associated with LBW. The proportion of LBW babies was higher among mothers with primary education (66.5%), married or living with their partner (71.6%) and those with low socioeconomic status (51.1%) (Table 7).

**Table 7: Factors associated with Low Birth Weight (N=6385)**

Variables	N	n (%)	OR (95% CI)	*AOR (95%CI)
<b>Maternal age (Years)</b>				
Adolescents (15-19)	459	66 (14.3)	1	1
Adults (20 +)	5927	376 (6.3)	0.41 (0.29-0.57)	0.34 (0.22-0.50)
<b>Level of education</b>				
No education	865	65 (14.8)	1	
Primary education	4220	294 (66.5)	0.91 (0.63-1.32)	
Secondary education or higher	1300	83 (18.7)	0.83 (0.55-1.26)	
<b>Wealth quintile</b>				
Low SES	3291	226 (51.1)	1	
High SES	3094	216 (48.9)	1.02 (0.78-1.33)	
<b>Marital status</b>				
Never married	458	44 (9.8)	1.62 (1.05-2.49)	1.23 (0.75-2.04)
Married or living together	5129	316 (71.6)	1	1
Divorced/ Separated/ Widowed	799	81 (18.4)	1.72 (1.23-2.42)	1.76 (1.24-2.50)
<b>Place of residence</b>				
Urban	2402	179 (40.4)	1	
Rural	3984	263 (59.6)	0.88 (0.67-1.16)	
<b>Maternal BMI</b>				
Undernutrition	352	42 (9.6)	1.84 (1.23-2.75)	2.29 (1.43-3.67)
Normal	4009	279 (63.2)	1	1
Overweight or obese	1987	120 (27.2)	0.86 (0.64-1.14)	0.99 (0.71-1.38)
<b>At least 4 ANC visits</b>				
No	2037	155 (53.0)	1	1
Yes	2718	138 (47.0)	0.65 (0.50-0.83)	0.64 (0.49-0.83)
<b>Child Sex</b>				
Male	3266	197 (44.5)	1	1
Female	3120	245 (55.5)	1.33 (1.07-1.68)	1.31 (0.98-1.75)

N= Total number of respondents, n= Number of respondents with low-birth-weight babies, % =row percent, AOR=Adjusted odds ratio, OR=odds ratio, CI= 95 % Confidence interval, SES=Socioeconomic status, BMI=Body mass index, ANC=Antenatal care

\* Adjusted for maternal age, marital status, maternal BMI, ANC attendance and child sex

#### 4.1.6 Predictors of Stunting in Under-five Children

A total of 8852 women with live births in the five years preceding the survey who had their height and age measurement documented in the dataset were considered in this analysis. As for LBW analysis, maternal age was considered as the main exposure while controlling for other maternal factors, including age, education, wealth index, marital status, place of residence, occupation, nutrition status, and child characteristics (birth weight, sex, and age) in the model. Although 34.2% of children born by non-adolescent mothers were stunted compared to 30.6% of adolescent mothers,

the adjusted analysis did not show any significant difference in childhood stunting between these two age groups; AOR: 0.97 (95% CI: 0.73-1.29) (Table 8).

In a multivariate analysis, socioeconomic status (SES) was significantly associated with childhood stunting (AOR = 0.69; 95% CI: 0.57–0.84), with children found in the higher socioeconomic group having a reduced odds of being stunted compared to those in the lower socioeconomic group. Children born with low birth weight were 2.4 times more likely to be stunted (95% CI: 1.80–3.20) compared to those born with normal birth weight. Female children were less likely to be stunted (AOR = 0.77; 95% CI: 0.67-0.89) compared to their male counterparts. Also, children whose age was beyond 1 year were 3 times more likely to be stunted as compared to those with less than one year (Table 8).

**Table 8: Factors associated with stunting (N=8852)**

	N	n (%)	OR (95% CI)	*AOR (95% CI)
<b>Maternal age (years)</b>				
Adolescent (15-19)	600	183 (30.2)	1	1
Adults (20+)	8252	2820 (34.2)	1.18 (0.96-1.45)	0.97 (0.73-1.29)
<b>Level of education</b>				
No education	1900	739 (24.6)	1	1
Primary education	5712	1978 (65.9)	0.83 (0.73-0.94)	1.05 (0.85-1.30)
Secondary education or higher	1240	286 (9.5)	0.47 (0.38-0.58)	0.81 (0.61-1.08)
<b>Wealth quintile</b>				
Low SES	5822	2262 (75.3)	1	1
High SES	3031	742 (24.7)	0.51 (0.45-0.58)	0.69 (0.57-0.84)
<b>Marital status</b>				
Never married	475	145 (4.8)	0.87 (0.70-1.10)	1.25 (0.95-1.67)
Married or living together	7457	2501 (83.3)	1	1
Divorced/ Separated/ Widowed	921	357 (11.9)	1.25 (1.04-1.49)	1.19 (0.93-1.51)
<b>Place of residence</b>				
Urban	2289	569 (18.9)	1	1
Rural	6564	2435 (81.1)	1.78 (1.48-2.15)	1.21 (0.93-1.56)
<b>Maternal BMI</b>				
Undernutrition	605	236 (7.9)	1.13 (0.93-1.38)	1.14 (0.85-1.52)
Normal	6009	2169 (72.3)	1	1
Overweight or obese	2220	596 (19.9)	0.65 (0.56-0.75)	0.77 (0.64-0.92)
<b>Child characteristics</b>				
<b>Birth weight</b>				
Normal	5245	1568 (90.4)	1	1
Low birth weight	341	166 (9.6)	2.23 (1.67-2.98)	2.40 (1.80-3.20)
<b>Sex</b>				
Male	4490	1631 (54.3)	1	1
Female	4363	1372 (45.7)	0.80 (0.72-0.89)	0.77 (0.67-0.89)
<b>Age (months)</b>				
0-11	1989	321 (10.7)	1	1
12-23	2065	781 (26.0)	3.17 (2.66-3.76)	3.19 (2.49-4.08)
24-59	4798	1901 (63.3)	3.41 (2.94-3.96)	3.36 (2.76-4.11)

N= Total number of respondents, n= Number of under-five children stunted, % =row percent AOR=Adjusted odds ratio, OR=odds ratio, CI= 95 % Confidence interval, SES=Socioeconomic status, BMI=Body mass index, ANC=Antenatal care

\*Adjusted for the maternal level of education, wealth index, marital status, place of residence, occupation, BMI, childbirth weight, sex and age

## 4.2 Discussion

### 4.2.1 The association between Adolescent and Non-adolescent Mothers' Characteristics and Childbirth Weight

There is a higher prevalence of low birth weight (14.3%) among adolescent mothers compared to non-adolescent mothers (6.3%). The prevalence of low birth weight among adolescent mothers was

higher than the 10.32% reported in the TDHS (2015) and the Eastern and Southern Africa zone (11%) (WHO, 2014) but nearly equivalent to that reported globally (14.6%) (WHO, 2019d).

**(i) Maternal age and Childbirth Weight**

After adjusting for potential confounders, the findings showed that maternal age was significantly associated with LBW. Similar findings were reported in other studies (Manyeh *et al.*, 2016; Mombo-ngoma *et al.*, 2016; Abebe *et al.*, 2018). Adolescent mothers have a greater risk of delivering LBW infants compared to adult mothers. Several factors were said to predispose adolescents to giving birth to low birth weight children, including having an unplanned pregnancy, biological immaturity, and poor nutrition status during pregnancy (Manyeh *et al.*, 2016).

**(ii) Maternal Attendance to Antenatal Care and Childbirth Weight**

According to WHO guidelines (WHO, 2018), a minimum of four ANC visits are required for a safe pregnancy. Findings from this study have shown that mothers who attended at least four ANC visits had a lower risk of delivering LBW infants compared to those who had few visits. These findings are similar to those from a study conducted in India (Jogia & Lodhiya, 2018). Attendance at ANC is likely to reduce access to health education and other services like iron and folic acid supplements, antimalarial and deworming drugs, which contribute to the better health of the mother and unborn baby.

**(iii) Maternal Marital Status and Childbirth Weight**

The study found a significant increase in the risk of LBW among mothers who were divorced/separated or widowed, of which the majority were adolescents. This is parallel to the finding reported by Gizaw and Gebremedhin (2018) but in contrast to the studies conducted in Ethiopia (Talie *et al.*, 2019; Tshotetsi *et al.*, 2019), which found no significant association between marital status and LBW. Lack of social and economic support and stress among single and separated/divorced/widowed pregnant adolescent girls could be contributing factors to the delivery of LBW infants (Marimuthu *et al.*, 2018).

**(iv) Maternal Nutrition Status and Childbirth Weight**

There were significantly higher odds of LBW among undernourished mothers compared to those whose nutritional status was normal. Optimal nutrition is particularly critical for pregnant teens (URT, 2011). However, the prevalence of underweight was higher in adolescent mothers compared

to their older counterparts. These findings were similar to the ones reported through studies conducted in India (Sananpanichkul & Rujirabanjerd, 2015) and Ethiopia (Tyagi *et al.*, 2017). Factors like poor SES, unemployment, poor dietary intake, and poor weight gain during pregnancy are likely to contribute to the delivery of LBW infants.

#### **4.2.2 The Association between Adolescent and Non-adolescent Maternal Characteristics and Stunting in Under-five Children**

From this study, it was determined that the prevalence of stunting among under-five children was 33.9%, which, according to WHO standards (WHO, 2017), is still unacceptably high and much higher compared to 25% in some other developing countries (URT, 2019). Although 34.2% of children born by non-adolescent mothers were stunted compared to 30.6% of those born by adolescent mothers, the adjusted analysis did not show any significant difference between these two age groups, AOR: 0.97 (95% CI: 0.73–1.29).

These findings are similar to those reported in Ethiopia (Agedew & Chane, 2015) but contrary to those presented by Habyarimana *et al.* (2016) who used the Rwanda Demographic and Health Survey. The lack of a significant difference in stunting among children born to adolescent mothers compared to older women signifies that stunting is affected by several other factors beyond maternal age. In this study, maternal SES, BMI, child sex, birth weight, and age were found to be significantly associated with childhood stunting. Other studies have found that poor birth spacing, SES, and nutrition status of older mothers are the factors associated with childhood stunting (Mistry *et al.*, 2018). Improving maternal nutrition and health before and during pregnancy reduces childhood stunting and enhances maternal survival (AU, 2009). Other maternal factors that were associated with childhood stunting as generated from the multivariate analysis are discussed in the sections below:

##### **(i) Maternal Socioeconomic Status and Childhood Stunting**

A negative association was found between mothers' high socioeconomic status and childhood stunting. This is consistent with the studies done in Bangladesh, sub-Saharan Africa and Ethiopia (Kamal *et al.*, 2010; Yaya *et al.*, 2020; Birara, 2014). High household purchasing power, good sanitation, and access to health care services are among the issues that are affordable among families with high socioeconomic status, and they are contributing to good nutrition status among under-five children (Chirande *et al.*, 2015). Poor social-economic status interferes with household food

security and access to quality social and health services (Kalu & Etim, 2018; Kalkidan, 2019; Yaya *et al.*, 2020) and negatively affects the health and nutritional status.

## **(ii) Maternal nutrition status and childhood stunting**

Maternal nutrition status was significantly associated with stunting in under-five children. Unlike the study conducted in Switzerland (Jornayvaz *et al.*, 2016), this study has found a lower risk of stunting in children born to obese women as compared to those whose mothers had normal BMI. These findings are similar to those reported in Ghana (Abubakari *et al.*, 2015), which found that infants of obese or overweight mothers were more stunted than those whose mothers had normal BMI. Obesity may be a reflection of good socioeconomic status in African settings.

### **4.2.3 Relationship between Stunting and Child's Birth Weight, Sex and Age**

#### **(i) Childbirth Weight and Stunting**

This study found that children born with a normal weight ( $> 2.5$  kg) were 2 times less likely to be stunted compared to those born with a low birth weight. It was further revealed that low birth weight ( $< 2.5$  kg) is a significant factor in childhood stunting. This is in line with the studies conducted in Rwanda, Indonesia and Ethiopia (Nshimyiryo *et al.*, 2019; Rachmi *et al.*, 2016, Silas *et al.*, 2018). The LBW is a predisposing factor for poor growth (Aryastami *et al.*, 2017) and is a reflection of intrauterine nutrient deprivation (Gaccioli & Lager, 2016).

#### **(ii) Child sex and Stunting**

In this study, under-five male children were found to be more stunted than females. The stunting in female children was significantly decreased by 22% compared to males. This agrees with studies conducted in Tanzania, Afghanistan and Ghana (Kejo *et al.*, 2018; Khan *et al.*, 2019; Ali *et al.*, 2017). A meta-analysis study in which data from 16 developing countries was used, reported a higher prevalence of stunting among boys (40%) than among girls (36%). In the analysis, boys from the household with the poorest social economic status were more likely to be stunted than girls in the same social-economic category (Wamani *et al.*, 2007). The justification for the disparities between boys and girls provided in a study conducted in the Mbeya region of the Tanzania mainland might support our differences. In that study, 60% of infants were stunted, and among them, more boys (65.3%) were stunted than girls (54.7%). Maternal preference for girls was highlighted as the reason for the disparities (McAuliffe *et al.*, 2011). Probably this might be related to favouring of girls during breastfeeding as reported in Nigeria whereby girls were two-fold likely to receive

exclusive breastfeeding than boys (Agho *et al.*, 2011) or early exposure to complementary foods among boys than girls as reported in Cote d'Ivoire and Senegal (Issaka *et al.*, 2015).

### **(iii) Child age and Stunting**

This study found that stunting was significantly associated with child age. The odds of being stunted were high among children whose age was over 11 months compared to the younger ones. The odds of being stunted were high in children aged 1-2 and 2-5 years (AOR = 3.18) compared to those children younger than 1 year. These findings agree with another study conducted in Tanzania which found a positive association between child age and stunting (Makori, 2018) and are in line with TNNS (2018). Poor breastfeeding practices and improper complementary feeding are some of the factors associated with stunting among children aged over one year of age. In this study, stunting was more prevalent in children who were older than one year of age compared to the younger group. This chronic malnutrition may be due to long-term nutrient deprivation and inadequate care (Mzumara *et al.*, 2018).



## **CHAPTER FIVE**

### **CONCLUSION AND RECOMMENDATION**

#### **5.1 Conclusion**

After controlling for the possible confounders, this study found that adolescent mothers aged 15–19 years were significantly at higher risk of delivering LBW babies compared to older mothers. With a national average low birth weight of 10% (TDHS, 2015), the prevalence of LBW was higher among the children of adolescent mothers (14% compared to those of non-adolescent mothers (6%). Other maternal factors that showed a significant association with LBW were frequency of ANC attendance, marital status, and BMI. Under-five stunting was independent of maternal age. The study found that non-adolescent mothers had a lower rate of under-five children who were stunted than adolescent mothers. However, after controlling for the possible confounding factors like maternal wealth index, maternal nutrition status, childbirth weight, sex and age of the child, the association was not statistically significant.

#### **5.2 Recommendations**

- (i) Along with ongoing government efforts to enforce charges against those who cause early pregnancies among school girls, there is a need to also support adolescent pregnant girls to access friendly health services and to return to school after delivery. Preventive and birth control methods must be taught in early classes to prevent unexpected pregnancies.
- (ii) This study showed the likelihood of stunting to be higher in male children than in females. Because of this, government policies, strategies, and guidelines may require specific interventions to address the needs of boys. This also needs further comprehensive research to check what causes under-five boys to be more stunted than girls.
- (iii) Nutrition interventions need to be prioritized in the regions with the highest number of stunted children and the higher prevalence of chronic malnutrition with consideration of the multi-causal nature of stunting and multi-sectoral collaboration.

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## RESEARCH OUTPUTS

### (i) Publication

Mtongwa, H. R., Festo, C., & Elisaria, E. (2021). A Comparative Analysis of Determinants of Low Birth Weight and Stunting Among Under-Five Children of Adolescent and Non-Adolescent Mothers Using 2015/16 Tanzania Demographic and Health Survey. *BMC Nutrition*, 7(64), 1-10. <https://doi.org/10.1186/s40795-021-00468-6>

### (ii) Poster Presentation