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PARENTAL EDUCATION AND CHILD NUTRITION OUTCOME IN LIBERIA

BY

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DECLARATION

I, EMMANUEL TAMBA PORPEH, JR., this work was done wholly or mainly while in candidature for a master of arts degree at the University of Ghana, apart from reference to other works, I have acknowledged all main sources of help, carried under the supervision of Dr. Aaron K. Christian at the Regional Institute for Population Studies of the University of Ghana, Legon.

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……………………………………… 12/12/2023 ………………………
Date Date

DEDICATION

I dedicate this dissertation to the Almighty God, the source of wisdom, strength, and inspiration. In his boundless grace, I find the courage to pursue knowledge and the resilience to overcome challenges. This work is a testament to His guidance throughout this academic journey.

May this humble effort reflect the gifts and opportunities He has bestowed upon me. I offer my deepest gratitude for his unwavering support, which has sustained me in moments of doubt and illuminated my path with divine light.

I acknowledge with reverence that all knowledge and understanding ultimately originate from the Divine. To God be the glory, now and forever.

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Abstract

Stunting is a condition characterized by persistent undernutrition, often due to poverty, poor maternal health, and inappropriate early-life care. This nutrition indicator is still of public health significance in Liberia. Using data from the Liberia Demographic Health Survey (LDHS 2019–2020), a nationally representative cross-sectional survey, this study aimed to explore the association between parental education and childhood stunting in Liberia. Stunting was defined as a height for age Z-score (HAZ) ≤ −2 using WHO criteria. Parental education was defined as a) having both parents with no education; b) having at least one parent with some education but less than secondary education and above; and c) having both parents with at least a secondary education and above. In the study, we described the data and identified patterns using univariate analysis. We checked relationships between different factors using bivariate analysis. Lastly, we used binary logistic regression to understand how parental education is associated with stunting in children. The result shows that approximately 31% of the children are stunted in Liberia, which is far above the WHO's measured to reduce stunting. Stunting was determined based on the height-for-age z-score (HAZ). A child was classified as stunted if the HAZ was less than -2 standard deviations from the WHO child growth standard median. These z-scores were computed using WHO Anthropometric software. Mothers who have attained primary and Incomplete Secondary Education make up 28.46%, and those with completed Secondary and Above education constitute 23.15% respectively. Descriptive analysis showed that 19.2% of fathers had attained primary education, while 49.9% had attained secondary education or higher. Children who have both parents with secondary and above education constituted 20.19%. Among mothers, 28% had primary or incomplete secondary education, while 23% had completed secondary or higher education. For fathers, 19% had primary education, with approximately 50% having secondary or

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higher education. About a fifth of the children had both parents with at least a secondary education. After adjusting the selected socio-demographic and economic variables, it was observed that children with both parents possessing at least a secondary education exhibited reduced odds (lower likelihood) of experiencing stunted growth compared to those whose both parents had no formal education [adjusted odds ratio (aOR): 0.68; Relative Standard Error (RSE): 0.12; p=0.03]. Findings suggest a protective association between parental educational attainment and children’s nutritional status. The study buttresses the importance of formal education, particularly above secondary education, which should not focus on mothers alone but also on fathers, to increase children's nutrition and health outcomes in the future

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ACRONYMS

WHO	World Health Organization
UNICEF	United Nations International Children's Education Fund
LMICs	Low- and Middle-Income Countries
EC	European Commission
NHIS	National Health Interview Survey
NFHS	National Family Health Survey
SUR	Seemingly Unrelated Regression Models
HFA	Height-For-Age
SDG2	Sustainable Development Goal 2
GDP	Gross Domestic Product
PCA	Principle Component Analysis
PSID-CDS	Panel Studies of Income Domestic Child Development Supplement
NHANES	National Health and Nutrition Examination Survey
LPM	Linear Probability Model
NPHC	National Population and Housing Census
LISGIS	Libera Institute for Statistics and Geo-Information Services
LDHS	Liberia Demography and Health Survey
BLB	Binary Logistic Regression
EAs	Enumeration Areas
PSSP	Probability Systematic Selection Process
USAID	United States Agency for International Development
BMI	Body Mass Index
GHI	Global Hunger Index
IYCF	Infant and Young Child Feeding

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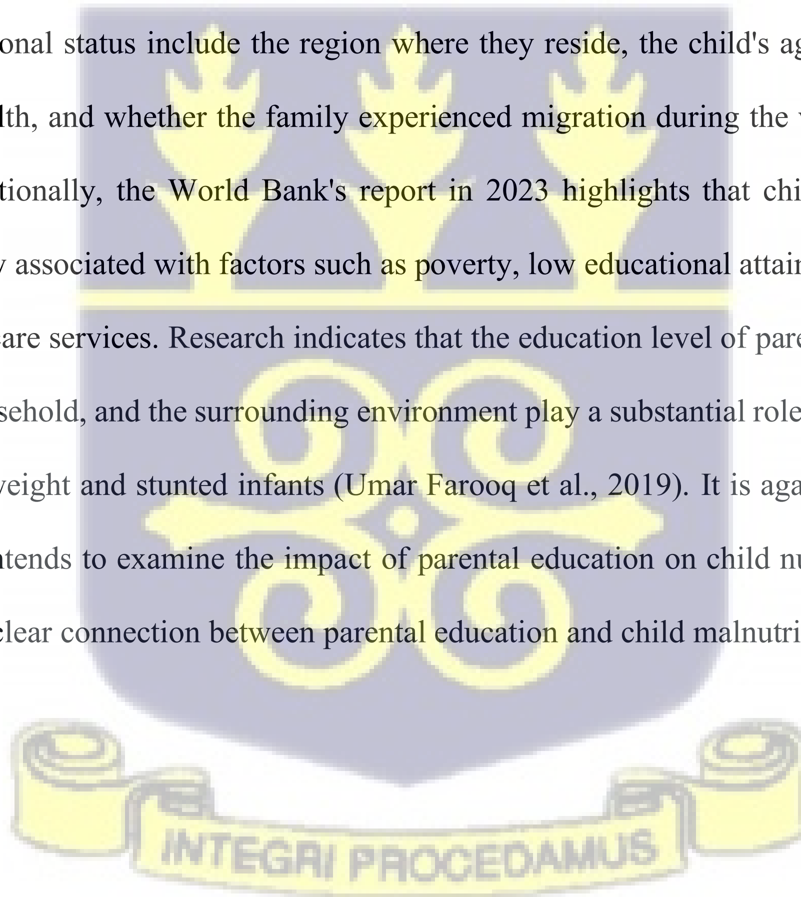
CHAPTER ONE
1.0 Introduction

1.1 Background of the Study

The early phases of a child's existence constitute a pivotal and crucial timeframe for laying the foundation for their robust growth and development. Recent research conducted by Soofi et al. (2022) has demonstrated that ensuring adequate nutrition during these initial stages can have a positive impact on birth outcomes, infant growth, and the prevention of newborn stunting. The researchers pointed out that insufficient maternal nutrition both before conception, during pregnancy, and after childbirth is intimately linked to unfavorable health outcomes for both mothers and children, particularly concerning adverse birth outcomes. Consequently, the researchers concluded that nutrition plays not only a fundamental role in an individual's development but also a significant contribution to a nation's advancement.

Globally, it was estimated in 2020 that there were 149.2 million children under the age of five years of age were stunted, 45.4 million who were wasted, and 38.9 million who were overweight or obese (UNICEF/WHO/WB Joint Child Malnutrition Estimates (JME) group 2021). The worldwide prevalence of stunting in children under 5 years of age was 22.3% in 2022, which is a drop from 33% in 2000. The prevalence of underweight children under 5 years of age was 13.9% in 2022, which is a decline from 25% in 1990. In 2022, Asia had the highest number of stunted children (52% of the global share), followed by Africa (43% of the global share) (UNICEF/WHO/WB Joint Child Malnutrition Estimates (JME) group, 2023). Asia and Africa are homes to approximately one-third of the world's stunted and underweight children. In 2022, the estimated prevalence of wasting in children under 5 years of age was 6.8%, which is a decline

from 8% in 2013, with around a third of these cases being severe (3%), and nearly one-third of these affected children resided in Africa (UNICEF/WHO/WB, Joint Child Malnutrition Estimates 2023). UNICEF (2020) reported that Liberia experiences high levels of childhood malnutrition, with one-third of children under the age of 5 being stunted, and 6% suffering from acute malnutrition. The report also underscores that over 2 million children under the age of 18 residing in Liberia are grappling with malnutrition. This underscores that malnutrition is a significant issue, particularly among children, in Liberia. Further research reveals that Liberian children face both chronic and acute undernourishment. Specifically, 36% suffer from chronic undernourishment, 23% are underweight, and 6% are acutely undernourished. The primary factors influencing children's nutritional status include the region where they reside, the child's age and gender, the household's wealth, and whether the family experienced migration during the war (Sobkoviak et al., 2012). Additionally, the World Bank's report in 2023 highlights that child malnutrition in Liberia is closely associated with factors such as poverty, low educational attainment, and limited access to healthcare services. Research indicates that the education level of parents, the economic status of the household, and the surrounding environment play a substantial role in influencing the health of underweight and stunted infants (Umar Farooq et al., 2019). It is against this backdrop that this study intends to examine the impact of parental education on child nutrition in Liberia. This suggests a clear connection between parental education and child malnutrition.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1.2 Problem Statement

Child Malnutrition remains one of the most pressing public health concerns in Liberia, with long-term consequences for child survival, growth, and development. Despite various national and international efforts to reduce the burden of undernutrition among children under five years of age, the rate of stunting remains alarmingly high. According to the Liberia Demographic and Health Survey (LDHS) 2019/2020, a significant proportion of children continue to experience poor nutritional outcomes, with notable disparities observed across geographic, economic, and educational lines. A growing body of evidence highlights parent education, particularly the part of mothers, as a critical determinant of child health and nutrition outcomes. Educated mothers are more likely to adopt health-promoting behaviors, utilize health services, and have better knowledge of child feeding practices. However, in the Liberian context, limited attention has been given to the individual and combined effects of maternal and paternal education on children's nutritional status. Furthermore, the cumulative impact of both parents' educational attainment has not been sufficiently explored, despite its potential implications for improving child health outcomes through household decision-making and resource allocation.

Additionally, while education is a key factor, it does not act in isolation. Other socio-demographic characteristics—such as household wealth, place of residence (urban/rural), mother's age, employment status, and access to health services—also interact with educational factors to influence child nutrition. Yet, the complex association between these variables remains inadequately understood within the Liberian context. Given the background, it becomes necessary to assess not only the individual influence of maternal and paternal education but also their combined effects, and to examine how other socio-demographic characteristics interact with these educational variables to shape the nutritional outcomes of children. This study is therefore

designed to fill these knowledge gaps and provide a comprehensive understanding of the determinants of child nutrition in Liberia, using nationally representative data. Research findings have revealed a notable prevalence of malnutrition in numerous developing nations. De Onis et al. (2013) reported that in the year 2013, the occurrence of stunting (which indicates impaired growth concerning a child's age) among preschool children in developing countries stood at 33%. Nevertheless, it's important to note that there were disparities among different regions. The same researchers observed that stunting rates were 35% for Africa, 34% for Asia, and 13% for Latin America and the Caribbean. Prevalence rates falling within the range of 30% to 39% are considered substantial. In the case of Liberia, the nation has made strides in working toward the goal of reducing stunting, but there is still a 29.8% prevalence among children under 5 years old, albeit lower than the regional average for Africa, which stands at 30.7% (WHO, 2022). Research findings highlight that stunting rates are even higher at 35.5% on a national scale, with peaks reaching 41% in Grand Bassa and 38% in Rivercess counties (Concern Worldwide, 2020).

The Global Hunger Index, Concern Worldwide (2023), ranks Liberia 117 out of 125 countries with a score of 32.2, placing its hunger level as a "serious" situation in terms of food security. One of the criteria used to measure a country as being "serious" when it comes to hunger is child stunting, undernourishment, and child mortality, under which a country can be assessed the stunting level. Using the Global Hunger Index (GHI) as part of the problem statement is important because it situates the study in a global policy context and emphasizes the severity of undernutrition in Liberia. As Liberia was classified as having a "serious" level of hunger in recent reports, and given that stunting is one of the key indicators contributing to this ranking, this justifies the need to examine the determinants of stunting, particularly parental education, as a modifiable factor. Similarly, research conducted by Adugna et al. (2023), using data from the Liberia

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Demographic and Health Survey conducted between October 2019 and February 2020, found that the overall prevalence of anemia among children aged 6–59 months in Liberia was 70.8%, with the highest burden in the Northwestern region at 77.2% and the lowest in the Northcentral region at 68.8%. The study also indicated that 3.4% of children in this age group had severe anemia, 38.3% had moderate anemia, and 29.1% had mild anemia. The highest burden of anemia was observed in children who were stunted. Paré et al. (2019) and Black et al. (2013) argued that malnutrition has wide-ranging negative impacts, including impairing intellectual capacity, limiting productivity in adulthood, increasing susceptibility to certain diseases, and being the underlying cause of approximately 45% of all deaths in children under 5 years of age globally. Similarly, Bourke et al. (2016) revealed that malnourished children experience more prolonged and severe illnesses and have a higher risk of mortality compared to better-nourished children. Malnourished children also exhibit delayed motor development (Srivastava et al., 2015), lower cognitive function, and reduced school performance (Bentley et al., 2015). Additionally, Betebo et al. (2017) found that individuals who experienced malnutrition as children have impaired work capacity and decreased reproductive performance in adulthood. Furthermore, the authors noted that malnutrition can have adverse effects not only on the individuals affected but also on their offspring.

Research demonstrates that malnutrition has a detrimental impact on a country's economic growth (Rashad & Sharaf, 2018). This implies that Liberia's high prevalence of malnutrition hurts the country's economic development. (UNICEF Liberia) reported that one in three children under the age of five in Liberia are stunted or too short for their age, as a result of not getting nutritious food over a long period, and frequent bouts of illness. This put Liberia on the list of 21 countries with

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the highest stunting levels in the world. It is a concern that continues to thwart human potential and economic growth in Liberia.

Malnutrition and hunger worsened during the country's civil war and were further deepened by the (2014-2016) outbreak of the Ebola virus disease (Concern Worldwide, 2020). The characteristics or influence of fathers are substantially under-represented in childhood nutrition research and interventions, despite their involvement and impact on children's lives. Fathers' role in handling stunting has not been extensively explored.

Numerous studies on child malnutrition have been conducted worldwide, including works by Maiga (2015), Narayan, John & Ramadas (2019), Reynolds, Horton, Anankware, Perosky, Lee, Nyanplu, & Lori (2022), Bosu (2015), and others, none of these research endeavors have specifically focused on the relationship between Parental Education (both the characteristics of mothers and fathers) and Child Nutrition using Liberia as a study setting. Therefore, this study aims to investigate the influence of parental education on child nutrition, with a particular emphasis on stunting, within the context of Liberia.

1.3 Research Questions

1. What is the association between maternal education and the nutritional outcome of children in Liberia?
2. What is the association between the father's education and the nutritional outcome of children in Liberia?
3. What is the cumulative effect of parental education and nutritional outcomes on children in Liberia?

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4. What association exists with other socio-demographic characteristics and nutritional outcomes of children in Liberia?

1.4 Overall Objective

The study seeks to examine the impact of a child's mother's and father's education on child nutrition in Liberia.

1.5 Specific Objectives

1. To assess the association between maternal education and the nutritional outcome of children in Liberia
2. To find out the association between fathers' education and the nutritional outcome of children in Liberia
3. To investigate the cumulative effects of parental education and nutritional outcomes of children in Liberia
4. To identify the association that exists with other socio-demographic characteristics and nutritional outcomes of children in Liberia

1.6 Research Hypothesis

H1: Children of mothers with higher education are less likely to be malnourished compared to children whose mother is not educated.

H2: Children whose fathers with higher education are less likely to be malnourished compared to children whose father is not educated.

H3: There is an association between parental education and feeding practices among children

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H4: Children who have both parents educated are less likely to be malnourished compared to children of parents with no education.

H5: Children with both parents educated are less likely to be stunted compared to children with one parent educated.

H6: Children who have both parents who have higher tertiary education or more are less likely to be stunted compared to children whose parents do not have up to tertiary education or more.

1.7 Rationale of the Study

Given the post-Ebola recovery, the COVID-19 pandemic's indirect nutritional impacts, and ongoing education reforms in Liberia, this study comes at a critical juncture for health and education policy in the country. Conducting studies on parental education and child nutrition is a rational and valuable endeavor for several reasons. The findings of the study can help the government and various stakeholders identify the underlying factors of parental and child nutrition in Liberia. Thus, to mention that the findings of this study shed light on the underlying factors that contribute to nutritional disparities among children. It can help identify the knowledge, attitudes, and behaviors of parents that may influence the nutritional choices and practices within the household. Understanding these factors can guide the development of targeted interventions to address specific needs and challenges faced by parents in promoting healthy eating habits for their children.

The findings of this study can inform the development of evidence-based public health policies. Thus, to establish that Governments and policymakers can use the outcome of this study to design interventions, educational programs, and policies aimed at improving parental education, nutritional awareness, and access to healthy food options. Such policies can have a positive impact

on the overall health and well-being of children, potentially reducing the prevalence of malnutrition, obesity, and associated health problems among parents and children in Liberia. The findings from this study can serve as an intervention planning and evaluation. To explain further, the findings of the study can guide the planning, implementation, and evaluation of interventions and programs targeting parental education and child nutrition. By understanding the specific needs and challenges faced by parents, interventions can be tailored to provide relevant information, resources, and support to improve nutritional practices within families. Moreover, ongoing evaluation of these interventions can help refine and optimize their effectiveness over time.

The findings of the study will be significant because they will help the government and other social governance bodies adopt measures to improve health and economic implications. This is because poor nutrition in childhood can have significant long-term health consequences, such as growth stunting, cognitive impairments, and increased risk of chronic diseases. These health issues can place a burden on healthcare systems and have economic implications. By studying the relationship between parental education (especially the father effect) and child nutrition, researchers can highlight the potential economic benefits of investing in parental education programs that promote healthy eating habits. This evidence can help advocate for resource allocation towards preventive measures and early interventions.

1.8 Organization of Study

This study will be organized into six chapters as follows: Chapter One will be the introduction encompassing the background to the study, statement of the problem, purpose of the study, objectives of the study, significance of the study, Conceptual framework, and organization of the study. Chapter Two: This section will review relevant literature by the study objectives. Chapter Three: A research methodology will discuss the following subheadings: research design,

population, instrumentation, data processing, and analysis. Chapter Four will focus on the analysis and presentation of data. Chapter Five: Discussion of findings. Chapter Six: A summary of findings, conclusion, and recommendations.

CHAPTER TWO
2.0 LITERATURE REVIEW

2.1 Introduction

The systematic procedure for identifying published or unpublished materials from secondary sources is referred to as a literature review (Leedy & Ormrod, 2013). A literature review involves assessing, amalgamating, and condensing the existing corpus of scholarly research and practitioner literature. Through the examination of empirical evidence and prior research, a comprehensive understanding of the subject of inquiry is developed, encompassing diverse contexts and viewpoints (Hajcak & Foti, 2020). The assimilated literature serves as a comprehensive overview of both local and international knowledge, facilitating the critical evaluation of pertinent resources that pertain to the phenomena being investigated (Papaioannou et al., 2016). In this study, the literature was reviewed focusing on the themes and sub-themes that were related to the research objectives.

2.2 Influence of Parental Education on Child Health

An intriguing research study continues to affirm the critical role of parental education, particularly maternal education, in shaping child health outcomes. A study by Mistry et al. (2021) analyzed disparities in children's health and healthcare utilization across various ethnicities in the United States using nationally representative data. The authors utilized both bivariate and multivariate analyses to reveal that Native American, Black, and Hispanic children exhibited lower socioeconomic status, poorer health, and less-educated parents in comparison to White children. Furthermore, Non-White children had fewer doctor visits on average than White children. These findings underscore significant discrepancies in access to and utilization of child healthcare

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services between White and non-White populations. Notably, the study demonstrated that these disparities persisted even after adjusting for family income and parental education. The persistence of these disparities highlights the complexity of health inequities and underscores the need to contextualize parental education within broader structural determinants. The researchers did identify an inverse correlation between a child's suboptimal health status and the level of parental education. Desai and Alva (1998) arrived at similar conclusions in their study, although they explored slightly different dependent variables and found that controlling for individual socioeconomic characteristics diminished the effect on child health. Both studies, however, indicated a diminishing impact of parental education on child health indicators when controlling for certain individual factors.

Turning to India, Kumar et al. (2022) utilized data from the 4th round of the National Family Health Surveys (NFHS-4) to delve into the determinants of nutritional indicators among children aged 0-59 months. Employing a Seemingly Unrelated regression (SUR) Model, the authors revealed that maternal health indicators played a highly significant role in explaining variations in child height-for-age, weight-for-age, and weight-for-height. Moreover, factors such as access to clean drinking water, household wealth index, and sanitation were closely associated with improvements in child health. Their study highlighted the substantial impact of mother-to-child transmission and early child care on child growth.

Pathak et al. (2020) examined the disparities in maternal healthcare services utilization across three Indian states – Kerala, Tamil Nadu, and Bihar, with maternal education emerging as a key determinant of antenatal care visits, institutional delivery, and child immunization. The researchers assessed interstate differences in healthcare service utilization, attributing variations in healthcare program implementation and service availability. Utilizing multivariate logistic regression, they

identified six utilization measures and revealed that nearly all mothers in Kerala and Tamil Nadu received antenatal care (98% and 95%, respectively), while the numbers were slightly lower in Andhra Pradesh and Karnataka (88% and 85%, respectively). The study emphasized the significance of factors like antenatal care, timing and frequency of antenatal check-ups, institutional delivery, and delivery assistance in determining access to maternal healthcare services. Desai and Alva (1998) examine the causal relationship between maternal education and child health across 22 developing countries, using Demographic and Health Surveys. They utilize indicators like infant mortality, child height-for-age (HFA), and immunization status. While Desai and Alva note a correlation between these indicators and maternal education, establishing a clear causality proves challenging. Similar findings are presented in Currie's (2008) study. Employing OLS or logit models, the impact of maternal education on infant mortality and HFA appears to diminish when accounting for factors such as husband's education, access to piped water, and toilet facilities. Furthermore, considering the residential area (urban or rural) further attenuates the effects of maternal education on these two dependent variables. However, using a fixed effects model, the influence of maternal education on infant mortality and HFA demonstrates statistical significance in only a subset of the 22 countries analyzed. In contrast, the immunization status remains statistically significant in both models for half of the countries studied.

Chou et al. (2007) capitalize on a natural experiment to gauge the influence of parental education levels on child health in Taiwan. The study emerged from a governmental reform extending compulsory education from six to nine years. Employing differences in regression discontinuity design and linear probability models of completed schooling, Chou et al. reveal that, after segregating treatment and control groups by age (12 and under for women or men and 13 to 20 or 25, respectively), maternal schooling yields favorable outcomes for infant health. This effect is

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more pronounced for mothers' education than for fathers. The researchers state that the heightened schooling resulting from the reform saved nearly 1 infant life per 1000 live births, leading to an approximate 11% reduction in infant mortality. As per their analysis, an increase in maternal schooling diminishes the likelihood of infants being born with poor health or dying in the neonatal or postnatal periods (Akseer et al., 2022).

Andrabi et al. (2019) analyze the link between parental schooling, child health outcomes, and parental health-seeking behavior, utilizing data from the North-West Frontier Province and Punjab in Pakistan. The study aims to comprehend how parents' education translates into outcomes for both child health and the health-seeking behavior of parents and children. Baseline model estimates reveal a positive correlation between fathers' education and immunization, while mothers' education positively influences child health outcomes. By applying instrumental variable estimation to address endogeneity in maternal schooling, the results indicate that the father's health knowledge is an even stronger positive determinant of child immunization than what the OLS estimates suggest. This estimation approach also highlights the substantial positive effects of maternal health knowledge and her role within the household on children's health. This study firmly establishes the impact of parental education on child health, showcasing a positive relationship.

2.3 Overview of Stunting

Globally, more than 149 million children, which accounts for 21% of those under the age of five, suffer from stunting, with 91% of these cases concentrated in low- and middle-income countries (LMICs) (UNICEF, 2020). Stunting refers to the chronic nutritional deprivation experienced by children, and it is defined as a height-for-age that falls below -2 standard deviations from the median in the WHO Child Growth Standards (WHO, 2020).

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The private sector, encompassing profit-oriented entities with private ownership, is increasingly recognized as a pivotal player in achieving Sustainable Development Goals, including the reduction of malnutrition (SDG 2). This recognition extends to investments made within workplaces, communities, and economic markets (Wellesley et al., 2020; Jenkins & Gilbert, 2018; Sheka et al., 2017). The private sector encompasses various entities, such as financial institutions, multinational corporations, micro, small, and medium-sized enterprises, cooperatives, individual entrepreneurs, and formal and informal sector farmers. This definition excludes non-profit-focused entities like private foundations and civil society organizations (Morgado & Lasfargues, 2017; Di Bella et al., 2013). The private sector holds the potential to engage in both direct nutritional interventions (like micronutrient supplements) and indirect interventions (such as innovations in agriculture, health, or education) (Sheka et al., 2017; Akseer et al., 2022).

Despite significant global progress in reducing stunting, chronic childhood malnutrition has profound social, human, and economic implications across individuals' lifetimes. These include impaired physical growth, reduced educational attainment, cognitive limitations, and diminished workforce productivity (Hoddinott et al., 2013; Galasso & Wagstaff, 2019; Fink et al., 2016; Sudfeld et al., 2016; Behrman et al., 2014). Studies indicate that stunting-related per capita income losses range from 5 to 7% in numerous LMICs (Galasso & Wagstaff, 2019). Conversely, stunting reduction is projected to enhance economic productivity, potentially boosting gross domestic product (GDP) by 4-11% in African and Asian regions (Galasso & Wagstaff, 2019). However, macroeconomic estimates often rely on observational data from single countries with limited sample sizes, which restricts their applicability to diverse LMICs globally. Additionally, evidence is scarce concerning income losses specifically within the private sector workforce due to childhood stunting, using various datasets and methodological approaches.

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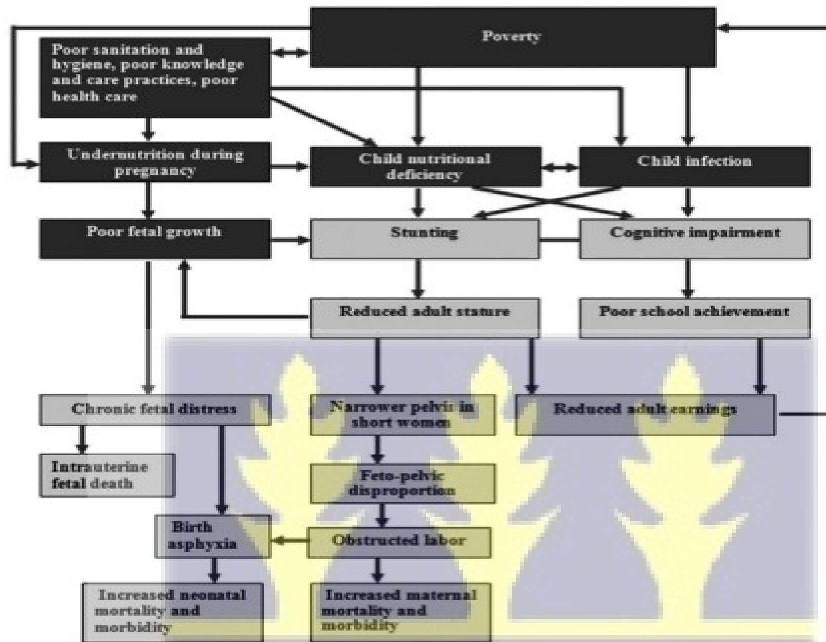
A recent study suggests that malnutrition costs multinational corporations an estimated $130-850 billion annually, roughly equivalent to 0.4-2.9% of collective GDP, though this estimate likely underestimates the burden of stunting due to data constraints (Wellesley et al., 2020).

Figure 1: Childhood stunting pathways to adulthood outcomes



Source: Dewey (2011)

The authors stress that acquiring empirical data on stunting-related costs for private sector workers (impacting human capital markets and wages), for private firms' financial outcomes, and for the return on investment in scaling up relevant interventions could provide long-term financial incentives for governments and corporations to enhance the nutrition, health, and performance of their workforce and local communities.

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2.4.0 Socio-economic Characteristics

2.4.1 Parents' Education & Health Knowledge

The connection between parental education and infant health is intriguing for two main reasons. Firstly, if health contributes significantly to overall well-being, it can be seen as a consequential outcome. Additionally, health can be viewed through the lens of distribution, shedding light on how health disparities are linked to other aspects. (Victora et al., 2021; Smith-Greenaway, 2015), proposed that lower parental education might impact their infants' future schooling and labor market outcomes by affecting their health. Parents with limited education might struggle to invest in their infants' health, which could subsequently lead to long-lasting consequences for the child's adult outcomes (WHO, 2019; Marmot et al., 2020). Thus, the implications of disparities in parental education extend beyond initial perceptions. One mechanism behind this is that educated parents are better equipped to understand health-related information, adopt preventive health behaviors, and seek timely medical care (Grepin & Bharadwaj, 2015). Parental education could directly influence infant health by contributing to the production of health (for instance, through increased knowledge leading to more effective health investments) and indirectly (such as through enhanced income levels enabling greater expenditure on health-related inputs).

While existing literature has overwhelmingly emphasized the significance of maternal education, few studies have delved into the relationship between paternal education and child health (Chen & Li, 2009). This is likely because fathers tend to allocate less time to childcare, potentially yielding a less direct link between paternal education and infant health. Mothers, being primary caregivers, might have a more immediate impact on their child's health than fathers (Aslam & Kingdon, 2012). In societies where mothers primarily care for their children, maternal education has been shown to exert a strong and substantial influence on child health compared to paternal

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education (Richard et al., 2021; Shibre et al., 2020). Thus, maternal education is widely considered a crucial predictor of infant health. Nonetheless, there is a shred of evidence to suggest that the role of fathers should not be underestimated. Fathers play a significant part in the lives of children, not just due to infants' emotional need for them, but also due to the substantial effect fathers have on children's cognitive, emotional, physical, and social well-being from early stages to adolescence, with far-reaching impacts on their adult lives. "Involved fathers provide unique benefits to their infants" that cannot be replicated by others (Cabrera et al., 2018; Burgess & Zafra, 2021). Father's education is also an important socioeconomic indicator for child survival, as empirical studies have shown its positive influence on improving socioeconomic conditions (Deshmukh et al., 2012; Khattak et al., 2017; Chen & Li, 2009).

2.4.2 Economic and Environmental Position

Household economic status remains a fundamental determinant of child health and nutritional outcomes. While some authors have raised questions about the direct influence of income on infant health (Attanasio et al., 2020), it's undeniable that income's impact on child survival operates through various interconnected factors. Numerous factors, including food consumption, quality of healthcare, and household sanitation, which significantly affect infant health, are contingent on income. Moreover, income is closely intertwined with the level of education, essentially representing a portion of the overall influence of education (Headey et al., 2019; fink et al., 2020). This study leverages these diverse factors to gain a deeper understanding of the determinants of infant health. The choice of income measurement is a critical aspect of the analysis. The study opts for a wealth index, which encompasses a range of household assets and is formulated by the World Health Organization (WHO, 2022), National Institute of Population Studies, Islamabad, 2014.

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Adequate access to sanitation facilities and safe drinking water plays a crucial role in achieving improved health outcomes for adolescents. Insufficient access to safe drinking water and proper sanitation facilities can lead to malnutrition through water and airborne diseases, ultimately hampering a child's ability to absorb nutrients (Cumming et al., 2019; Pruss-Ustun et al., 2019, Freeman et al., 2022). Favorable environmental conditions, including households equipped with piped water, sanitation, and electricity, generally face fewer risks of contamination compared to households lacking these amenities (UNICEF & WHO, 2023). This study constructs an environmental index using a summation method to assess the impact of environmental conditions on infant nutrition.

2.4.3 Health Knowledge and Behavioral Factors

Numerous prior studies have examined the causal links between maternal education and the health of infants, emphasizing the role of education in improving care practices, sanitation, and health-seeking behaviors. These studies have consistently demonstrated a strong correlation between a mother's level of education as an indicator of care, such as improved sanitation conditions, health-seeking behaviors, and enhanced health knowledge (Yaya et al., 2021; Chai et al., 2022). Educated mothers are better equipped to make informed choices regarding the health of their infants, assuming the role of primary caregivers and being attuned to potential health risks (Victora et al., 2021; Bbaale, 2011). Maternal education also contributes to shifts in behavior that lead to reduced instances of childhood diarrhea (Wang et al., 2020; Hagos et al., 2021). Education not only fosters a more caring family environment but also imparts knowledge about health quality. A study conducted in Bangladesh by Biplob et al. (2011) identified specific health-related knowledge linked to higher education levels, including the use of oral rehydration therapy for treating diarrhea, hand hygiene after using the toilet, understanding the benefits of boiling water, and recognizing

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infections as primary sources of diseases. This heightened health awareness triggers behavioral changes that promote health-seeking behaviors and consequently improve infant health. Knowledge about hepatitis disease is included in the empirical analysis to account for maternal awareness of health quality.

Maternal autonomy, another behavioral variable, stands out as a pivotal factor influencing infant health Acharya et al., 2019; Kabeer, 2020). They found that women with higher levels of empowerment and decision-making authority tend to have healthier children. Education also affects child survival by bolstering mothers' decision-making power within the household. The increasing trend in education disrupts traditional power dynamics within families, granting educated mothers a bit more autonomy. Given that women typically assume the role of primary caregivers and invest more time in ensuring the well-being of their infants compared to men (Desai & Johnson, 2014; Smith et al., 2023), this shift is significant.

The decision-making process regarding the desired number of children (reproductive attitude) is internal. The choice to have a second child is influenced by the health of the first child. Educated parents typically lean towards having fewer children (Sedgh et al., 2016). However, Ahmed et al. (2022) pointed out that adequate family planning can mitigate this endogeneity concern. In this study, the total outcomes of pregnancies are used to reflect maternal reproductive behavior.

This research effort represents a unique endeavor to examine the association between parents' education and child malnutrition. The study employs a sample of 3,199 women and their corresponding children under 5 years of age from the latest Pakistan Demographic and Health Survey of 2012-13. This study makes a two-fold contribution to the existing child health literature: (i) Previous studies have presented substantial evidence of the significant influence of maternal and paternal education on infant nutrition (Chai et al., 2022; Yaya et al., 2021), where maternal

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and paternal education were discussed separately. This study, on the other hand, introduces parents' education as a composite factor, recognizing that while educated mothers play a significant role in child nutrition through various linkages (Shibre et al., 2020; Burgess & Zafra, 2021), educated fathers also contribute to child health by influencing the socioeconomic and behavioral aspects of a household. In the context of the Pakistani setting, father's formal education can have a significant impact, as a higher proportion of fathers (34%) possess secondary schooling compared to mothers (10%), and the illiteracy rate among mothers (57%) exceeds that among fathers (29%) (Pakistan Bureau of Statistics, 2020). If higher education is deemed important within a family, then the father's education holds more significance than the mother's education in Pakistan. Additionally, mothers with higher education tend to prefer partners with higher education due to their higher income potential and their ability to contribute to the household's future environmental, economic, and nutritional status (Khattak et al., 2017). Educated individuals also express a preference for marrying educated females, who are more likely to exhibit family-oriented behavior (Esping-Andersen, 2016; Kravdal & Wiggen, 2021). Given the importance of parents' education, this study combines parental education levels into a parents' education index. As such, this study aims to investigate the association between parents' education and child health, considering both short and long-term aspects of infant nutrition. (ii) The study constructs environment and parents' education indexes using the summation method, which is the most suitable technique for indexing categorical items, unlike methods like principal component analysis (PCA), which have been used in past studies (Anwar et al., 2013; Frost et al., 2005). The summation method allows for the reclassification of variables after indexing, which is challenging with PCA. Furthermore, PCA indexing can yield biased results. The higher value of Cronbach's alpha also affirms the reliability of these index compositions.

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2.5 The various ways through which socioeconomic status impacts child health

In the context of developing and emerging economies, Black et al. (2017) and Marmot et al. (2020) research holds significant importance as it offers a potential roadmap for policymakers to target specific dimensions of societal advancement. The study delves into the role of socioeconomic status and its influence on child well-being. Marmot's investigation revolves around establishing potential connections between parental socioeconomic status, such as education, income, occupation, and child health, as well as examining the causal links between child health and future educational and employment outcomes. Previous research conducted by Braveman and Gottlieb (2014), Behrman et al. (2020), and Victora et al. (2021) has demonstrated the notable impact of health capital on educational attainment and earnings. However, Marmot's work primarily focuses on developed nations, despite acknowledging the prevalent health challenges faced by developing countries.

The study identifies a perplexing conundrum, often referred to as a "chicken and egg" dilemma, which remains unresolved in this realm of inquiry: why does income play such a crucial role in determining educational achievement? Consequently, Marmot's findings point to substantial evidence linking parental socioeconomic status and child health, as well as connections between child health and various future outcomes. The study concludes that parental socioeconomic status indeed influences child health during early developmental stages. However, a limitation encountered in this study, as well as similar ones, arises from the complexity of health's impact due to its multifaceted nature. As health effects encompass various dimensions, attempting to encapsulate these impacts within a singular index presents a significant challenge based on currently available evidence.

The correlation between health and income within this research domain is referred to as a "gradient," highlighting the gradual relationship where higher income is associated with improved health. While older studies like Currie (2008) laid the groundwork for such questions, Currie and Schwandt (2016) offer updated longitudinal evidence, confirming that the association between low income and poor child health persists across the life course, with stronger gradients observed in later childhood due to cumulative disadvantages. In this context, poverty seems to have more than just a "threshold" effect on health, as depicted by Currie and Schwandt (2016). Within this framework, Case and Paxson (2021) examine the connection between household income and children's health. Focusing on children, the researchers can eliminate the reverse relationship that suggests health influences income, simplifying the analysis. They employ data from the National Health Interview Survey (NHIS), the Panel Study of Income Dynamics with its Child Development Supplement (PSID-CDS), and the Third National Health and Nutrition Examination Survey (NHANES) to study this gradient using a linear probability model (LPM). The primary objective is to assess whether the chronic health status of adults is linked to their childhood health, which may also be influenced by the household's income-generating capacity. Their findings indicate such a connection exists; poorer childhood health leads to worse health outcomes in adulthood. Moreover, they find that poorer children, as they become adults, tend to have lower health statuses and education levels. These conclusions are essential for understanding the impact of socioeconomic factors on children's well-being. However, these results do not establish a causal link between household income to child health.

Drawing on the outcomes of Case (2021), Currie and Stabile (2002) explore how socioeconomic status affects older children based on the socioeconomic gradient. This paper improves upon Case et al. (2002) by addressing the cross-sectional study's limitation, which cannot distinguish between

two potential mechanisms contributing to the steep gradient. Currie and Stabile (2002) argue that this relationship intensifies over time, mainly due to the adverse health shocks experienced by children from low-socioeconomic households.

A contrasting perspective is presented by Le Tendre and Qi (2019 and Islam et al. (2020), whose study on the income-health gradient in developing countries offers a divergent view. They utilize data from the Indonesian Family Life Survey, focusing on children aged 0-14. Their findings diverge from Case and Paxson (2021) and Currie and Stabile (2002), indicating that while low income negatively affects health status, the impact of income on health doesn't vary with age. The study highlights that children's general health improves with age in Indonesia, contrary to findings in developed countries. This divergence remains robust even after accounting for health at birth and parental health. The authors attribute this to acute illnesses prevalent in developing nations. Due to the short-lived nature of these illnesses, they are more significantly correlated with parental decisions regarding child health.

2.6 Theoretical Framework (The Human Capital Theory)

The human capital theory propounded by Gary S. Becker addresses how children's health and nutrition are important determinants of their future productivity and economic success. It suggests that investing in a child's health can lead to long-term benefits for both the individual and society as a whole. In the context of parental education and the nutritional status of children, the theory suggests that parents who are educated and have better nutritional status are more likely to invest in their children's education and health, which in turn leads to better outcomes for their children in terms of education, health, and future earnings. Studies have shown that there is a strong correlation between parental education, child nutrition, and stunting. In particular, children of parents with higher levels of education are more likely to experience stunting than those with less

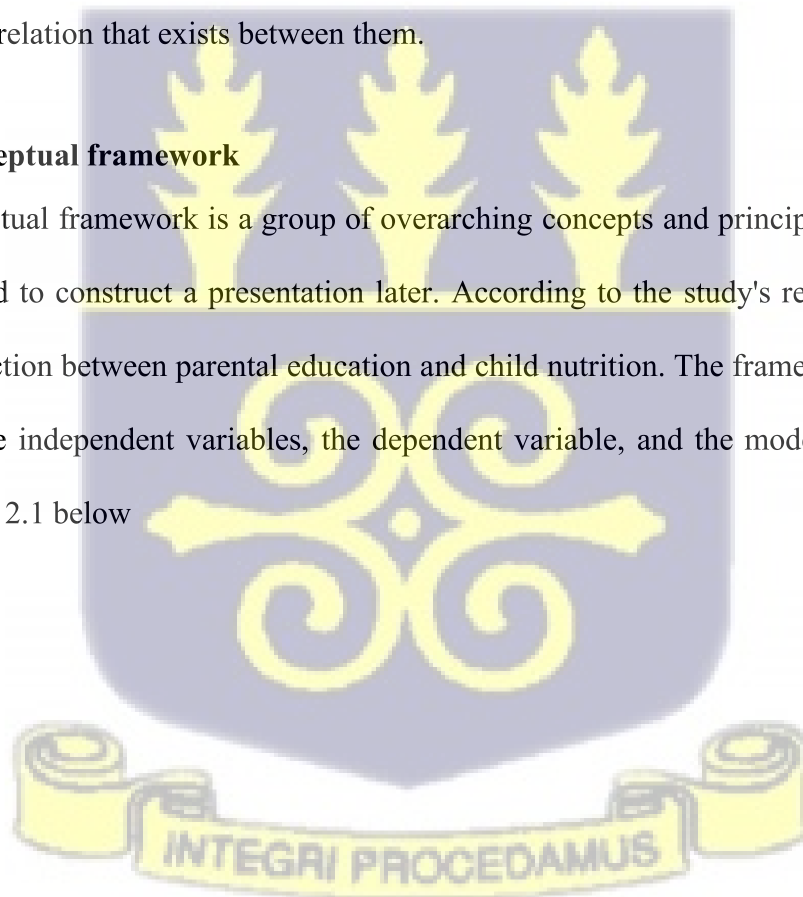
educated parents. The reason is that educated parents are more likely to have access to information about proper nutrition and health practices, as well as the resources to provide their children with healthy food and medical care.

2.7 Conceptual Framework

A conceptual framework is a written or visual product that illustrates the key concepts or variables to be researched and their assumed relationships, either graphically or narratively (Bousquet et al., 2015). This is done to demonstrate that the conceptual framework is viewed as a visual presentation that gives a narrative or graphical explanation of the study variables that are desired and the presumptive correlation that exists between them.

Figure 2: Conceptual framework

Hence, a conceptual framework is a group of overarching concepts and principles accepted from a study and used to construct a presentation later. According to the study's research objectives, there is a connection between parental education and child nutrition. The framework showing the link between the independent variables, the dependent variable, and the moderating variable is shown in Figure 2.1 below



Parent Characteristics
- Mother's Education
- Father's Education
- Parent Education

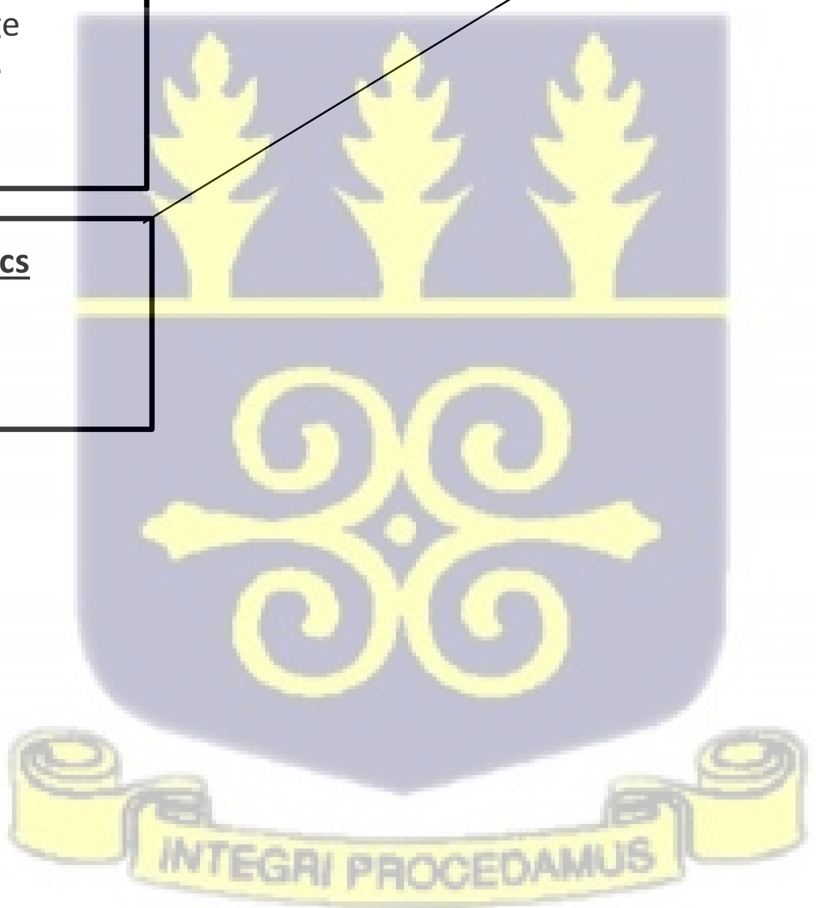
Household
- Place of Residence
- Sanitation
- Region

Control Variables
- Mother's Age
- Father's Age
- BMI
- Parity

Child Characteristics
- Sex
- Age

Mediating Variables
- Wealth Status

Child Nutritional Status
- Stunting



CHAPTER THREE
3.0 RESEARCH METHODOLOGY

3.1 Introduction

This part provides background information on the source and nature of the data used for this study, sample selection, classification of variables, and the methods of analysis in the study. The research methodology section of this study outlines the strategies and protocols utilized in conducting the research. Research methodology refers to the systematic exploration aimed at addressing research questions (Kothari, 2004). As defined by Mishra and Alok (2022), research methodology constitutes the underlying principles governing the execution of a specific research endeavor. It delineates the organized steps taken to investigate a particular research issue. Given that the study intends to evaluate the intricate regulatory aspects of parental education and childhood nutrition, it is imperative to follow a well-structured scientific inquiry to establish a credible foundation for validating the dependability and precision of the processes, methods, procedures, and findings of this investigation.

This section presents an exposition of the chosen research approach and research design. It also outlines the target population and the sampling technique employed for the research. Additionally, it furnishes a comprehensive portrayal of the instruments employed for data collection and the associated data collection procedures, along with the methodologies for analyzing the gathered data.

Study Design

The study employed a quantitative cross-sectional design using secondary data from the 2019-2020 Liberia Demographic and Health Survey (LDHS). The analysis specifically utilized the Children's Recode (KR) file, which contains detailed information on children under five years of

age, including their anthropometric measurements, household characteristics, and parental background. After cleaning for missing values, the final analytic sample consisted of 1,620 children, which is adequate for statistical analysis and generalizable to the national population of children under five in Liberia. The cross-sectional nature of the data means that information was collected at one point in time, making it suitable for assessing associations between parental education and child nutritional outcomes.

3.3 Source of Data

This study utilizes secondary data from the 2019-20 Liberia Demographic and Health Survey (LDHS), specifically the Children's Recode (KR) file, which includes detailed information on children under five and their mothers. The LDHS is nationally representative and employs a two-stage stratified sampling design. It is implemented by the Liberia Institute for Statistics and Geo-Information Services (LISGIS) with technical assistance from ICF International under the DHS program.

3.4 Research Approach

The research approach that will be undertaken for this study will primarily be quantitative, wherein secondary data from the Liberia Demographic Health Survey (LDHS) conducted in 2019-2020. A quantitative research approach includes the collection and analysis of numerical data to draw statistical inferences and identify patterns or correlations.

3.4.1 Study Setting

Liberia is a country located in the West of Africa, bordered by three countries and the Atlantic Ocean. On December 22, 2020, Concern Worldwide with her partner Liberia WASH Consortium,

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provided a pleasant setting for exploring parental education and child nutrition, has measured 35.5% in Liberia (stunting) among children under five years.

Stunting is one of the impediments to the growth of a child; about a third of all children under five are stunted (UNICEF, 2020). Stunting is a result of poor nutrition, inadequate maternal care, poor sanitation, lack of access to clean water and poverty, parents with low educational status, and a weak health system. Tackling food insecurity, reaching out to vulnerable communities for proper nutrition and awareness, and educating parents who enhance better outcomes.

3.4.2 Population and Sample

The study's population encompasses "the complete individuals who are particularly intrigued in the subject children under five, considering maternal and paternal educational influences on stunting. This study focused on all individuals from Liberia who participated in the 2019-2020 Demographic Health Survey. The population for the current study is 5,418,377, which is the current population of Liberia (UNPF, n.d.). The 2019-2020 LDHS had this response: all 9,745 households in the selected housing units were eligible for the survey, and of that number, 9,207 of these households were occupied. Of the occupied households, 9,068 were successfully interviewed, rating the response as 99%. Of those successful household interviews, 5,192 were completed in 2019 and 3,876 in 2020. Households that were interviewed, 8,364 women aged 15-49 were identified for individual interviews; 8,065 women were interviewed, yielding a response rate of 96%. A total of 4,527 were eligible for individual interviews; 4,249 of these men were interviewed, producing a response rate of 94%. After excluding missing cases/values in the variables, the final sample size for this study is 1,620. As for the LDHS, it adopts the multi-stage stratified cluster sampling design, ensuring a representative sample of the data at national and

regional levels. The sample for this 2019-2020 LDHS was designed to provide estimates of population as well as health indicators at the national and county levels, including rural and urban. Hence, this sample is representative altogether to be used in examining the influence of parental education and children's nutrition outcomes. There were instruments used in the field to collect the data on children's stunting from the women's questionnaire, which provides data required on the children. During the listing, an average of 129 households was found in each of the clusters, afterward, a fixed number of 30 households was then selected with an equal probability systematic selection process (PSSP).

Furthermore, the cardinal point of this study only pertained to child data sets, reason it contains all information relating to women aged 15-49 and children 0-59 months. The data was collected by the Liberia Institute of Statistics and Geo Information Services (LISGIS) in partnership with the Ministry of Health.

To continue this research, the study utilized the secondary data from the Liberia Demographic and Health Survey (2019-2020), through the United States Agency for International Development (USAID DHS) Program, and extracted the pertinent data.

3.4.3 Sampling process

The 2019/2020 Liberia Demographic Health Survey (LDHS) was conducted nationwide with a nationally representative sample of residential households. It is the children's file used to analyze the association between parental education and childhood stunting. The study used Stata Software Version 15 to perform data analysis on variables of interest. Before the analysis was performed, the data were weighted so that the sample could be representative and generalized to the majority population. The sample weighted procedure is as follows: The Primary Sampling Unit or sample cluster-v021 was identified, and the sample stratum for sampling the errors is v022. Howbeit, the

LDHS sample weights variable (v005) was identified, and the variable for weighting was generated by dividing the weights by 1000000 to adjust for the sampling possibilities. Afterward, the weighted data came into being by using this command: Stata software

Gen weight = v005/1000000

svyset {pw = weight}, psu(v021) strata(v023).

The study employed this form of analysis: univariate analysis, bivariate analysis, and multivariate regression using binary logistic regression. The univariate analysis was used to describe each characteristic of the study participants and variable outputs. The bivariate analysis was used to test the association between the independent variables and the dependent variable. Furthermore, the bivariate and multivariate analyses were demonstrated using Binary logistic regression (BLR). The multivariate analysis was also performed using Binary logistic regression to determine how the independent variables interact with each other to influence the nutritional status of children in Liberia while controlling for the net effect of each independent variable.

3.4.4 Target Population

Purposely, the target populations for this study were children aged 0-59 months. Additional measures were employed following the inclusion criteria for the sample. The total sample size for this study is 1,620 children whose mothers reported about their children's stunting. Initially, it is the children file used, which contains a total of 8,065 women respondents, but not all of the women who participated were asked about children being stunted or not reported on stunting. In the case of these women for whom the questions were not asked about their children stunting and other women who have children but could not fit the international definition of stunting if their "height-for-age is more than two standard deviations below the (WHO) Child Growth Standards median" be a part are people with children above the aged 0-59 months consequentially were all dropped.

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The focus of the study is children aged 0-59 Months for whom there were exact and plausible anthropometric data garnered, and for whom stunting was reported. Accordingly, parental education was dedicated to the study, women were also questioned about their educational level, especially couples and those in unions, including single parents. Women who are couples, single parents, and those in union were considered since we are specific on parental education and childhood nutrition (stunting). It is from this insight that we allow those who are couples, and those in union, to understand the impact parental education may have on childhood stunting. People who were not in a union and were not coupled were dropped. With the burden of paternal and maternal education, health, and nutrition, which has a herculean influence on parental education and, accordingly nutritional status of children under five years.

3.5 Inclusion and Exclusion Criteria

The inclusionary employed here in the sample is

- ✓ Only children aged 0-59 months are included in the sample
- ✓ Children who had missing records about their fathers were excluded from the sample
- ✓ For analysis of the Height-for-Age Z-scores, this paper relied on the recommendations from the World Health Organization, which has defined limits for accepting stunting data based on the 1977 and revised 2006 NCHS/WHO growth charts.
- ✓ The Body Mass Index (BMI) of the mother, Weight (kg)/(height (m)}^{2,} is being measured. When an individual accumulates below 18.5, Underweight, 18.5 – 24.9 Normal weight, 25.0 – 29.9 Overweight, and 30.0 and above Obese (WHO) measure.
- ✓ This study finds that a fixed exclusion range used to analyze the mean z-score for HAZ was above -1.5. Height-for-age: <-5.65 and >+4

These are limits that have been used in the analysis of anthropometric data worldwide (WHO 2006/7).

3.6 Measurement Variables

3.6.1 Dependent Variables

The study had one outcome variable, namely stunting, which defines children's nutritional status on the Z-scores of the height-for-age (HAZ). The variable stunting was generated and divided by one hundred (100) just to find a dichotomous variable (Yes and No) to know whether the child was stunted or not stunted about height-for-age more than two standard deviations below the new growth standards as mentioned by (WHO, 2006) referencing chronic, severe, and acute malnutrition respectfully.

Table 1 Operational Definition and Measurement of Dependent Variables and Independent Variables

Variable	Measurement
Stunting	0 = Not Stunted (Height-for-age z-score greater than or equal to -2 SD) 1 = Stunted (Height-for-age z-score less than -2 SD)
Mother Education	0 = No Education 1 = Primary and Incomplete Secondary Education 2 = Completed Secondary Education and Above
Father Education	0 = No Education 1 = Primary Education 2 = Secondary and Above education
Both (Paternal and Maternal Education	0 = Both Father and Mother have no education 1 = One of the parents with some secondary education

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	2 = Both parents with completed secondary education and above

3.6.2 Independent Variables

One of the major predictors of children's nutrition, particularly in this study, is parental education, which influences the well-being of children. Stunting is a complex phenomenon and may be considered a synonym for social disadvantage and poor parental education. Parental education variable is used to examine to determine its influence on under-five children's nutritional status. Though other variables like control factors which focused on maternal and paternal education, age of both maternal and paternal and maternal (BMI), household characteristics include: wealth status, place of residence (rural/urban), region, access to safe water (source of drinking water), access to improved sanitation facility (toilet facility shared with households), marital status, religion, child characteristics include: age, sex of child.

Table 2. Operational Measurement of Mother/Father Characteristics

Mother BMI	0 = Underweight, 1 = Normal weight, 2 = Overweight, 3 = Obese
Child Age in Months	0 = 0-23 Months, 1 = 24-59 Months
Sex of Child	1 = Male, 2 = Female
Sex of Head of Household	1 = Male, 2 = Female
Mother's Age in Group	1 = 15-19, 2 = 20-24, 3 = 25-29, 4 = 30-34, 5 = 35-39, 6 = 40-44, 7 = 45-49
Father Age	0= 15-24, 1 = 25-34, 2 = 35-44, 3 = 45+
Religion	1 = Christian
	2 = Muslim
	3 = Traditional and No Religion
Parity	1 = 1-2, 2 = 3-4, 3 = 5-6, 4 = 7-9, 5 = 10-16

Table 3. Operational definition of household characteristics

Place of Residence	0 = Rural, 1 = Urban
Wealth Status	0 = Poorer, 1 = Middle, 2 = Richer
Sanitation (water)	0 = Unimproved, 1 = Improved
Sanitation (Toilet)	0 = Unimproved, 1 = Improved
Region	1 = North Western
	2 = South Central
	3 = South Eastern A
	4 = South Eastern B
	5 = North Central
Religion	1 = Christian
	2 = Muslim
	3 = Traditional and No Religion

3.7 Limitations of the Data

There were some lacunas when it came to the data obtained from women who have children above the age of 0-59 months beyond the measure of international standards and who were not asked about stunting. Also, a question was asked directly to mothers whose children were between the ages of 0-59 months on the stunting of their children. These women were asked about their husband/partner's education, which they responded to. We excluded maternal and paternal including children above the age range, women who were not asked about their children's stunting and education were dropped from the study sample, leading to only those the questions were asked. A variable was formed (maternal and paternal education), creating parent education as one of the independent variables, if not the most vital variable.

CHAPTER FOUR
4.0 RESULTS

4.1 Introduction

The chapter represents the distribution of various variables used in the study and the tests of association substantiated between the independent variables and the dependent variable. It is in three different sections based on how the data was organized to address the dependent variable of the study. The inchoate is the univariate analysis which is the first section that talks about the distribution of stunting by percentage, the next section is bivariate analysis would explores the relationships between parental education levels (paternal and maternal) and stunting rates, the third section is the last binary logistic regression is used to model the likelihood of stunting based on (maternal, paternal, and parental) education level along with other independent variables that are relevant factors. These analyses collectively provide a comprehensive understanding of the factors influencing stunting in children of Liberia.

This chapter presents the outcomes of the quality of data assessment in all the sections as we go through each of them. The chapter further displays the results of cross-tabulations where selected independent variables went against the dependent variable. Progression using the bivariate logistic models, results are shown, discussed, and in addition interpreted.

4.2 Univariate Analysis

The univariate analysis explores each of the variables in the dataset separately.

Given the total sample size of the study, the chart presents the number of children reported to be stunted and those whose children were not stunted. Stunting being the dependent variable, the chart shows that the percentage of children in the blue field who are stunted constitutes 30.68%, while the section next represents children not stunted in the yellow field with 69.32%.

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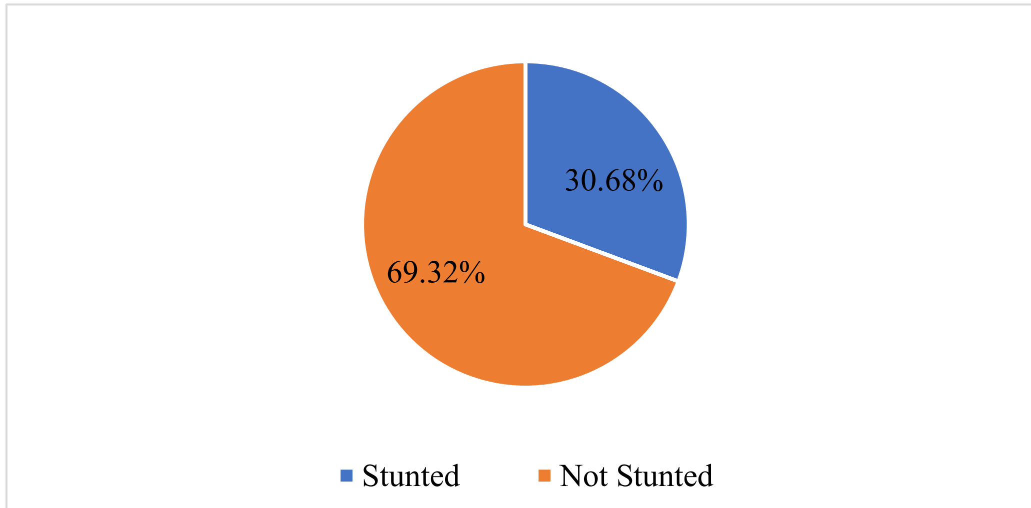
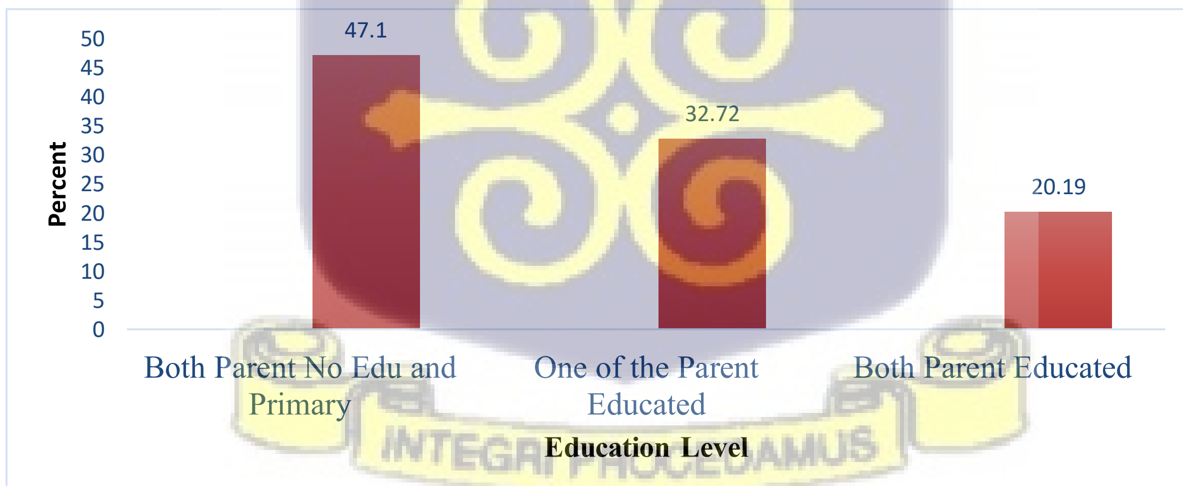
Figure 3: Distribution of Stunting status among children under 5



Source: Computed from LDHS (2019-2020) Data.

The pie chart represents the percentage of parents who have different levels of education. The x-axis shows three categories: both parents have no education or only primary education, one of the parents is educated, and both parents are educated.

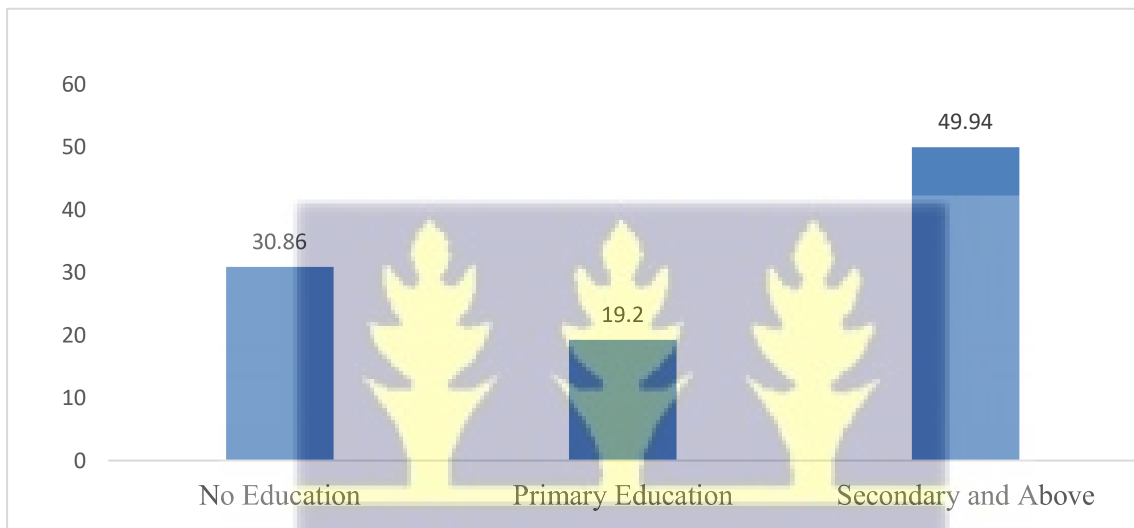
Figure 4 Distribution of Parental Educational Level



Source: Computed from LDHS (2019-2020) Data

The graph indicated the percentage of fathers with different levels of education, with the highest being fathers who have a secondary education and above, at 49.94%. The next highest accumulated percentage of fathers is with no education at 30.86%, and the lowest percentage of fathers who have a primary education at 19.2%.

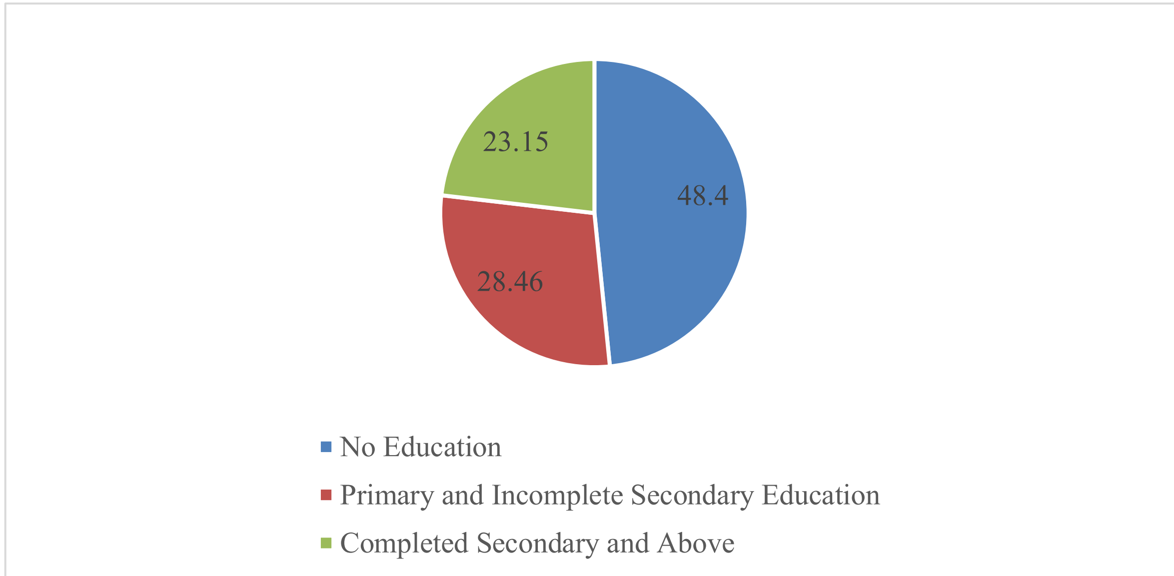
Figure 5 Distribution of Father's Educational Level



Source: Computed from LDHS (2019-2020) Data

The chart indicates the level of education of mothers at different fronts, with mothers with no education constituting about 48.4%. Mothers who have primary and incomplete secondary education represent the second highest, at 28.46%, while others with completed secondary education and above indicated 23.15%.

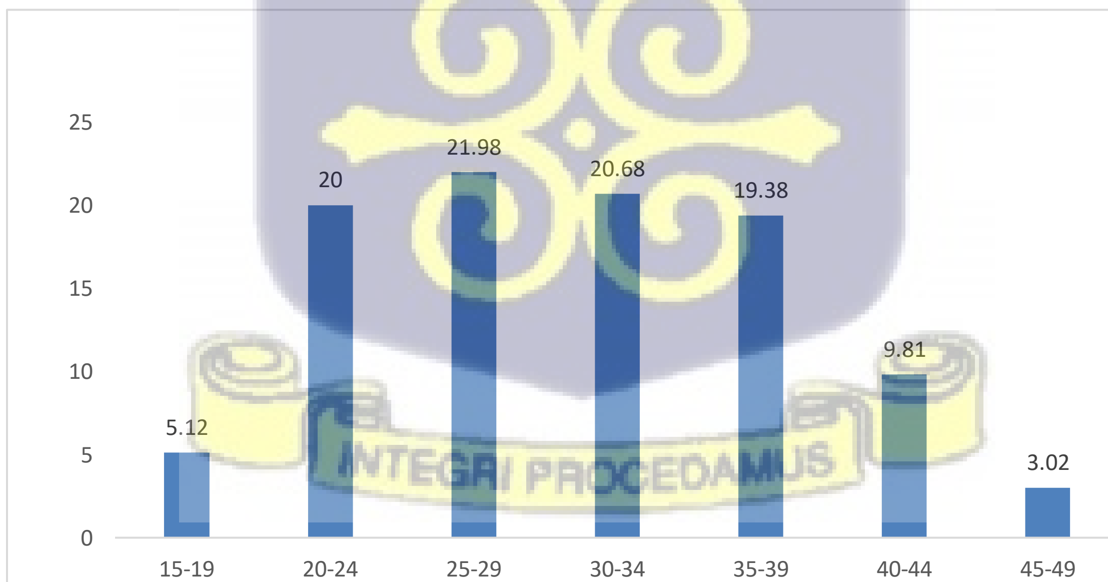
Figure 5: Distribution of Moher Educational Level



Source: Computed from LDHS (2019-2020) Data

The graph shows the age distribution of mothers. The highest number of mothers is in the age group of 30-34 years old, followed by 35-39 years old. The lowest of mothers are in the age range of 45-49 years old.

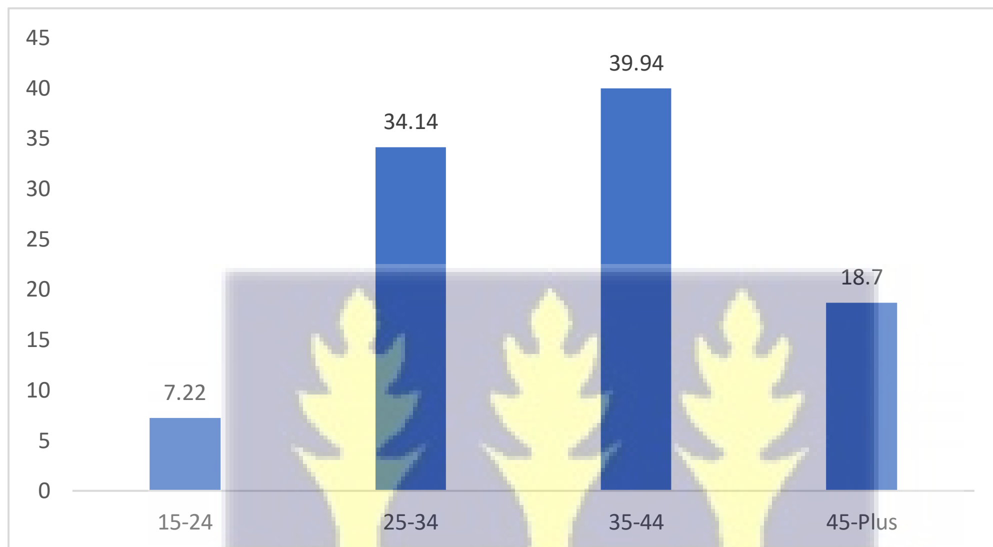
Figure 6 Distribution of Mother Age



Source: Computed from LDHS (2019-2020) Data

It shows the percentage distribution of fathers in each age group. The highest percentages of fathers are in the 35-44 age group, with 39.94% of fathers falling in this range, followed by the 25-34 age group, with 34.14%. The lowest percentage of fathers is in the 15-24 age group, with only 7.22% of fathers falling in this age range.

Figure 7: Distribution of Father Age



Source: Computed from LDHS (2019-2020) Data

The chart shows the percentages of mothers with children in different categories. The categories are based on the total number of children ever born to the mother. The highest percentage of parity is (30.86%), which has 3-4 children, followed by Parity 5-6 (24.07%). The lowest percentage of parity (2.59%) is for 10-16 children.

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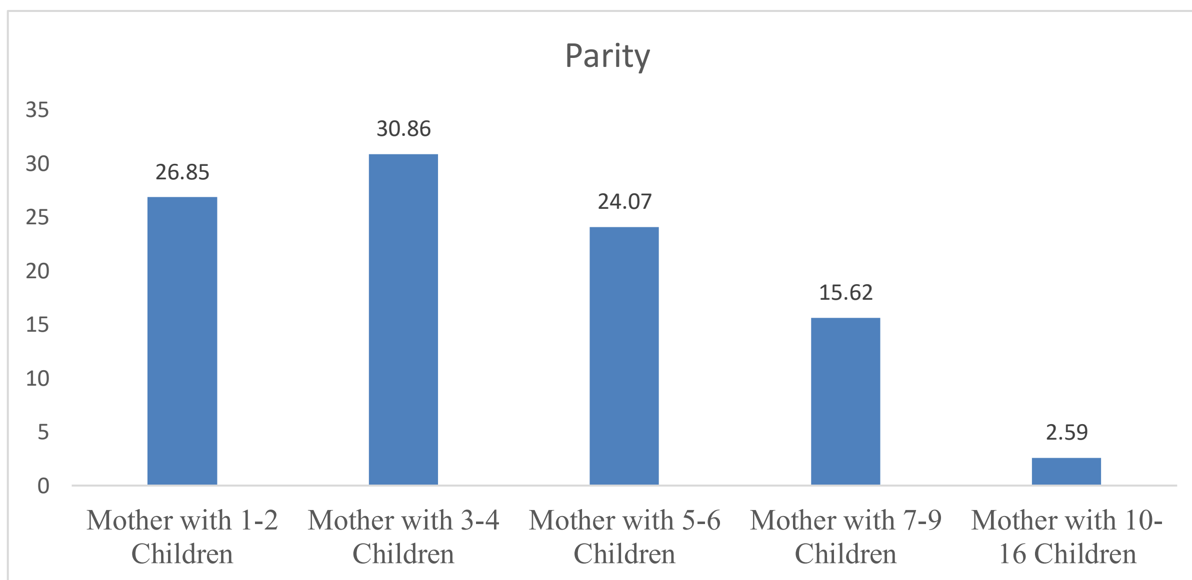
Figure 8: Distribution of parity



Source: Computed from LDHS (2019-2020) Data

The table below also displays the percentage distribution by sex of households. The results from the sample population revealed that 78.89% of the households in Liberia have male heads of households, while 21.11% of the households have female heads of households. This means that male-headed households are more common than female-headed households in Liberia. Based on the percentages provided for the Body Mass Index, it seems that normal weight which is measured at 18.5-24.9 constitutes about 63.35% of the population, overweight 25.0-29.9 also constitute 22.92%, those obese >=30.0 had 9.81%, and underweight that is measured <18.5 had the lowest percent of 3.91%.

According to the report from the Liberian Demographic Health Survey 2019-2020, the percentage of male children under five years was 49.57%, and the percentage of female children under five years was 50.43%. The table also shows the percentage of children in two age groups, 0-23 months and 24-59 months. The percentage of children in the 0-23 months age group is 43.52%, while the percentage of children in the 24-59 months age group is 56.48%.

Table 4. Mother characteristics and the various percentages

Variable	Percent (%)
Sex of head of household	
Male	78.89
Female	21.11
Mother (BMI)	
Underweight	3.91
Normal weight	63.35
Overweight	22.92
Obese	9.81
Sex of Child	
Male	49.57
Female	50.43
Age of Children in Months	
0-23 Months	43.52
24-59 Months	56.48

Source: Computed from LDHS (2019-2020) Data

The table below shows the distribution of wealth status, place of residence, source of drinking water, and type of toilet facility of the study population assessed in the Liberia Demographic Health Survey (LDHS). The results show that 63.7% of the population is classified as "poor," 19.01% as 19.01% as "middle," and 17.28% as "richer."

The table indicates that 70.43% of the population lives in rural areas, while 29.57% live in urban areas. The table shows that 73.15% of the households in Liberia have access to improved water sanitation facilities, while 26.85% of the households have unimproved water sanitation facilities.

For toilets, 30.93% of the households have access to improved sanitation facilities, while 69.07% of households have unimproved sanitation facilities.

Table 5. Univariate analysis of household characteristics

Variable	Percent (%)
Wealth Status	
Poor	63.7
Middle	19.01
Richer	17.28
Place of Residence	
Rural	70.43
Urban	29.57
Sanitation (Water)	
Unimproved	26.85
Improved	73.15
Sanitation (Toilet)	
Unimproved	69.07
Improved	30.93

Source: Computed from LDHS (2019-2020) Data

4.3 Bivariate analysis

Bivariate analysis using cross-tabulations and chi-square tests was employed to examine the association between parental education and child nutritional outcomes.

The table below shows the percentage of stunted children in Liberia based on the education level of their mothers, fathers, and both parents. The results indicate that children of mothers with no education had the highest percentage of stunting (32.4%). The chi-square test was used to determine the statistical significance of the differences in stunting prevalence between the

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categories. Children of mothers with primary/incomplete secondary education (33.62%), with a p-value of 0.002, and children of mothers with complete secondary and above education (23.47%) have a p-value of 0.002 as well.

Table 6. Parent characteristics and those of stunting

Variable	Stunted (%)	Not Stunted (%)	p-value
Mother Education			
No Education	254 (32.4)	530 (67.60)	
Primary/ Incomplete Secondary	155 (33.62)	306 (66.38)	
Complete Secondary and Above	88 (23.47)	287 (76.53)	
Total	497	1,123	1,620
X^2 =12.1397	Df=2		<0.002
Father education			
No Education	170 (34.0)	330 (66.0)	
Primary Education	108 (34.73)	203 (65.27)	
Secondary and above	219 (27.07)	590 (72.93)	
Total (N)	497	1,123	1,620
x2 = 9423	df=2		<0.007
Parental Education			
Both parents have No Education	264 (34.6)	499 (65.40)	
One Parent Educated	159 (30.0)	371 (70.00)	
Both Parent Educated	74 (22.63)	253 (77.37)	
Total	497	1,123	1,620
x2 = 15.5931	**df=2**		**<000**

Source: Computed from LDHS (2019-2020) Data

Similarly, children of fathers with no education had the highest percentage of stunting (34%) with a p-value of 0.007, followed by children of fathers with primary education (34.73%) with a p-value of 0.007, and children of fathers with secondary and above education (27.07%) also had the p-value of 0.007. Children of both parents with no education had the highest percentage of stunting (34.6%), which had a p-value of 0.000, followed by children of one parent educated (30%), with a p-value of 0.000, and children of both parents educated (22.63%) had a p-value of 0.000.

4.3.1 Bivariate analysis of mother (BMI), number of children born, and stunting

. The is aimed to examine the characteristics of mothers and their children and it found that (39.68%) of children whose mothers were underweight were stunted with a p-value of 0.007, (32.32%) of children whose mothers had a normal weight were stunted also with a p-value of 0.007, (29.72%) of these children whose mothers were overweight were also reported stunted had the p-value of 0.007, and (20.12%) of the children whose mothers were obese reported stunting with the p-value of 0.007.

The average parity of mothers was 1-2 (32.28%), had a p-value of 0.694, while mothers with 3-4 parity (28.6%) had a p-value of 0.694. For mothers with 5-6 parity, it was (30.26%) with a p-value of 0.694, for mothers with 7-9 parity, it was (32.02%) with a p-value of 0.694, and for mothers with 10-16 parity. This aspect of the analysis aims to delve into the bivariate relationships between household sanitation practices, wealth status, and stunting. Throw light on the nuanced connections that exist within these domains.

The first variable is the source of drinking water and stunted growth. The table shows that 34.94% of children who drink unimproved water are stunted, with a p-value of 0.024, while 29.11% of

children who drink improved water are stunted, with a p-value of 0.024, along with a chi-square statistic of 5.0829 with 1 degree of freedom. (Okuba, Tolessa 2022-08-01)

ty, it was (35.71%) with the p-value of 0.694.

Table 7. Mother characteristics and stunting

Mother BMI	Stunted	Not Stunted	p-value
Underweight	26 (39.39)	40 (60.61)	
Normal weight	331 (32.36)	692 (67.64)	
Overweight	109 (29.38)	261 (70.35)	
Obese	31 (19.00)	130 (81.00)	
Total (N)	497	1,123	1,620
x2 = 12.1418	df=3		<0.007
Parity			
1-2	140 (32.28)	295 (67.82)	
3-4	143 (28.60)	357 (71.40)	
5-6	118 (30.26)	272 (69.74)	
7-9	81 (32.02)	172 (67.98)	
10-16	15 (35.71)	27 (64.29)	
Total (N)	497	1,123	1,620
x2 = 2.2255	**df=4**		**>0.694**

Source: Computed from LDHS (2019-2020) Data

Furthermore, the same table shows the relationship between the source of the toilet facility and stunted growth. It shows that 32.53% of children who used unimproved toilet facilities are stunted,

with a p-value of 0.016, while 26.55% of children who used improved toilet facilities are stunted, with a p-value of 0.016, and the chi-square test statistic is 5.8232 with 1 degree of freedom. This indicates that there is a statistically significant association between the source of the toilet facility and stunted growth. A study conducted in Zambia about toilets and stunting (Ulfa Al Uluf, Mohmudiono et al, 2018) coincided with this result.

Similarly, the third table shows the relationship between wealth status and stunted growth. It also shows that 33.91% of children from poorer households are stunted with a p-value of 0.000, while 29.55% of children from middle-income households are stunted with the same p-value of 0.000, and only 20% of children from richer households are stunted with the chi-square test statistic which is 20.2813 with 2 degrees of freedom and a p-value of <0.001. It explains that there is a statistically significant association between wealth status and stunted growth. A study done by Chijioke O. Nwosu and John Ele-Ojo Ataguba (2013-2018) supports that there is a strong tie between wealth status and stunting.

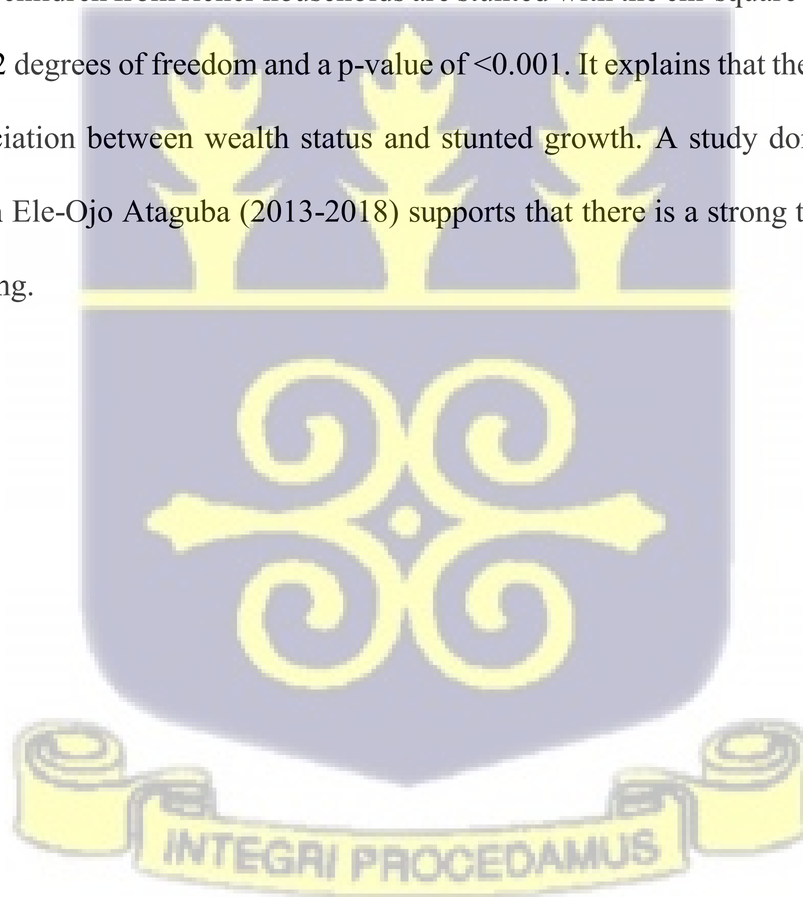

Table 8. Characteristics of stunting

Source of drinking water	Stunted	Not Stunted	p-value
Unimproved	152 (34.94)	283 (65.06)	
Improved	345 (29.11)	840 (70.89)	
Total (N)	497	1,123	1,620
x2 = 5.0829	df=1		<0.024
Source of toilet facility			
Unimproved	364 (32.53)	755 (67.47)	
Improved	133 (26.55)	368 (73.45)	
Total (N)	497	1,123	1,620
x2 = 5.8232	df=1		<0.016
Wealth Status			
Poorer	350 (33.91)	682 (66.09)	
Middle	91 (29.55)	217 (70.45)	
Richer	56 (20.00)	224 (80.00)	
Total (N)	497	1,123	1,620
x2 = 20.2813	**df=2**		**<0.000**

Source: Computed from LDHS (2019-2020) Data

4.3.2 Bivariate analysis of demographic characteristics

This Bivariate Analysis aims to uncover the relationships and potential disparities within the demographic landscape through the lens of various basic variables, shedding light on essential aspects such as the age of the mother, the age of the father, the age of children under five in months,

sex of head of household, sex of the child, region, place of residence, and the prevalence of stunting.

The results of the test for different factors such as the mother's age, father's age, age of children in months, sex of the head of household, sex of the child, religion, five regions, and the place of residence. The table indicates the percentage of stunting and other demographic variables. Among the various variables, the p-value for the age of children in months is less than 0.05, which means there is a significant association between the age of children and stunting, and the place of residence is also significantly associated with the p-value 0.001 However, for the other factors, the p-value is greater than 0.05, which implies that there is no statistical relationship between the age of mother, age of the father, sex of head of household, sex of the child, religion, and five regions (p-value>0.05).

Table 9. Demographic Characteristics of some independent variables and stunting

Mother Age	Stunted	Not Stunted	p-value
15-19	24 (28.92)	59 (71.08)	
20-24	122 (37.65)	202 (62.35)	
25-29	102 (28.65)	254 (71.35)	
30-34	91 (27.16)	244 (72.84)	
35-39	95 (30.25)	219 (69.75)	
40-44	46 (28.93)	113 (71.07)	
45-49	17 (34.69)	32 (65.31)	
Total (N)	497	1,123	1620
x2 = 10.7944	df=6		>0.095
Father Age			
15-24	40 (34.19)	77 (65.81)	
25-34	183 (33.09)	370 (66.91)	
35-44	188 (29.06)	459 (70.94)	
45+	86 (28.38)	217 (71.62)	
Total	497	1,123	1,620
x2 =3.7431	df=3		>0.291
Age of Children in Months			
0-23	169 (23.97)	536 (76.03)	
24-59	328 (35.85)	587 (64.15)	
Total (N)	497	1,123	1,620

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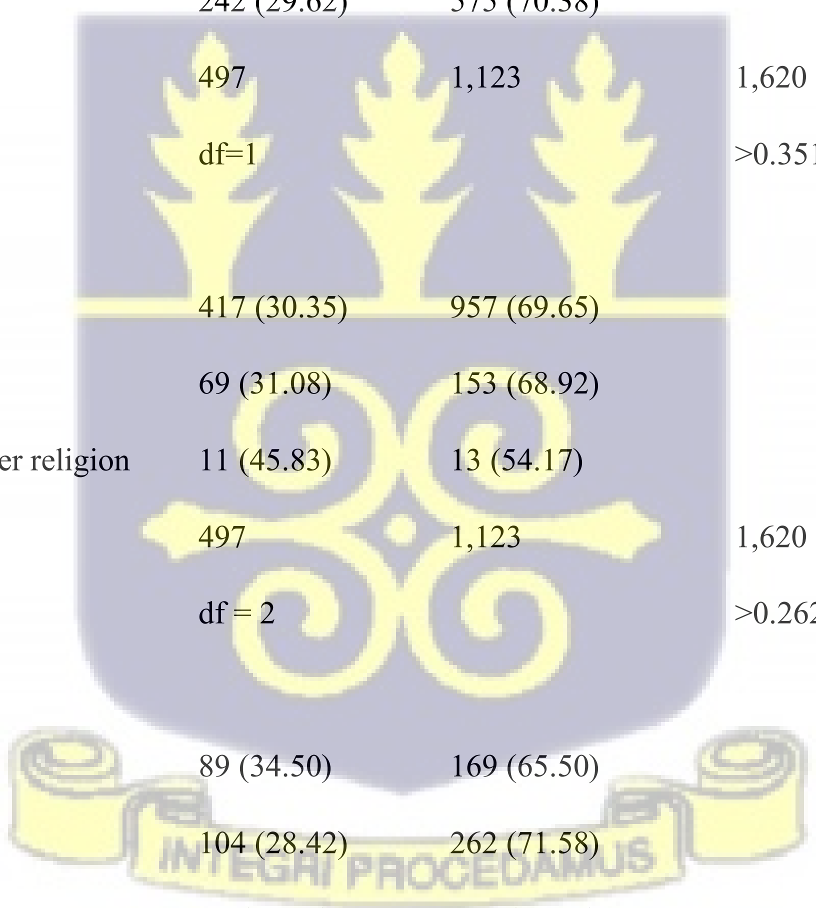
x2 = 26.4048	df=1		<0.000
Sex of Head of Household			
Male	388 (30.36)	890 (69.64)	
Female	109 (31.87)	233 (68.13)	
Total (N)	497	1,123	1,620
x2 = 0.2898	df=1		>0.590
Sex of the Child			
Male	255 (31.76)	548 (68.24)	
Female	242 (29.62)	575 (70.38)	
Total	497	1,123	1,620
X2 = 0.8683	df=1		>0.351
Religion			
Christian	417 (30.35)	957 (69.65)	
Muslim	69 (31.08)	153 (68.92)	
Traditional/Other religion	11 (45.83)	13 (54.17)	
Total	497	1,123	1,620
X^2 = 2.6788	df = 2		>0.262
Five Region			
North Western	89 (34.50)	169 (65.50)	
South Central	104 (28.42)	262 (71.58)	
South Eastern A	80 (30.42)	183 (69.58)	
South Eastern B	74 (26.43)	206 (73.57)	



North Central	150 (33.11)	303 (66.89)	
Total (N)	497	1,123	1,620
x2 = 6.2980	df=4		>0.178
Place of Residence	Stunted	Not Stunted	
Rural	377 (33.04)	764 (66.96)	
Urban	120 (25.05)	359 (74.95)	
Total (N)	497	1,123	1,620
x2 = 10.1248	**df=1**		**<0.001**

Source: Computed from LDHS (2019-2020) Data

4.4 Binary Logistic Regression

The binary logistic model is conducted/run when the outcome variable is measured by two categories. In the first, the outcome variable, child nutrition, is measured by stunted or not stunted. There are six (6) models run under this section; two each indicating whether it is being adjusted or not adjusted. The unadjusted model tests the relationship between the main independent variables (mother/father/parental education) and the outcome variable stunting, measured as (stunted/ not stunted). The adjusted model tests the relationship between the main independent variables (socio-demographic variables and child nutrition. The table provided shows the results of Model 1 Unadjusted, which represents the relationship between the mother's educational level and stunting.

Pursuance with the results, a mother’s low education level affects the risk of children under five experiencing stunting by 3.01 times compared to mothers with higher education levels (aOR = 3.01; 95% CI = 1.92 to 4.73), with statistically significant (p = 0.002).

Model 2. The next table, after adjusting for the independent variable of mother education, brought additional independent variables to test the association between mother education and stunting. The result from the table indicates that the OR for mothers with primary and incomplete secondary education is 0.992 times the odds of having stunted children compared to children of mothers with no education, which is not statistically significant (0.952). The OR for mothers with completed secondary education and above is 0.737 times the odds of having stunted children compared to children whose mothers have no education, which is not significant (0.064). It suggests that mothers with higher education levels may be less likely to have stunted children.

Mother (BMI) reference for Underweight, the OR for mothers with normal weight is 0.75 times odds of having stunted children compared to children whose mothers were underweight, which is not statistically significant ($p = 0.31$), the OR for mothers who are overweight is 0.695 times odds of having stunted children compared to children whose mothers had underweight, which is also not statistically significant ($p = 0.228$). However, the OR for mothers who are obese is 0.474, which is statistically significant ($p = 0.031$). This suggests that mothers who are obese may be less likely to have stunted children compared to children whose mothers are underweight. Except for mothers who are obese and have a positive correlation (association), others were not statistically significant.

The OR for mothers in the middle wealth status category is 0.883 times the odds of having stunted children compared to children of mothers in the poorer category, which is not statistically significant ($p = 0.435$). The OR for mothers in the richer wealth status category is 0.657 times the odds of having stunted children compared to children of mothers in the poorer category, which is marginally significant ($p = 0.075$). This indicates that mothers in the wealthier category may

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be less likely to have stunted children. This supports the study by Chanda, H. (2020) that a richer wealth status is less likely to have stunted children.

The ORs for mothers in the age groups 1.446, 0.955, 0.812, 0.695, and 0.841, respectively, were not significantly associated. The parity to mothers indicated that none of these ORs were statistically significant. The place of residence, source of drinking water, type of toilet facility, region, and religion were not statistically associated with stunting.

4.4.1 Binary Logistic Regression

Model 1 Unadjusted represents the mother's educational level and stunting, which form the relationship between the Mother's Education and stunting. The dependent variable is stunting, and the reference category for all independent variables is shown in parentheses.

Table 10. Model 1 Unadjusted Mother Education

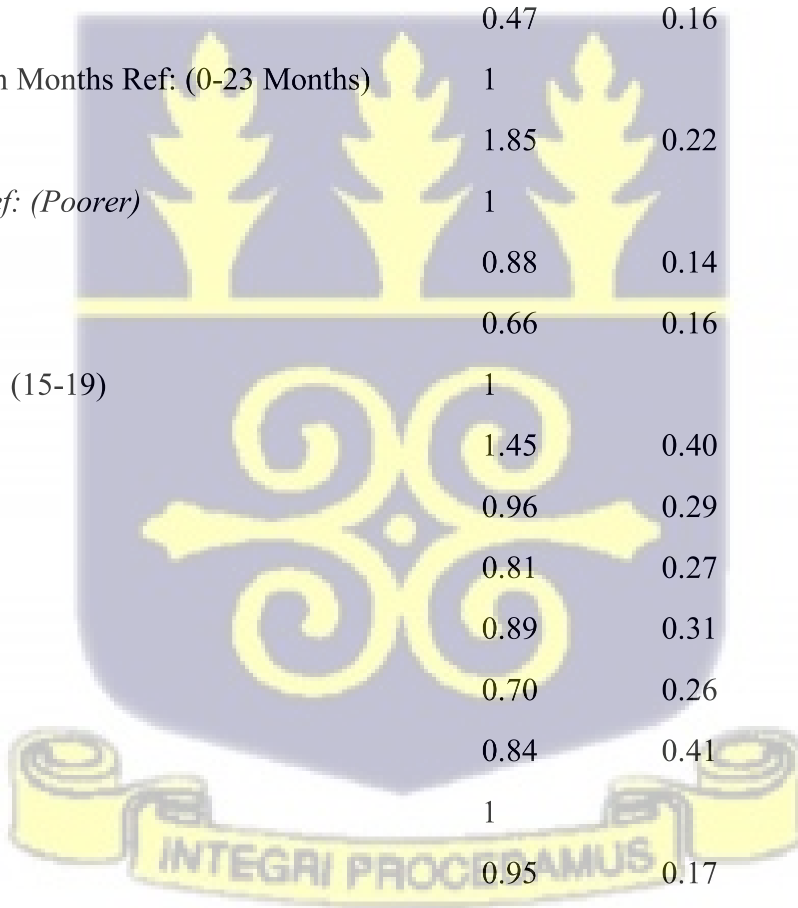
Model 1 Unadjusted

Variable	OR	RSE.	t-value	p-value
Mother Education: Ref (No Education)	1			
Primary	1.06	0.13	0.44	.66
Secondary and above	0.64	0.09	-3.11	.002
Constant	**0.48**	**0.04**	**-9.64**	**0**

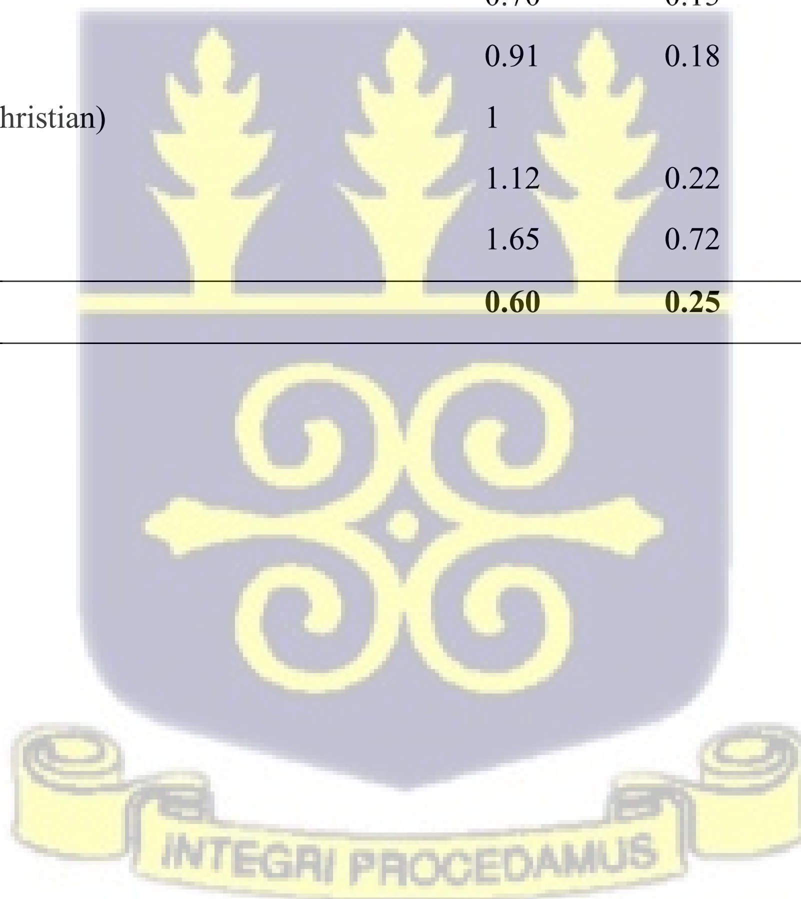
Table 11. Model 2 Adjusted. Mother Education and other independent variables and stunting

Model 2 Adjusted

Variable	OR	RSE	t-value	p-value
Mother Education Ref: (No Education)				
Primary and Incomplete Secondary Education	0.99	0.13	-0.06	0.95
Completed Secondary Education and Above	0.74	0.12	-1.85	0.06
Mother (BMI): Ref (Underweight)				
Normal Weight	0.75	0.21	-1.01	.31
Overweight	0.70	.21	-1.20	0.23
Obese	0.47	0.16	-2.15	0.03
Children's Age in Months Ref: (0-23 Months)	1			
24-59 Months	1.85	0.22	5.21	0.000
Wealth Status Ref: (Poorer)	1			
Middle	0.88	0.14	-0.78	0.44
Richer	0.66	0.16	-1.78	0.08
Mother Age Ref: (15-19)	1			
20-24	1.45	0.40	1.32	0.19
25-29	0.96	0.29	-0.15	0.88
30-34	0.81	0.27	-0.63	0.53
35-39	0.89	0.31	-0.33	0.74
40-44	0.70	0.26	-0.96	0.34
45-49	0.84	0.41	-0.36	0.72
Parity Ref: (1-2)	1			
3-4	0.95	0.17	-0.26	0.79
5=6	1.1	0.25	0.43	0.67
7=9	1.13	0.29	0.47	0.64



10-16	1.39	0.59	0.79	0.43
Place of Residence Ref: (Rural)	1	.	.	.
Urban	0.95	0.15	-0.35	0.73
Source of drinking water Ref: (Unimproved (Water)	1			
Improved	0.95	0.13	-0.40	0.69
Type of toilet facility Ref: Unimproved toilet)	1			
Improved toilet	0.92	0.13	-0.58	0.56
Region Ref: (North Western**)**	1			
South Central	0.90	0.19	-0.49	0.63
South Eastern A	0.88	0.19	-0.59	0.55
South Eastern B	0.70	0.15	-1.64	.1
North Central	0.91	0.18	-0.48	.63
Religion Ref: (Christian)	1			
Muslim	1.12	0.22	0.57	0.57
Traditional No	1.65	0.72	1.16	0.25
Constant	**0.60**	**0.25**	**-1.22**	**0.22**



4.4.2 Binary Logistic Regression Model three and Model four

In the third Model, which is an unadjusted father education and stunting relationship is being tested, the predictor variable is not adjusted for any other variables. In Model 4, the predictor variables are adjusted for other variables in the model. These adjusted ORs in Model 4 represent the change in the odds of the dependent variable occurring for a one-unit increase in the predictor variable, holding all other variables in the model constant.

The third model in the table provided shows the results of a logistic regression model that examines the relationship between a father's education level and stunting. The odds ratio (OR) for stunting among children whose fathers have primary education is 1.033 times higher compared to children whose fathers do not have any education, with a p-value of 0.83, while the OR for stunting among children whose fathers have secondary education or above is 0.721. The OR for the reference group (children whose fathers have no education) is 1. The p–p-value for the OR of children whose fathers have secondary education or above is 0.008, which is statistically significant at the 0.05 level.

In the next model, four (4), the table provided shows the results of a logistic regression model with stunting as the outcome variable and the father's education level, children's age in months, wealth status, father age, source of drinking water, and type of toilet facility as predictor variables. The odds ratio (OR) measures the association between each predictor variable and the outcome variable. It represents the odds of stunting for a one-unit increase in the predictor variable, holding all other variables constant.

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The OR for the Primary education level is 0.96, which indicates a lower odds of children being stunted compared to children whose fathers had no education, with a p-value of 0.794, which

indicates that there is no significant association between Primary education level and stunting. The OR for Secondary Education and above is 0.785 which also states that children whose fathers have secondary education and above have lower odds of being stunted compared to children whose fathers have no education, with a p-value of 0.06, which suggests that there may be a weak negative association between secondary education and above and stunting.

The OR for children aged 20-59 months is 1.852 times higher compared to children aged 0-23 months, with a p-value of 0.000, indicating that there is a significant positive association between children aged 24-59 months and stunting. The OR for middle-wealth status and stunting is 0.894, which is lower when compared to children in the poor wealth category, with a p-value of 0.459, which suggests that there is no significant association between middle-wealth status and stunting. The OR for richer wealth status is 0.576, which is far less than being stunted compared to children of poor wealth with a p-value of 0.004, indicating that there is a significant negative association between richer wealth status and stunting.

The OR for fathers aged 25-34 is 0.871 with a p-value of 0.53, which suggests that there is no significant association between fathers aged 25-34 and stunting. The OR for fathers aged 35-44 is 0.685 with a p-value of 0.086, indicating that there may be a weak negative association between fathers aged 35-44 and stunting. The OR for 45+ is 0.621, indicating that fathers aged 45+ children have lower odds of being stunted compared to children whose fathers are aged 15-24, with a p-value of 0.049, which suggests that there is a significant negative association between fathers aged 45+ and stunting.

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The OR for Improved source of drinking water is 0.886 with a p-value of 0.344, which suggests that there is no significant association between improved source of drinking water and stunting.

The OR for Improved toilet facilities is 0.948 with a p-value of 0.694, indicating that there is no significant association between improved toilet facilities and stunting.

The third model shows father education and stunting, while on the other hand, model four (4) portrayed father education with stunting why adding other variables: Wealth Status, father age, age of the children in months, and source of drinking water and type of toilet facility.

Table 12. Model 3 Unadjusted Father's Education

Model 3 Unadjusted

Variable	OR	RSE	t-value	p-value
Father Education Ref: No Education	1			
Primary Education	1.03	0.16	0.21	0.83
Secondary Education and Above	0.72	0.09	-2.66	.008
Constant	**0.52**	**0.05**	**-7.02**	**0**

Table 13. Model 4 Adjusted Father Education with other independent variables and stunting

Model 4 Adjusted

Variable	OR	RSE	t-value	p-value
Father Education Ref: (No Education)	1			
Primary	.96	0.15	-0.26	0.79
Secondary Education and Above	.785	0.10	-1.88	0.06
Child Age in Months: Ref (0-23 Months)	1			
24-59 Months	1.85	0.22	5.31	0
Wealth Status: Ref: (Poorer)	1			
Middle	0.89	0.14	-0.74	0.46
Richer	0.58	0.11	-2.86	.004
Father Age: Ref (15-24)	1			
25-34	0.87	0.19	-0.63	0.53
35-44	0.69	0.15	-1.72	0.09
45-Plus	0.62	0.15	-1.96	0.05
Source of drinking water Ref: (Unimproved Water)	1			
Improved	0.89	0.11	-0.95	0.34
Type of toilet facility Ref: (Unimproved toilet)	1			

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Improved toilet	0.95	.13	-0.39	0.69
Constant	**.57**	**0.14**	**-2.38**	**0.02**

4.4.3 Binary Logistic Regression of Parental Education

The Binary Regression Model looked at the characteristics of parental education and stunting model five (5). In the sixth model, parental education and other independent socio-demographic variables are joined to test the outcome, and all other variables with stunting. The fifth model in the table below shows the odds ratio (OR), robust standard errors (RSE), t-value, and p-value for the association between parental education level and stunting. The reference category is "No Education". The OR for "One parent Incomplete Secondary education" is 0.81 (95% CI: 0.65-1.01), which implies that the odds of stunting for children whose parents have an incomplete secondary education are 0.81 times the odds of stunting for children whose parents have no education. This estimate's robust standard error (RSE) is 0.099, the t-value is -1.73, and the p-value is 0.083. The OR for "Secondary and Above Education" is 0.553 (95% CI: 0.42-0.73), meaning that the odds of stunting for children whose parents have secondary and above education are 0.553 times those for children whose parents have no education. The RSE for this estimate is 0.084, the t-value is -3.89, and the p-value is 0.000.

The results below on the six models show the odds ratio (OR), robust standard error (RSE), t-value, and p-value for each variable in the logistic regression model that predicts the probability of a child being stunted based on various factors. Parental education as an independent variable has three categories. The reference category is no education, which means the ORs for the other two categories are compared to this group. In other words, the OR for one parent with incomplete secondary education is 0.923, which means that children whose one parent has incomplete education have 0.923 times the odds of being stunted as children whose parents have no education,

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holding all other variables constant. This effect is not statistically significant as the p-value is 0.536, which is greater than 0.05. Similarly, the OR for secondary and above education is 0.681, which means that children whose parents have secondary and above education have 0.681 times the odds of being stunted as children whose parents have no education, considering all other variables constant. This effect is statistically significant as the p-value is 0.029, which is less than 0.05.

The Mother's Body Mass Index (BMI) has four categories: underweight, normal weight, overweight, and obese. The reference category is underweight; the ORs for the other three categories are compared to this group. The OR for normal weight is 0.794, which means that children whose mothers have normal weight have 0.794 times the odds of being stunted as children whose mothers are underweight. The effect is not statistically significant as the p-value is 0.423, which is greater than 0.05. Furthermore, the OR for obesity is 0.509, which also indicates that children whose mothers are obese have 0.509 times the odds of being stunted as children whose mothers are underweight, holding all other variables constant. The effect is marginally significant, as the p-value is 0.054, which is close to 0.05.

The age of the child in months has two forms: 0-23 months and 24-59 months. After referencing for 0-23 months, the OR for 24-59 months is 1.864, which revealed that children who are 24-59 months old have 1.864 times the odds of being stunted as children who are 0-23 months old, considering all other variables constant. The effect is statistically significant as the p-value is 0.000, which is less than 0.05.

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In the case of wealth status referencing for the poorer category, the ORs for the other two categories are compared to this group. The OR for the middle is 0.908, which revealed that children who belong to the middle wealth status have 0.908 times the odds of being stunted as children who

belong to the poorer wealth status. It also indicates that there is no statistical significance as the p-value is 0.554, which is greater than 0.05. The OR for richer explains that there is no statistical significance, given that the p-value is more than 0.05. The age of mothers, father age, sex of head of household, total children born, source of drinking water, type of toilet facility, place of residence, sex of child, region, and religion were all found not significantly associated because their p-value was greater than 0.05

Table 14. Model 5 Unadjusted Parent education and stunting

Model 5 Unadjusted

Variable	OR	RSE	t-value	p-value
Parental Education: Ref (No Education)	1			
One Parent's Incomplete Secondary Education	0.81	0.10	-1.73	0.08
Secondary and Above Education	0.55	0.08	-3.89	0.000
Constant	**0.53**	**0.04**	**-8.36**	**0**

Table 15. Model 6 Adjusted Parent education with other independent variables and stunting

Model 6 Adjusted

Variable	OR	RSE	t-value	p-value
Parental Education: Ref (No Education)	1			
One Parent's Incomplete Secondary Education	0.92	.12	-0.62	0.54
Secondary and Above Education	0.68	.119	-2.19	0.03
Mother (BMI) Ref: (Underweight)	1			
Normal Weight	0.79	.229	-0.80	0.42
Overweight	0.74	.228	-0.97	0.33
Obese	0.51	.178	-1.93	0.05
Child Age in Months Ref: (0-23 Months)	1			
24-59 Months	1.86	.221	5.25	0.000
Wealth Status: Ref (Poorer)	1			
Middle	0.91	.147	-0.59	0.55
Richer	0.69	.162	-1.59	0.11
Mother Age Ref: (15-19)	1			

20-24	1.53	0.45	1.43	0.15
25-29	1.05	0.35	0.14	0.89
30-34	0.92	0.33	-0.24	0.81
35-39	1.05	0.39	0.12	0.90
40-44	0.83	0.34	-0.47	0.64
45-49	1.03	0.53	0.05	0.96
Father Age Ref: (15-24)	1			
25-34	0.94	0.24	-0.25	0.81
35-44	0.81	0.22	-0.75	0.45
45+	0.76	0.23	-0.91	0.37
Sex of household head (Male)	1			
Female	1.09	0.15	0.65	0.52
Parity Ref: (1-2)	1			
3-4	0.97	0.18	-0.15	0.88
5-6	1.15	0.26	0.61	0.55
7-9	1.19	0.31	0.67	0.50
10-16	1.43	0.60	0.86	0.39
Sex of child Ref: (Male)	1			
Female	0.89	.1	-1.00	0.32
Place of Residence Ref: (Rural)	1			
Urban	0.94	.148	-0.38	0.71
Source of drinking water Ref: (Unimproved water)	1			
Improved	0.94	.124	-0.50	0.62
Type of toilet facility Ref: (Unimproved toilet)	1	.	.	.
Improved toilet	0.94	.13	-0.48	0.63
Region Ref: (North Western)	1			
South Central	0.92	0.19	-0.40	0.69

South Eastern A	0.89	0.20	-0.52	0.60
South Eastern B	0.71	0.16	-1.54	0.12
North Central	0.91	0.18	-0.50	0.62
Religion Ref: (Christian)	1			
Muslim	1.12	0.23	0.57	0.57
Traditional No	1.64	0.71	1.14	0.26
Constant	**0.60**	**0.26**	**-1.19**	**0.23**

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4.5. Discussion

In consonance with the findings, the objectives of the study are presented here in this discussion. The study set out to investigate the influence of parental education on child nutrition, with a particular emphasis on stunting, within the context of Liberia. Specifically four main objectives were laid out and these were to: assess the association between maternal education and the nutritional outcome of children in Liberia; find out the association between father's education and the nutritional outcome of children in Liberia; investigative the cumulative effective of parental education and nutritional outcome of children in Liberia, and finally identify the association that exists with other socio-demographic characteristics and nutritional outcome of children in Liberia.

In light of objective one, it was observed that there is a non-negligible association (correlation) between maternal education without being adjusted for and child nutrition outcomes in Liberia. The sign of a mother's low education affects the risk of children under five experiencing stunting by 3.01 times compared to mothers with completed secondary and above education levels (aOR = 3.01; 95% CI = 1.92 to 4.73), with statistical significance (p = 0.002). Mother's education is associated with improvement, as the nutritional outcome of the child also improves, and when the mother's educational status plummets, the nutritional outcome of the child would also plummet or become worse off. This aligned with the study by (AD Laksono, RD Wulandari, N Amaliah, 2022), who, in a study in Indonesia, found that higher maternal education reduces the risk of child malnutrition. While Indonesia and Liberia differ contextually, especially in economic and healthcare systems, the commonality lies in both being low to middle-income countries where maternal knowledge influences practices. Turowska et al. (2019) make a similar reference to how maternal education has a significant association with children under five and stunting. Studying in Eastern Europe, reached similar conclusions but in a higher-income context. The implication is

that, regardless of geography, maternal education correlates with improved child outcomes, though mechanisms (e.g., healthcare access, cultural practices) may vary.

When considering the mother's education and stunting, wherein other variables are included like in model 2, where we adjusted, the OR for mothers with completed secondary education and above is 0.737, which is marginally significant (0.064). It still implies that mothers with completed secondary education and above may be less likely to have stunted children, suggesting that when controlling for variables such as BMI, child age, and wealth index, the direct effect of education is somewhat attenuated. This underscores the complex interplay between education and socioeconomic conditions. Lawal et al. (2018), in Nigeria, and Gobena et al. (2023), in Ethiopia, found similar results, noting that maternal education and wealth independently and interactively affect child nutrition. However, unlike these studies, our findings in Liberia showed that variables like drinking water source and sanitation were not significantly associated with stunting after adjustment. This may reflect contextual differences in access to public health infrastructure across the countries.

In addition to the next model 2, when it was adjusted, the mother's education, other variables alongside the mother (BMI), Age of children in months, and wealth status were all found significantly associated. Mother Education, Mother age, parity, place of residence, source of drinking (water), types of toilet facilities, region, and religion after being adjusted these were found not significantly associated Juxtaposing both models 1 and 2 implied when other factors are involved, there is a slight variance about mothers' education and stunting of children under-5. A study conducted by (Lawal SA, Okunlola DA, Adegboye OA, 2018) in Nigeria, and another study by (Gobena, W. E., Wotale, T. W., Lelisho, M. E., & Gezimu, W., 2023) also conducted in Ethiopia, aligned with some of the variables found in this study, significantly associated with

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stunting. In contrast with some of their findings, the mother's education, place of residence, sources of drinking water, and type of toilet facilities were significantly associated, whereas this work did not.

With regards to objective two, fathers' education alone without adding other factors that may influence the association between the father's education level and stunting, a positive association between the variables of concern (fathers' education and nutrition outcome) was observed that children whose fathers have secondary education or higher were 0.721 times lower than those whose fathers have no education. There is a statistically significant as, p = 0.008. This positive relation implies that as a father's education goes up or down the educational ladder, the child's nutritional outcome becomes better and vice versa. A study conducted by Paulo Renato Correa (2022) in Angola corroborated this study about father education and how it contributes to childhood stunting. It is a neighboring country with comparable social conditions, reinforcing that educated fathers may contribute to improving household resource allocation and healthcare decisions. There is no way one can discuss the role of a father without aligning it with the mother's educational role. Intriguingly, the age of the child, sex of the child, type of toilet, and source of water were all found significantly associated, but after adjusting for the model, it was similar to where the source of water, type of toilet facility, wealth index, place of residence was all not associated. In the fourth model, however, it was noteworthy that the fathers' education now, the father's education has been adjusted, having other factors that may have influenced stunting. The results show that the OR for secondary education and above is 0.785 with a p-value of 0.06, suggesting that paternal education's effect might be mediated by other factors such as income or maternal empowerment. There is one other demographic variable that showed signs of significantly affecting the nutritional outcome of children. One of such is the age of children in

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months, and there is a positive association between children in months and stunting. In furtherance, wealth status, especially those in the richer category, was significantly associated, indicating that children whose fathers are richer are less likely to be stunted when compared to children of poorer fathers. It could be attributed that richer fathers are more responsive to their children's health and well-being. The ages of fathers in two categories, 35-44 and 45+, had a positive and significant association to influence with stunting. The source of drinking water and type of toilet facility, having been adjusted, had no impact on stunting from the results. A study conducted by Li Z, Kim R, et al (2020) in some least middle-income countries attributed that father education was not important after adjusting for confounders, similar to this study. However, some other studies had contrary output about how significant it is with the father's educational role and impact are as it relates to childhood malnutrition.

In continuation of models five and six on parental education and childhood nutrition, parental education (paternal and maternal) had a very strong influence on childhood stunting. It is indicated that children whose parents have attained secondary education and above had the RSE for this estimate is 0.084, the t-value is -3.89, and the p-value is 0.000. A study conducted by Chowdhury, T. R., et al (2021) in Bangladesh reached similar conclusions, emphasizing that combined parental education enhances decision-making and promotes better feeding practices. Despite cultural differences, the similarity in findings suggests a universal advantage of joint parental education for child health. This is particularly relevant for Liberia, where efforts to improve educational access and equity could indirectly reduce stunting. In that report, it was found that mothers ' BMI, the age of children under five, source of drinking water, type of toilet facility, and wealth status were significantly associated with stunting.

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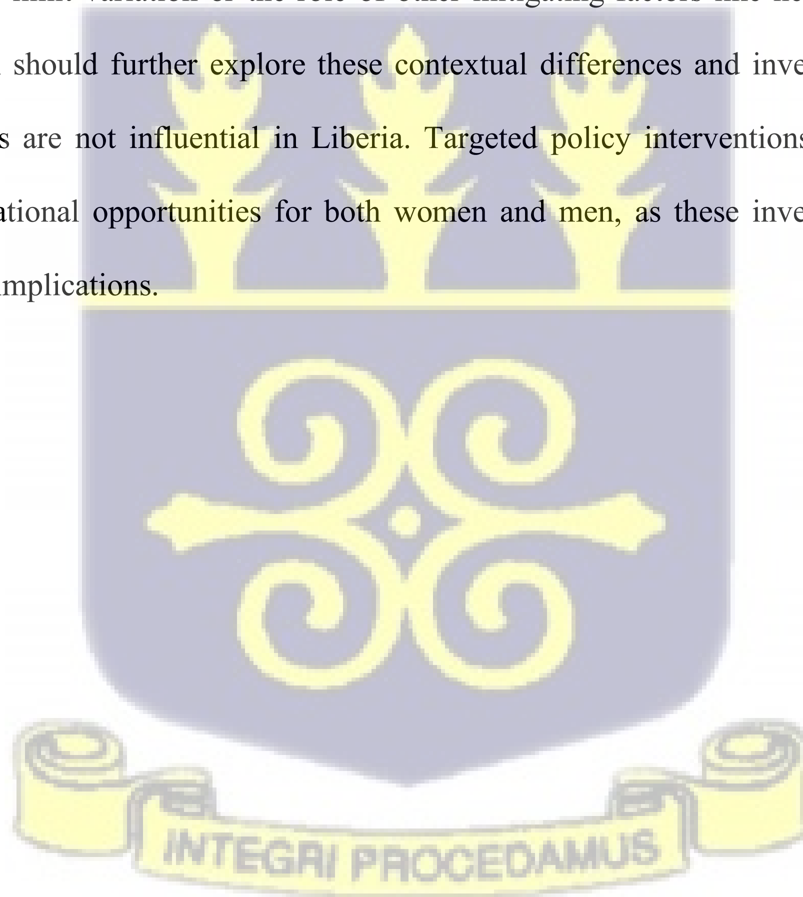
The significant advantage is in their children's well-being compared to children whose parents had no education and those with primary education, as per the chances of improving children's health. There are findings from other studies regarding parental education and childhood nutrition that might seem contrary to this finding. In the last model, parental education, stunting, and other variables were factors determining the influence it may influence stunting were included. Parental education (paternal and maternal), when combined with acquiring secondary education and above, clearly states that the higher the aggregate of knowledge attained by parents, the better decision-making for their children's nutritional status and health becomes. Another study conducted by Saeed, A., Sadaf, S., & Hassan, K. (2023) in Pakistan higher stunting was associated with the rural area, sources of drinking water, educated (maternal and paternal), employed mothers, some of whom are not associated with this finding except for parent's education, mother's BMI, and Child age. The age of children under 5, after being adjusted for, was significantly associated with stunting. The study in Pakistan also found that nutritional vulnerability is highest in early childhood. It further elucidated that children under the age of five are prone to be stunted. Mother (BMI) in the model was found that children whose parents were obese were significantly associated with the p-value 0.054 compared with normal weight, underweight, and overweight, which were all significantly not associated with stunting. A study by Md Belal Hossain and Md Hasinur Rahaman Khan (2017) in Bangladesh, Li et al. (2020) did a similar study in Indonesia and Bangladesh, attributed that even after adjusting some factors, they have a strong correlation that is contrary to this finding. In the case of this study, parental education, mother (BMI, and child age are significant predictors of stunting. Variables that are not significant were significantly associated with the output, like wealth status, place of residence, source of drinking water, type of toilet facility, sex of the child, and other variables used that were not used in this study.

There were variables like wealth status, poorer, middle, and rich were not significantly associated including the mother's age, father's age, sex of head of household, total children born, source of drinking water drinking, type of toilet facility, place of residence, sex of child, region, and religion were not significantly found associated in this model six.

Overall, the study affirms that maternal and paternal education significantly predict child nutritional outcomes in Liberia. The findings align with regional and global literature but also reveal contextual nuances. For instance, while access to clean water and sanitation is typically linked to better child health, these were not significant in this dataset, perhaps due to widespread deficiencies that limit variation or the role of other mitigating factors like healthcare behavior. Further research should further explore these contextual differences and investigate why some global predictors are not influential in Liberia. Targeted policy interventions should focus on increasing educational opportunities for both women and men, as these investments have far-reaching health implications.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5.0. CHAPTER FIVE

SUMMARY OF KEY FINDINGS, CONCLUSION, AND RECOMMENDATION

5.1. Introduction

The summary of the findings in consonance with the objectives of the study is presented here in this chapter, coupled with conclusions and recommendations, especially for future studies and policy direction. The study set out to investigate the influence of parental education on child nutrition, with a particular emphasis on stunting, within the context of Liberia.

5.2. Summary of Key Findings

In light of the findings, the study aimed to examine the relationship between parents' educational level and the childhood nutrition outcome of children in Liberia. The study used the Liberia Demographic and Health Survey (2019-2020) data. Particularly, stunting was classified into two categories: 'stunted and not stunted'. Parent education, as the cardinal variable, was formed through the merging of maternal education and paternal education. The analysis of this data is limited to children stunting growth under five. Moreover, the data was analyzed using univariate analysis to describe the data and find patterns that exist within each, bivariate analysis to test the association between two variables, and binary logistic regression to determine the relationship between parental education and child nutritional outcomes. In the first section, univariate analysis, the outcome variable stunting constituted 30.68%, which is far above the global standards set by the World Health Organization (WHO). The percentage of educated parents who have completed secondary and above education was 20.19%, if one of the parents had an education, it was 32.72%, and those with no education and primary as well constituted 47.1% of the study population. Separately, paternal and maternal education, paternal who had secondary education and above was

49.94%, while maternal who had completed secondary education and above constituted 23.15%. With the bivariate analysis, the mother's education, the father's education, the parent's education, the age of the children, wealth status, the mother (BMI), source of drinking water, type of toilet facility, the age of the mother, and place of residence were all significantly associated. In the binary logistic regression, there were six models run to determine whether the independent variables and confounders were predictors of stunting. At the beginning of model one (1), mother's education was a major predictor when it came to the stunting of children under five. When other independent variables became factors to determine whether they were predictors, only children's age and mother's BMI were significantly associated as predictors of stunting, and the rest were not. Father's education in the next model was a predictor of children's nutritional outcome, but when the model was adjusted, it was not only the age of the children and wealth index that were significantly correlated with stunting. Parents' education with cumulative effectiveness had a greater portion as a major predictor of stunting. The results of this study mentioned the impact parents' education have as per the overall health of their children. One of the predictors of stunting was the age of children, while other variables were not included in the findings.

5.3. Recommendations

The findings of this study have implications for both research and policy-making in Liberia. Based on the findings, it is recommended that the Liberian government should prioritize the education of parents, especially mothers and fathers, to reduce the prevalence of stunting in children. The Ministry of Health and the Ministry of Education should jointly design and implement targeted educational programs that promote awareness of child nutrition, hygiene, and health-seeking behaviors. These programs should be culturally relevant and accessible to parents with limited formal education, particularly in rural areas. Existing health outreach programs, such as maternal

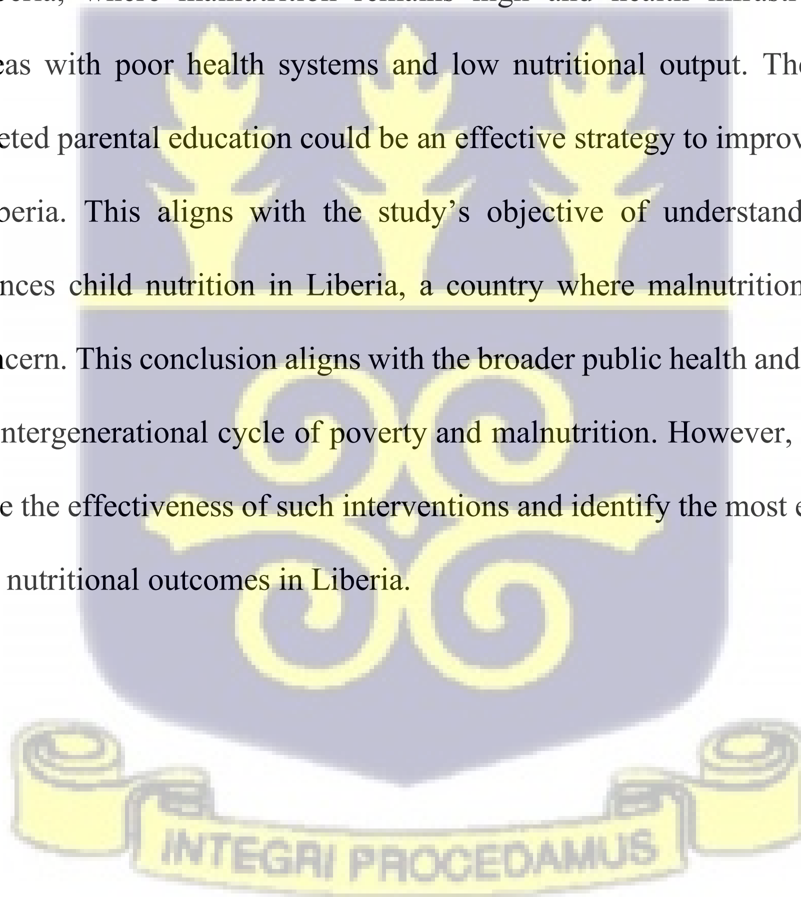
and child health clinics, can serve as platforms for delivering practical nutrition education to parents. Social and economic support programs for poor households, given the significance of wealth status in the adjusted models. Health workers should be trained to communicate the importance of appropriate infant and young child feeding (IYCF) practices and the benefits of parental education for child wellbeing. The suggestion to prioritize education is grounded in the demonstrated influence of parental knowledge and literacy on nutrition-related decision-making. the feasibility of these recommendations is enhanced by their alignment with Liberia's national development plans and international commitments such as the Sustainable Development Goals (SDG 2 – Zero Hunger and SDG 4 – Quality Education). The government should also provide educational programs that focus on the importance of proper nutrition for children. Improvements in WASH (Water, Sanitation, and Hygiene) infrastructure and services considering their bivariate association with child stunting. These programs should be designed to reach parents who have limited access to education. Furthermore, the government should collaborate with International Organizations such as the WHO and UNICEF to develop and implement policies that will help reduce the prevalence of stunting in children in Liberia. These partnerships can also facilitate the adoption of global best practices and the development of evidence-based policy frameworks.

5.4. Conclusion

Sufficient nutrition is a conduit component that yields the growth and healthy lifestyle of children under five in Liberia, with a focus on stunting as a key indicator of undernutrition. Using data from the Liberia Demographic and Health Survey (LHDS) 2019/2020, findings reveal a positive association between parental education, particularly maternal education, and improved child nutritional outcomes. The study aims to investigate the relationship between parental education and child nutritional outcomes in Liberia, where the health system is poor and nutritional outcomes are low. The study's findings suggest that parental education is positively associated with

nutritional outcomes, and this relationship is stronger in areas with weak health systems and low nutritional output, suggesting that parental education can serve as a mitigating factor in the face of structural health and nutritional deficits. The study also highlights the need for interventions that target parental education to improve child nutritional outcomes in Liberia.

In conclusion, the study provides evidence that parental education, especially among mothers, is a crucial factor in improving child nutritional outcomes in Liberia. Educated parents are more likely to make informed health dietary decisions for their children, access and utilize available health services, and adopt improved child-feeding practices. These benefits are especially important in a context like Liberia, where malnutrition remains high and health infrastructure is limited, especially in areas with poor health systems and low nutritional output. The study's findings suggest that targeted parental education could be an effective strategy to improve child nutritional outcomes in Liberia. This aligns with the study's objective of understanding how parental education influences child nutrition in Liberia, a country where malnutrition remains a major public health concern. This conclusion aligns with the broader public health and development goal of breaking the intergenerational cycle of poverty and malnutrition. However, further research is needed to explore the effectiveness of such interventions and identify the most effective strategies to improve child nutritional outcomes in Liberia.



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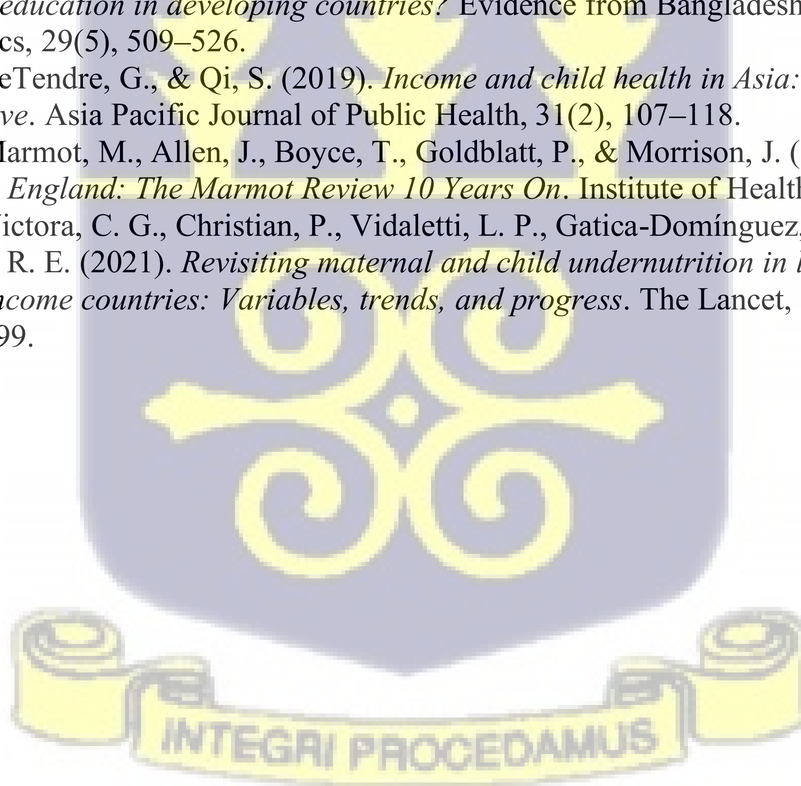

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