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Prevalence of and Factors Associated with Childhood Malnutrition in Lesotho, 2018–2024

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UNIVERSITY OF THE WITWATERSRAND



FACULTY OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

PREVALENCE OF AND FACTORS ASSOCIATED WITH CHILDHOOD MALNUTRITION IN LESOTHO, 2018-2024

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A Research Project

Submitted in partial fulfilment of the requirements for the degree:

MSc. in Epidemiology (Implementation Science)

Supervisor: Professor Latifat Ibisomi, University of the Witwatersrand.

September 2025

Declaration

I, Lintle B. Potiane, declare that this Research Report is my original work. It is being submitted for the Degree of Master of Science in Epidemiology in the field of Implementation Science to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa. I declare that this report has not been submitted in part or full for any other degree or examination at this or any other university.



Lintle Bernadina Potiane

September 2025

Dedication

This is for you, my baby girl, Modi Diarra Karabo Precious Mogalakwe. May this research be a testament to your boundless potential.

Abstract

Background: Childhood malnutrition is a significant public health concern in many developing countries, including Lesotho. While undernutrition has continued to plague low- and middle-income countries, recent years have seen a rise in overnutrition. Overnutrition is identified as overconsumption of calories and proteins. Undernutrition is linked to under-five mortality and hinders efforts to improve child health outcomes in many countries. This study aimed to estimate the prevalence of childhood malnutrition in Lesotho and to identify the factors associated with it.

Methods: This was a secondary data analysis of the 2023-24 Lesotho Demographic and Health Survey. Based on the height-for-age, weight-for-age, and weight-for-height anthropometric indices (Z scores), child nutritional status was classified as stunting (low height-for-age), underweight (low weight-for-age), wasting (low weight-for-height), well-nourished, and overnutrition (overweight). Data analysis was done using STATA 17. The prevalence across the nutritional statuses was estimated using Chi-square tests for categorical variables and the Kruskal-Wallis test for continuous variables. A multinomial logistic regression was used to identify factors associated with malnutrition.

Results: Of the 980 children, 32.3% were undernourished, 59.9% were well-nourished, and 7.8% were overnourished. The median age for undernutrition was two years (IQR:1-3), and one year for overnutrition (IQR:0-1). The prevalence of undernutrition was higher among children whose mothers had no formal education or only primary education (41.0%), those from households with unimproved toilet facilities (38.5%), those from lower-wealth tertile households (43.9%), and children from the Thaba-Tseka district (45.6%). Undernutrition was significantly associated with several factors, with some differences between the two models. Sex, birth size, birth order, and wealth index were significant in both the univariable and multivariable models. However, the univariable model showed significant associations with maternal education, type of toilet facility, type of residence, and certain districts (Mohale's Hoek, Quthing, and Thaba Tseka), while the multivariable model showed significant associations with age, diarrhoea, and maternal age. On the other hand, the odds of overnutrition decreased 0.53 times, for every year increase in age [OR: 0.53 (95% CI: 0.37,0.76)].

Conclusion: Over one-third of children experienced undernutrition, while approximately 8.0% were classified as overnourished. Factors associated with undernutrition included the child's sex, age, birth size, birth order, and wealth index. Therefore, gender-sensitive strategies are needed to address nutritional disparities among male and female children. Support through routine food supplementation programs during postnatal visits can combat undernutrition. Additionally, maternal health education initiatives should promote proper feeding practices and early childhood care.

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List of Abbreviations/Acronyms

ANC	Antenatal Care
LBW	Low birth weight
LDHS	Lesotho Demographic and Health Survey
LMICs	Low- and Middle-Income Countries
MoH	Ministry of Health
SSA	Sub-Saharan Africa
UNICEF	United Nations Children's Fund
WHO	World Health Organization

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Definition of Terms

Childhood	All children who are aged between 0 and 59 months (UNICEF, 2018)
Malnutrition	Non-communicable illnesses associated with diet-related undernutrition (wasting, stunting, underweight), insufficient mineral and vitamin intake, as well as overweight and obesity (WHO, 2021).
Childhood malnutrition	Non-communicable illnesses associated with diet-related undernutrition (wasting, stunting, underweight) and overconsumption of mineral and vitamin intake among children aged between 0 to 59 months (WHO, 2021).
Stunting	When a child is too short for their age. It is denoted by children with height-for-age z-scores who are less than -2 standard deviations from the reference population's median. Height for age < -2SD (WHO, 2024)
Underweight	When a child's weight is too low for their age. It is denoted by children with weight-for-age z-scores that are less than -2 standard deviations from the reference population's median. Weight for age < -2SD (WHO, 2024)
Wasting	When a child's weight is too low for their height. It is denoted by children with weight-for-height z-scores that are less than -2 standard deviations from the reference population's median. Weight for height < -2SD (WHO, 2024)
Overweight	When a child's weight is too high for their height. It is denoted by children whose weight-for-height is greater than two standard deviations from the population's median. Weight for height > 2SD (WHO, 2024)

CHAPTER 1: INTRODUCTION

The introductory chapter defines childhood malnutrition and explains its implications. It provides a background on the trends of malnutrition worldwide and possible determinants that drive the prevalence of malnutrition among children under five. The chapter further explains the health problem induced by childhood malnutrition in Lesotho, followed by the research question, aim, and objectives. To conclude the chapter, the justification for conducting this study is discussed.

1.1 Background

Malnutrition is a severe public health problem that adversely impacts children's development worldwide, especially among children under five years (Katoch, 2022). According to Liben et al. (2016), an imbalanced diet that is deficient in every essential nutrient and lacks or has a high intake of nutrients can lead to malnutrition. Malnutrition is, therefore, defined as a condition that manifests as either taking excessive nutrients or not receiving enough nourishment (Gaston et al., 2022).

Child development in height and weight is a primary indicator of their nutritional status; hence, stunting, wasting, and underweight are key measures used to determine the magnitude of undernutrition (Liben et al., 2016), while overnutrition is identified as overconsumption of calories and proteins (John et al., 2023), which manifests as overweight or obesity in children under five years. Furthermore, Ma et al. (2020) identified obesity as a crucial global lifestyle-related public health burden.

Childhood malnutrition, incorporating undernutrition and overnutrition, remains a prevalent public health issue in many countries, accounting for approximately 45% of global child mortality (Alaba et al., 2023). Cases of under-five malnutrition are seen in low- and middle-income countries (LMICs) primarily because of impoverishment, which is linked to inadequate healthcare infrastructure, unsanitary environments, and inadequate nutritional habits (Vassilakou, 2021). Conversely, overweight, often known to be an issue exclusive to high-income countries, is becoming more prevalent in LMICs (WHO, 2024). According to UNICEF (2023), approximately six percent of children under five were overweight or living with obesity globally. Since the early 2000s, Africa has encountered a rapid 23% surge in the rate of overweight children under five years.

However, Asia has been the primary contributor to the global under-five overweight or obesity, accounting for approximately 50% of the world's total (WHO, 2024). Moreover, with the highest rates of stunting, wasting, and underweight, South Asia has been labelled the global epicentre for child malnutrition (Bishwajit & Yaya, 2020). On the other hand, the prevalence of overweight and obesity varied from 1.4% to 5.4% within South Asian countries, with the Maldives showing the highest prevalence (Bishwajit & Yaya, 2020).

Malnutrition is a significant contributor to global child mortality rates, responsible for over 50% of all child fatalities worldwide, specifically in LMICs, where 54% of child mortality rates are linked to malnutrition (Djoumessi, 2022). In 2016, one million child mortality cases were due to malnutrition (Ssentongo et al., 2021), and of these fatalities, 45% were from LMICs (Amadu et al., 2021). The attainment of Sustainable Development Goal (SDG) 3.2, which aims to end avertable deaths of infants and children under five years is compromised. Specifically, this goal targets a reduction in neonatal mortality to 12 deaths per 1,000 live births, and under-five mortalities to 25 deaths per 1,000 live births, by 2030 (United Nations, 2015). However, these high rates pose a challenge for all countries.

Akombi (2017), Kuse & Debeko (2023), and others have defined malnutrition as a multifaceted health concern that is brought on by numerous and interrelated factors, such as poverty, parental education, poor sanitation, low food intake, other infections inclusive of diarrhoea, substandard feeding practices and the number of family members. Additional risk factors linked to childhood malnutrition included the age of the child, maternal educational attainment, low birth weight, family wealth index, residential area, and the type of toilet facility (Aboagye et al., 2022). According to Ibrahim et al. (2017), in 2016, 159 million children had stunted growth, and 50 million children were wasted. Following the implementation of several interventions, a reduction in childhood malnutrition prevalence was reported: approximately 149 million under-fives were stunted, 45 million were wasted, and 38.9 million were overweight worldwide. That is, 21.9%, 13.4%, and 7.3% of under-fives were stunted, wasted and overweight, respectively (WHO, 2022). Despite a reduction of 10 million cases of undernutrition decreasing from 159 million to 149 million between 2016 and 2022, this progress is insufficient to meet the global goal to end all forms of malnutrition by 2030.

Globally, stunting in children under five has declined from 41.5% in 2000 to 30.7% in 2020. However, Africa is the only continent where the total number of stunted children has increased from 54.4 million in 2000 to 61.4 million in 2020 (Roche, 2023). The prevalence of stunting varies across the regions, with East Africa reporting the highest rates at around 39.0%, West Africa at 31.8%, Southern Africa at 30.6% and Central Africa at 28.8%; countries like Burundi and Malawi exhibit particularly high stunting rates, reaching up to 57.7% and 47.1%, respectively (Akombi et al., 2017). The adverse outcomes of childhood malnutrition, including stunting, weakened immunity and compromised cognitive development, perpetuate the levels of poverty and hinder socio-economic progress.

1.2 Problem Statement

The reduction of childhood malnutrition is crucial to improving child mortality rates. As part of Lesotho's commitment to the SDGs, it aims to lower the child mortality rate to 25 fatalities per 1000 live births by 2030 (United Nations, 2024). However, the country's under-five mortality rate remains a significant public health challenge and has fluctuated over the years, with recorded deaths of 113 in 2004, 117 in 2009, 85 in 2014, and 54 in 2024 (Ministry of Health Lesotho & ICF International, 2024), making this goal seemingly unattainable.

To alleviate high levels of malnutrition, the government of Lesotho and UNICEF implemented initiatives such as The Maximum Intervention Programme to enhance nutritional and food security in the country (United Nations, 2020). In 2022, the Ministry of Agriculture, Food Security and Nutrition also launched nutrition clubs in an effort to reduce child malnutrition (Lesotho News Agency, 2023). However, Lesotho still grapples with a high burden of child malnutrition and children are the hardest hit by poverty despite numerous child-centred poverty reduction initiatives (UNICEF, 2020). This has contributed to persistently high levels of stunting among children under five in Lesotho. The prevalence of stunting has fluctuated over time, decreasing from 39% in 2009 to 33% in 2014, before rising again to 36% in 2024. Similarly, the prevalence of underweight children has varied, declining from 13% in 2009 to 10% in 2014, only to return to 13% in 2024. In contrast, wasting has shown a downward trend, decreasing from 5% in 2009 to 2% in 2024. However, the prevalence of overweight among children under five has remained stagnant at 7% over the same period (Ministry of Health Lesotho & ICF, 2024).

According to The World Food Programme (2016), 19.5% of all child fatalities between 2008 and 2014 in Lesotho were due to childhood malnutrition. Childhood malnutrition has far-reaching consequences, not only affecting child mortality rates but also has lasting harmful implications, including poor academic outcomes, delayed mental and physical growth, decreased ability to work, and compromised quality of life in adulthood (Gaston et al., 2022; Simwanza et al., 2023). It is evident that child malnutrition is a critical health concern in Lesotho and its reduction is pivotal to achieving SDG 3.2, which focuses on lowering child mortality. Hence there is a need to identify the factors associated with childhood malnutrition in Lesotho.

1.3 Research Question

What is the prevalence of childhood malnutrition, and what factors are associated with it in Lesotho between 2018 and 2024?

1.4 Research Aim

To determine the prevalence of childhood malnutrition and identify its associated factors in Lesotho between 2018 and 2024.

1.5 Objectives

1. To determine the prevalence of childhood malnutrition in Lesotho, 2018-2024.
2. To identify the factors associated with childhood malnutrition in Lesotho, 2018-2024.

1.6 Justification

Improved child health can be achieved by eradicating risk factors contributing towards malnutrition. However, children in Lesotho remain susceptible to adverse health outcomes in the face of high levels of poverty. This situation has perpetuated the high levels of stunting, which, according to the Ministry of Health Lesotho and ICF (2024) stands at 36%. This rate exceeds the 30.7% stunting average in Africa, (Global Nutrition, 2022).

There is limited literature regarding childhood malnutrition in Lesotho, and this study will improve on the available literature, bringing more knowledge to the topic in the country. Furthermore, this study will inform evidence-based policies and interventions to address this crucial health problem. By examining the prevalence and identifying factors associated with childhood malnutrition, this

study will contribute valuable knowledge for policymakers and stakeholders to develop evidence-driven and effective nutrition interventions.

Furthermore, this study examines the child, maternal, household and geographic factors associated with childhood malnutrition. It therefore provides evidence for interventions at various levels to improve child health outcomes. Ultimately, this study will contribute to reducing childhood malnutrition in Lesotho, thereby improving Basotho's overall quality of life.

CHAPTER 2: LITERATURE REVIEW

This chapter synthesises studies on malnutrition among children under five and assesses factors correlated with childhood malnutrition, such as child-related, maternal, household, and geographic factors. A brief discussion of a conceptual framework adapted from the UNICEF (2020) determinants of maternal and child nutrition framework concludes this chapter.

2.1 Childhood Malnutrition

Globally, the understanding of malnutrition has evolved, recognising that it is not only a result of inadequate food availability but also influenced by interrelated factors such as socioeconomic status, maternal health, and access to healthcare services (Siddiqui et al., 2020). The landscape of undernutrition has changed across different regions over the years. While some areas have seen improvements due to enhanced nutrition programs and increased awareness, Sub-Saharan Africa (SSA) remains a region of concern where the number of malnourished children continues to rise (Roche, 2023). In contrast, regions such as South Asia have made strides in reducing stunting and wasting rates through targeted initiatives, although disparities still exist (World Bank, 2018). The global community faces the challenge of addressing these inequalities to ensure that all children receive the nutrition they need for healthy growth and development (World Bank, 2018).

In recent years, the phenomenon of overnutrition has emerged alongside undernutrition, creating a double burden of malnutrition which threatens children's livelihoods globally (Benedict et al., 2021; Shinsugi et al., 2019), particularly in the LMICs, where there are persistently high rates of undernutrition and a surge in overweight (Lerm et al., 2021). Regions such as SSA face unique challenges, as they grapple with rising numbers of stunted children while also witnessing an increase in childhood obesity (Humbwavali et al., 2018). To combat childhood malnutrition and attain global goals, it is crucial to address these interrelated factors to ensure all children receive the necessary nutrition for healthy growth and development.

2.2 Child Factors of Childhood Malnutrition

2.2.1 Age of the child

A child's age has been cited as one of the factors contributing towards childhood malnutrition. A positive correlation between wasting and age was observed, while an inverse correlation between stunting and age was observed in a study conducted in Bengal, India (Sarkar, 2016). According to the findings, children aged six to 11 months were more susceptible to one form of malnutrition (47%). Comparatively, children aged two years were more susceptible to having multiple forms of malnutrition (52%) (Sarkar, 2016). However, in a study conducted in Uganda, results highlighted the odds of wasting among infants to be 2.2 times greater than those aged 12 to 24 months (Mawa, 2018).

Additionally, the odds of stunting among children 24 to 35 months are 1.95 times greater than those aged 12 to 24 months (Mawa, 2018). A significant variation was distinguished in the rate of stunting among children under six months (24.1%) and those over six months (36.6%) (Saha et al., 2022).

2.2.2 Sex of the Child

The child's sex is another essential proximal factor of childhood malnutrition. Studies conducted in Pakistan show that women prefer to give male children healthier nutrition because of cultural norms (Ghosh, 2020). As a result, malnutrition among females in Pakistan is considerably greater than that of males, highlighting a disparity in gender at the child level (Ghosh, 2020). Parallel to this, 42% of female children had multiple forms of malnutrition compared to 39% of their male counterparts in India (Sarkar, 2016).

Conversely, contrasting results were reported in a survey conducted in Ethiopia: 38.4% of males and 34.7% of females were found to be stunted, and 13.5% of males and 10.9% of females were wasted (Amare et al., 2019). In a similar trend, underweight in males and females was 26.6% and 23.8%, respectively (Amare et al., 2019). Comparatively, males in SSA are susceptible to some form of malnutrition.

2.2.3 Birth Weight

Low birth weight (LBW) is associated with the nutritional health of children under two (Saha et al., 2022). According to UNICEF-WHO (2023) estimations, approximately 14% of newborns, 19.8 million newborns worldwide, had LBW in 2020. However, the world's epicentres for LBW and malnutrition are SSA and South Asia, where over 70% of all newborns concurrently have LBW and some form of malnutrition (UNICEF-WHO, 2023). Aboagye et al. (2022) reported that the rate for LBW in SSA was 5.4%, with South Africa accounting for the highest rate (13.1%) and Chad accounting for the lowest (0.9%).

According to Aboagye et al. (2022), children with less than 2500 grams birth weight were more susceptible to illness, including diarrhoea, anaemia, and respiratory infections, which increases the risk of some form of malnutrition. The findings in this study demonstrated notable variations within the malnutrition spectrum across birth weight. In particular, being stunted was prevalent among children with LBW (42.2%) as opposed to those with normal weight or greater (30.7%). This was also the case with underweight and wasting: children with LBW were prone to underweight and wasting (26.5% and 10.5%, respectively) compared to children of normal weight and above (16.5% and 8.0%, respectively) (Aboagye et al., 2022).

The odds of stunting, being underweight and wasting among children with LBW were higher (1.68, 1.82 and 1.35, respectively), compared to children with average weight and above (Aboagye et al., 2022). On the farthest extreme, however, high birth weight is significantly correlated with overweight or obesity in childhood (Kapral et al., 2018). A notable correlation between high birthweight and subsequent childhood overweight and obesity was identified. Children with normal and LBW had decreased odds of obesity as opposed to children born with high weight (Kapral et al., 2018). Kapral et al. (2018) also reported that the likelihood of obesity in children with higher birth weight was 20.1% and 20.4%, respectively, compared to those with LBW (14.8% and 11.9%, respectively).

2.2.4 Birth Order

Epidemiological research has indicated a positive correlation between birth order and childhood malnutrition. Accordingly, there is a heightened risk of malnutrition among children whose birth

order is higher (Ghosh, 2020). Contrarily, in a study conducted in India, being underweight and stunted were inversely correlated with higher birth order; however, there was no significant correlation with wasting (Sarkar, 2016). Findings from recent studies highlighted that stunting, being underweight and wasting increased with the birth order number in SSA. The rate of stunting, underweight and wasting was 29.5%, 14.7% and 7.3%, respectively, among firstborn children (Aboagye et al., 2022). This increased with higher birth order numbers, where being stunted, underweight and wasted were 34.7%, 20.3% and 9.2%, respectively, among children whose birth order was five and above (Aboagye et al., 2022).

2.2.5 Child Breastfed

The main contributors to childhood malnutrition among children younger than two years include inadequate breastfeeding and complementary feeding practices, together with a higher prevalence of transmissible infections (Mekonen et al., 2024). Although previous research has demonstrated a strong correlation between exclusive breastfeeding and reduced malnutrition risk in newborns, the relationship between exclusive breastfeeding and other types of coexisting forms of malnutrition is yet to be established (Khaliq et al., 2022). Nonetheless, no correlation was found between continual breastfeeding and the presence of stunting and overweight (Khaliq et al., 2022).

2.2.6 Diarrhoea

Weight loss due to diarrhoea can result in malnutrition because it enables poor absorption of vital nutrients and decreased energy availability (Iddrisu et al., 2021). In recent decades, many childhood malnutrition cases globally have been attributed to digestive disorders like diarrhoea (Iddrisu et al., 2021). According to Haq et al. (2022), children without diarrhoea or fever had an alleviated risk of malnutrition relative to those with diarrhoea or fever.

These results were observed in both male and female children.

2.3 Maternal Factors of Childhood Malnutrition

2.3.1 Maternal Age

Maternal age has also been identified as one of the factors of childhood malnutrition. A study conducted in SSA indicated that children of mothers between the ages of 15 and 24 are more likely

to suffer from poor nutritional outcomes than children of mothers 25 and older (Adedokun & Yaya, 2021). The results suggest that children of mothers aged 15 to 24 are 13% more likely to experience stunting and 8% more likely to experience wasting compared to children whose mothers are 35 years or older (Adedokun & Yaya, 2021). A study conducted in the North West province, South Africa showed a similar trend, where children of mothers aged 16 to 20, 21 to 25 and 26 to 30 years experienced severe undernutrition (44.4%, 32.3% and 23.1% respectively) (Mokwena & Kachabe, 2022).

2.3.2 Maternal Education

The mother's educational attainment determines children's nutrition. Research has demonstrated a positive correlation between a mother's educational attainment and her child's nutritional wellbeing (Ghosh, 2020). An educational assumption is that women are empowered with information and equipped with expertise to make informed decisions for themselves and their children. To reinforce this hypothesis, Ghosh (2020) indicated that improved access to information, appropriate feeding techniques, and improved sanitation are all made possible by a mother's education. Haq et al. (2022) further reported that the risk of malnutrition was lower in households with a higher socioeconomic status and a mother with a higher educational attainment than their counterparts. Mawa (2018) corroborated this by reporting an increase in the odds of wasting (3.66) among children of mothers who did not have formal education in Uganda. This translated into an 80% increase in wasting among children of mothers with only primary education, in contrast to mothers who had achieved secondary education and above (Mawa, 2018). Contrarily, a distinctive inverse relationship was observed between children's nutritional well-being and their mother's educational attainment in Bangladesh (Haq et al., 2022).

2.3.3 Marital Status

Marital Status has been quoted as one of the factors associated with childhood malnutrition. However, SSA results showed no variability in the prevalence of stunting between children born to single or married mothers (31.3%) (Aboagye et al., 2022). Nonetheless, a notable difference was observed in underweight and wasting, where children born to single mothers had a lower prevalence of underweight (14.9%) compared to children born to married women (17.4%). A

similar trend was seen in children born to single mothers, who had a lower prevalence of wasting (6.3%) compared to children born to married women (8.4%) (Aboagye et al., 2022).

2.3.4 Frequency of Antenatal care (ANC) attendance

A correlation between the underutilisation of maternal healthcare resources, such as prenatal care and childhood malnutrition was seen in a study that reviewed 32 SSA countries (Aboagye et al., 2022). Epidemiological evidence has shown that childhood malnutrition decreases with increasing ANC visits. The susceptibility to stunting, underweight and wasting was higher among children born to women who did not attend ANC (41.8%, 28.7% and 13.1%, respectively) than those born to mothers who attended ANC at least four times (27.3%, 13.77% and 6.6% respectively) (Aboagye et al., 2022).

2.3.5 Timing of Antenatal care (ANC) attendance

Studies have consistently shown that mothers who attend ANC earlier in their pregnancy have improved health outcomes, specifically for their newborns. Furthermore, the number of ANC visits per the WHO's recommendation and the timeliness of ANC attendance is just as crucial as the number of visits (Biracyaza et al., 2021; Mina et al., 2023). To support this, a study conducted in India found a statistically significant link between the timing of ANC visits and undernutrition (Shyam et al., 2020).

2.4 Household Factors of Childhood Malnutrition

2.4.1 Wealth Index

The MoH and ICF International (2016) found that household wealth is related to the probability of malnutrition. Children of families with low wealth index suffer the highest malnutrition outcomes compared to children from families with higher wealth indices. This was reiterated by Sarkar (2016), who reported that, in India, approximately 51% and 63% of the children from lower-index households were stunted and underweight, respectively. Conversely, Ghosh (2020) reported that wealthy households are susceptible to obesity because they tend to buy costly yet less healthy foods than households with a lower wealth index. However, in high-income countries, Wealthy households select more nutritious meals, whilst migrants from impoverished backgrounds usually consume conventional and low-nutrient meals (Ghosh, 2020).

2.4.2 Source of drinking water

Lack of access to clean water for consumption has been determined as one of the contributing factors to childhood malnutrition. In SSA, the prevalence of stunting, underweight and wasting was higher in children who had water from unimproved sources (32.9%, 18.3% and 8.4%, respectively) than those with water from improved sources (30.4%, 16.3% and 8.0% respectively) (Aboagye et al., 2022). Additionally, malnutrition was more prevalent in the Democratic Republic of Congo, where over 66% of its population lacked access to clean water (Simwanza et al., 2023).

2.4.3 Type of Toilet Facility

The rates for stunting, underweight and wasting were significantly higher among children from households with unimproved toilet facilities (34.6%, 20.3% and 9.6%, respectively) than those with improved toilet facilities (27.0%, 12.8% and 6.3% respectively) (Aboagye et al., 2022).

2.5 Geographic Factors of Childhood Malnutrition

Type of residence

The prevalence of stunting, underweight, and wasting was considerably higher among children from rural areas (35.3%, 19.7%, and 9.0%, respectively) than among children from urban areas (23.1%, 11.6%, and 6.4%, respectively) (Aboagye et al., 2022). Ghosh (2022) claims that children in urban areas, regardless of sex, are susceptible to being overweight compared to their counterparts in rural areas due to urbanisation and reduced levels of physical activity.

2.6 Conceptual Framework

The conceptual framework used adapted some variables from UNICEF's 2021 maternal and child nutrition framework. The exposure variables include information about the child, mother, household, and geographic factors.

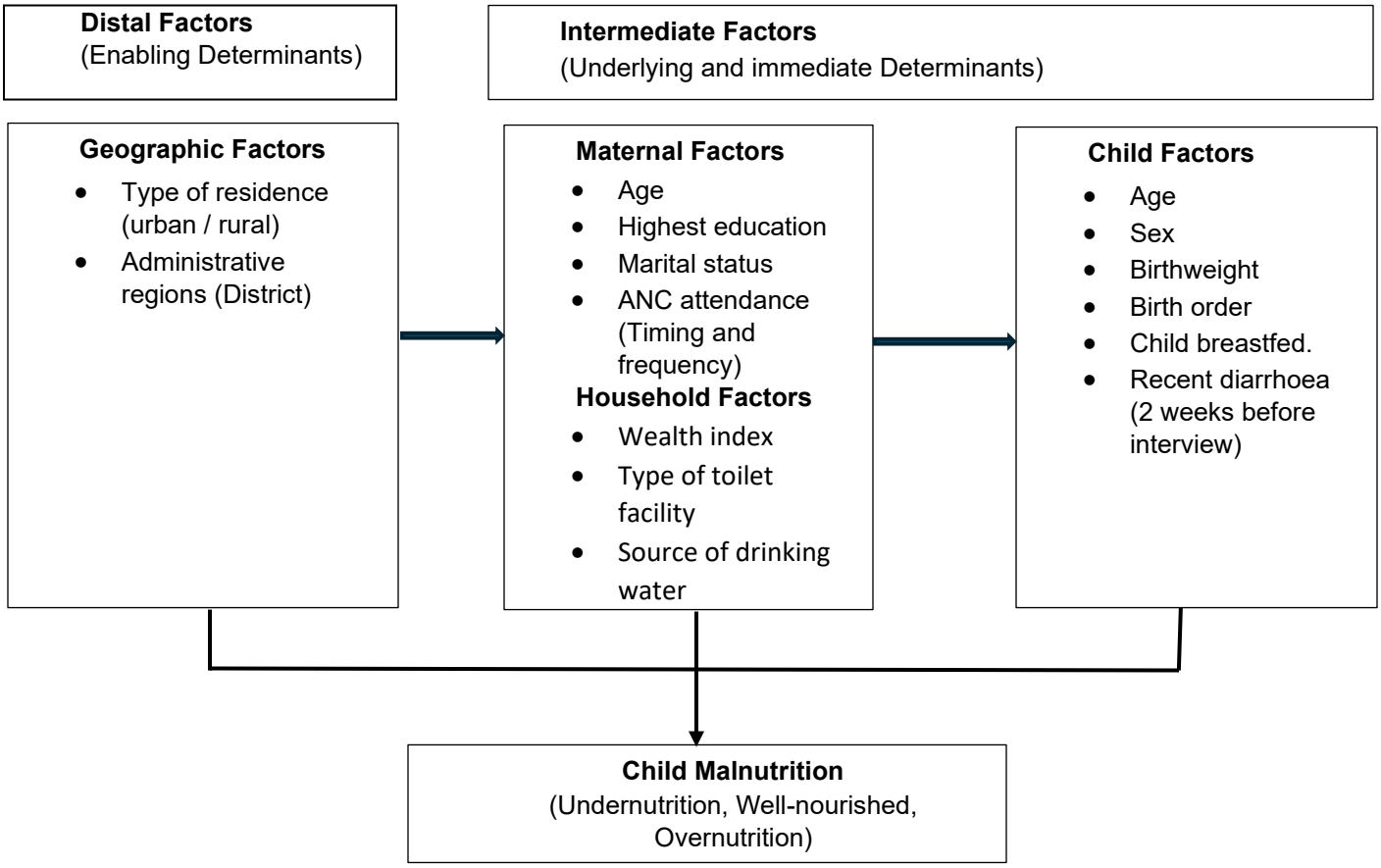


Figure 2.1: Conceptual Framework adapted from the UNICEF conceptual framework on the determinants of maternal and child nutrition, 2020.

The conceptual framework shows a combination of interrelated factors influencing a child's nutritional well-being. The immediate determinants included are age, sex, birth size, birth order, breastfeeding practices, and recent diarrhoea. The underlying determinants included are the mother's age, educational level, marital status, the frequency and timing of ANC, access to clean water and sanitation and household wealth index. The underlying determinants influence the

immediate determinants of malnutrition in children, which subsequently might induce illnesses that result in malnutrition (Amir-ud-Din et al., 2022).

Additionally, household factors like access to clean water and sanitation can limit a child's access to adequate nutrition and, in turn, affect maternal health. Geographic factors such as type of residence can also influence the decision to attend ANC, reflecting the proximity to healthcare facilities.

Feeding practices and care are the direct determinants of maternal and child nutritional status, which are interrelated. Access to resources that support healthy nutritional habits, at home and in the community, is fundamental to mothers and children (UNICEF, 2021).

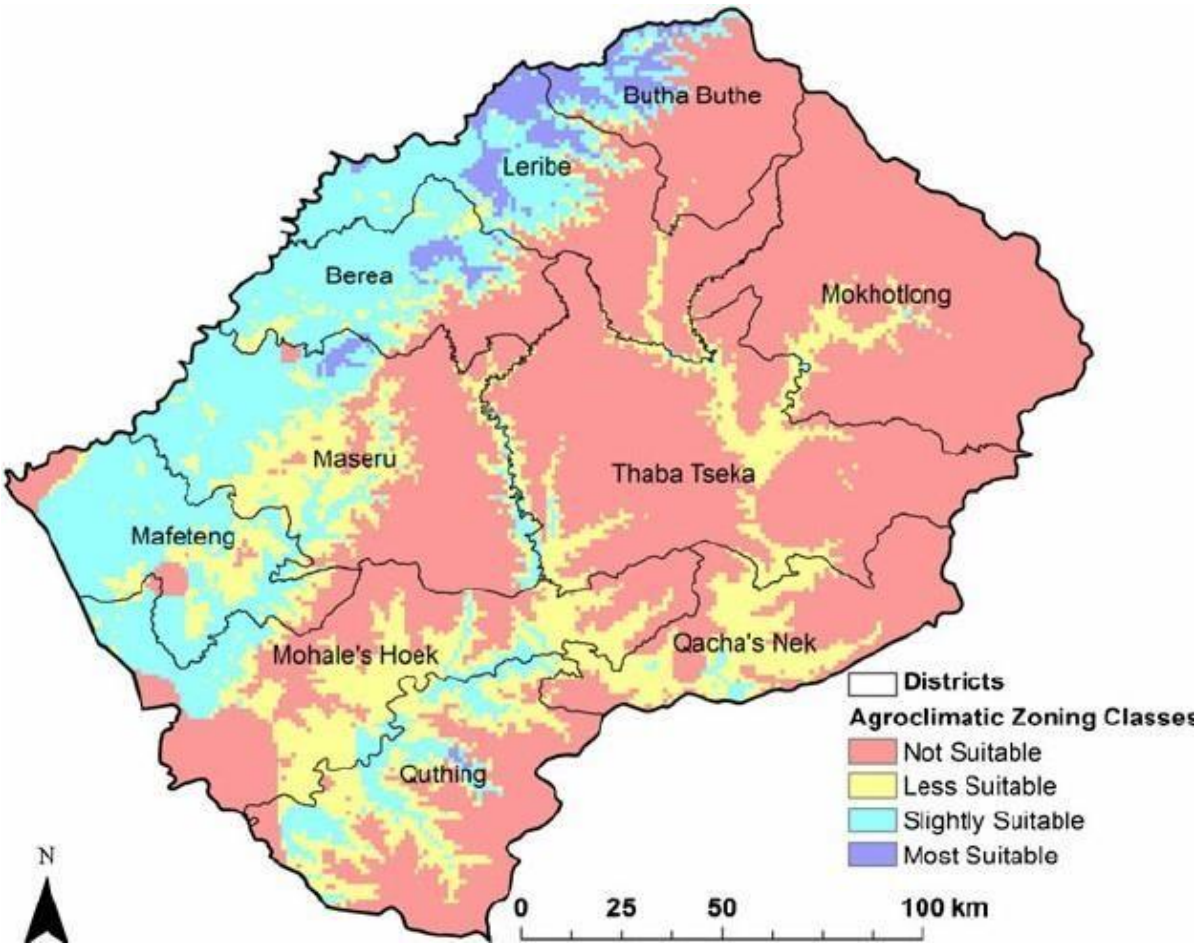
CHAPTER 3: METHODS

This chapter outlines the geographical, ecological, and socio-economic characteristics of Lesotho- the study site. It discusses the sampling process and study population. It also outlines how the variables were generated and recoded from the primary study. It further details how data management and analysis were conducted to answer the research question. To conclude the chapter, the study's limitations and ethical considerations are also discussed.

3.1 Study Site

Lesotho is a mountainous country completely landlocked and bordered by South Africa. According to its altitude, Lesotho is organised ecologically into four zones: highlands, foothills, Senqu River Valley, and the lowlands, further divided into ten administrative districts (Linono et al., 2007). The climate of Lesotho is typically categorised as temperate with alpine features (World Bank, 2020).

According to the Food and Agriculture Organization (2023), agricultural land in Lesotho covers approximately 279,773 hectares, only nine percent of its total land. Despite this, a substantial percentage of Lesotho's population depends on farming as a primary source of income (FAO, 2023). Lesotho has experienced persistent and recurrent droughts that plague crop farming and contribute to Lesotho's deteriorating food security (Dick-Sagoe et al., 2023). Lesotho is also faced with developmental concerns of impoverishment, the spread of illness, low yields from agriculture, and food insecurity (Nkoko et al., 2023). According to the 2015 UN Human Development Index, Lesotho is ranked 160 of 187 nations: approximately 57.1% of Basotho live below the national poverty threshold of 138 Maloti (USD 8.11) per adult per month (WHO, 2022). Home to an estimated 2.2 million people, Lesotho is virtually exclusively of one ethnicity known as Basotho (WHO, 2022). Despite the country's predominantly rural population, most of its medical staff, health-related grants, and one referral health facility are in its capital city, Maseru (Bryden et al., 2021). Since mountains make up most of the country, many communities are still only accessible by horse or foot (Tomlinson et al., 2016).



Source: (Moeletsi & Walker, 2013)

Figure 3.1: Map of Lesotho showing administrative districts and suitability for growing maize under dryland conditions.

3.2 Study Design

This was a secondary data analysis of the 2023-24 Lesotho Demographic and Health Survey, a cross-sectional study.

3.3 Data Source

This study used the 2023-24 LDHS dataset. ICF International granted permission to access this dataset through the DHS website (DHSprogram.com). See Appendix C for the approval letter.

3.4 Description of the 2023-24 LDHS

The DHS is one of the most extensive cross-sectional studies in the world. It provides information about fertility, contraception use and reproductive health, child and maternal health, mortality, and

HIV/AIDS (Croft, Trevor N., Allen, Courtney K., Zachary, Blake W., et al. 2023). The stratified sample for the 2023-24 LDHS was determined in two phases. To accomplish stratification, every district was divided into urban and rural regions, where 20 sampling strata were generated. A twophase selection technique was used to independently choose samples from each stratum; 400 enumeration areas were selected in the initial phase. In the subsequent phase, a sample of 9,976 households was selected (MoH Lesotho and ICF International, 2024). During the survey, 1,126 children under five who resided in the LDHS sample households had their height and weight measured (MoH Lesotho and ICF International, 2024).

3.5 Study Population

A total of 2,537 children under five years old were eligible for anthropometric measurements. Of these, measurements were successfully obtained for 1,126 children. However, 26 of these measurements were incomplete, leaving 1,100 children with complete anthropometry measurements. The measurements for 11 children were out of plausible limits and were thereby deemed invalid. After accounting for these exclusions, a total of 1,089 children with complete and valid anthropometric measurements were included in the analyses for this study.

The flow chart (Figure 3.2) shows the sample size and study sample selection used for analysis.

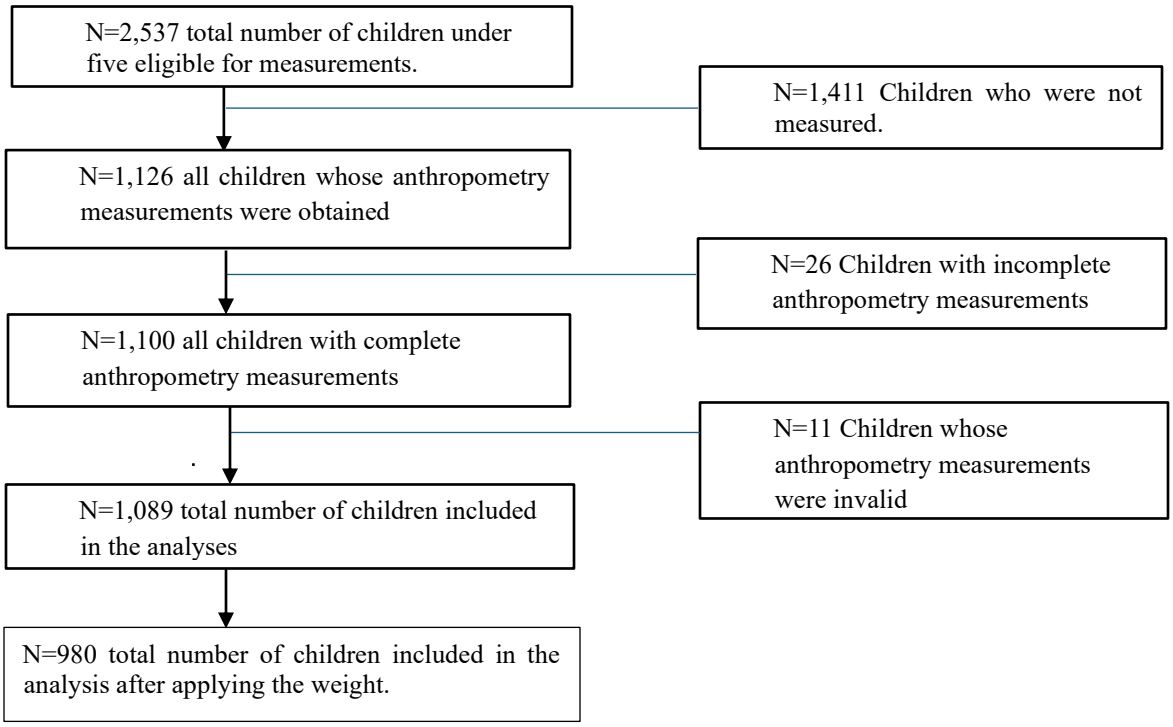


Figure 3.2: Flow chart showing the process for selecting and obtaining the study sample.

3.6 Sampling

The 2023-24 LDHS sampled eligible children under five years residing in the selected households. For this analysis, only children with complete anthropometric measurements were retained. Although sampling was not conducted in this study, a power calculation was performed to determine whether the sample size could predict malnutrition among children under five, as well as to evaluate its statistical power. Children under five years old at the time of the survey, who were present during data collection and had their height and weight measured, were included in the study sample. Therefore, the sample size of this study was 1,089 children. To generate the outcome variable (Childhood malnutrition), the categories undernutrition, well-nourished, and overnutrition were generated using the height/age standard deviation, weight/age standard deviation, and weight/height standard deviation.

To perform the power calculation, the variable "timing of ANC attendance" was used. According to WHO (2017), ANC services play a crucial role in the early detection and management of malnutrition and related complications. The care women receive during pregnancy impacts the health and development of their children (WHO,2017).

Supposing that 44.4% of women attended ANC before four months of pregnancy, while 56.6% attended after four months. The power calculation was conducted using STATA 17 as follows:

power twoproportions 0.3 0.2, n1(483) n2(606)

The formula above resulted in a power of 96.7%. This indicated that the sample size of 1,089 was sufficient to find the difference between children who have one or more forms of malnutrition and children who do not as statistically significant.

3.7 Variables

3.7.1 Childhood Malnutrition (Outcome Variable)

This study classified childhood malnutrition into three well-defined categories: undernutrition, well-nourished, and overnutrition. To generate undernutrition, the height/age standard deviation "hw70" was used to derive stunting; the weight/age standard deviation "hw71" was used to derive wasting, and the weight/height standard deviation "hw72" was used to derive underweight. The zscores less than -2 indicated undernutrition. Hence, the presence of undernutrition was denoted "1", and the absence was "0".

On the other hand, the z-scores greater than two indicated overnutrition. Hence, the presence of overnutrition was denoted "1", and the absence was denoted "0". Well-nourishment was derived from composite variables: undernutrition and overnutrition. The absence of undernutrition and overnutrition was coded "1", while the presence of either was coded "0". The outcome variable was then categorised into three levels: "1", undernutrition; "2", well-nourished; and "3", overnutrition.

For a definition of the outcome variable (childhood malnutrition), refer to **Figure 3.3**

Childhood Malnutrition		
Undernutrition	**Well-nourished**	**Overnutrition**
The presence of stunting, wasting or underweight	The absence of stunting, wasting, underweight and overweight.	The presence of overweight.

Z-Score Reference point			**Outcome**
z-score less than -2	-2 >= z-score <= 2	z-score greater than 2	
1	0	0	**Undernutrition**
0	1	0	**Well-nourished**
0	0	1	**Overnutrition**

Figure 3.3: Description of Outcome Variable (Childhood Malnutrition)

3.7.2 Exposure Variables

This included the child (age, sex, birthweight, birth order, whether the child was breastfed and recent diarrhoea (2 weeks before the interview)), maternal (age, highest education, marital status, time and frequency of ANC attendance), household (Toilet facility, source of drinking water, wealth Index) and geographic factors (type of residence and districts).

Table 3.1: Description of Variables

Primary Dataset			**This Research**	
Variable (Name and Label)	**Definition**	**Category (coding)**	**Variable**	**Category (coding)**
Outcome variable				
Hw70 (height/age SD (new who)) Hw71 (weight/age SD (new who)) Hw72 (weight/height SD (new who))	Anthropometric measurements of children aged under five years	(Anthropometric Z scores) Z scores range from hw70 (-5.98-4.30) Z scores range from hw71 (-4.98-2.85) Z scores range from hw72 (-4.49-4.29)	Childhood Malnutrition	**Undernutrition (1)** (stunting, wasting or underweight) **Well-nourished (2)** (No undernutrition or overnutrition) **Overnutrition (3)** (overweight/obese)
Explanatory variables				
Child Factors				
B4 (Sex of the child)	Sex of a child under five years	Male (1) Female (2)	Sex of child	Male (1) Female (2)
B8 (current age of child)	Age of the child who is under five years	0-4(Continuous)	Age of child	0-4(Continuous)
M18 (birth size)	Birth size of the child,	Very large (1) Larger than average (2) Average (3) Smaller than average (4) Very small (5) Don't know (8)	Birth size	small (1) (smaller than average, very small) Normal (2) (average) large (3) larger than average, very large)
Bord (Birth order number)	The ordinal position/number in which a child is born	1-12 (continuous)	Birth order	1-12 (continuous)
M4 (months of breastfeeding)	Whether a child under five was breastfed or not	Ever breastfed, not currently breastfeeding (93) Never breastfed (94) Still breastfeeding (95)	Child breastfed	Ever breastfed (1) (ever breastfed, not currently breastfeeding and still breastfeeding) Never breastfed (0)
H11 (had diarrhoea recently	Whether the child had diarrhoea two weeks before the interview	No (0) Yes, the last two weeks (2) Don't know (8)	Recent diarrhoea	Yes (1) No (0)
Maternal Factors				
V013 (mothers age in years	Women of childbearing years (15-49)	15-19 (1) 20-24 (2) 25-29 (3) 30-34 (4) 35-40 (5) 41-44 (6) 45-49 (7)	Mother's age	15-24 (1) 25-34 (2) 35-49 (3)

V106 (Highest educational level)	Highest educational attainment of the mother	No education (0) Primary (1) Secondary (2) Higher (3)	Education completed	No/primary education (1) (no education, primary) Secondary and above (2) (secondary, higher)
V502 (current marital status)	Marital status of women aged 15-49	Never in union (0) Currently in union/living with a man (1) Formerly in union/living with a man (2)	Marital status	Never in union (1) Currently in union/living with a man (2) Formerly in union (3)
M13 (timing of first ANC visit)	First ANC visit of a woman during pregnancy	1-9 (continuous)	Timing of ANC attendance	1st trimester (1) (months 1-3) 2nd trimester (2) (months 4-6) 3rd trimester (3) (month 7-9)
M14 (frequency of ANC visits)	Number of ANC visits of a woman during pregnancy	1-20 (continuous) No attendance (0) Don't know (98)	Frequency of ANC attendance	Suboptimal attendance (1) (0-3 visits) Optimal attendance (2) (4+ visits) No attendance (3)
Household Factors				
V113 (Source of drinking water)	Sources of drinking water in the household	Piped into dwelling (11) Piped to yard/plot (12) Public tap/standpipe (13) Neighbour's tap (14) Tube well/ borehole (21) protected well (31) unprotected well (32) protected spring (41) unprotected spring (42) rainwater (51) tanker truck (61) river/ dam/ lake/ ponds/ stream/ canal/ irrigation canal (71) bottled water (81) not a de jure resident (97)	Source of drinking water	**Improved source (1)** (piped into dwelling/ yard/ plot, public tap/ standpipe, neighbour's tap, tube well/ borehole, protected well, protected spring, rainwater, bottled water) **Unimproved source (2)** (unprotected well, unprotected spring, river/ dam/ lake/ ponds/ stream/ canal/ irrigation canal, tanker truck)
V116 (Type of toilet facility)	Type of toilet facility used by household members	Flush to piped sewer system (11) Flush to septic tank (12) Flush, don't know where (15) Ventilated improved pit latrine (VIP) (21) Pit latrine with slab (22) Pit latrine without slab (23) No facility/ bush/ field (31) Composting toilets (41) Not a de jure resident (97)	Type of toilet facility	**Improved toilet facility (1)** (Flush to piped sewer system, flush to a septic tank, flush, don't know where) **Unimproved toilet facility (2)** (Ventilated improved pit latrine, pit latrine with slab, pit latrine without slab/ open pit, no facility/ bush/ field)

V190 (Wealth Index)	Wealth status of a household	Poorest (1) Poorer (2) Middle (3) Richer (4) Richest (5)	Wealth index	Poor (1) (poorest, poorer) Middle (2) (middle) Rich (3) (richer, richest)
Geographic Factors				
V025 (Type of place of residence)	Urban or rural residence	Urban (1) Rural (2)	Type of residence	Urban (1) Rural (2)
V024 (Region)	Administrative Districts	Butha-Buthe (1) Leribe (2) Berea (3) Maseru (4) Mafeteng (5) Mohale's Hoek (6) Quthing (7) Qacha's Nek (8) Mokhotlong (9) Thaba-Tseka (10)	Districts	Butha-Buthe (1) Leribe (2) Berea (3) Maseru (4) Mafeteng (5) Mohale's Hoek (6) Quthing (7) Qacha's Nek (8) Mokhotlong (9) Thaba-Tseka (10)

3.8 Data Management

Data management was performed in STATA 17, and data were stored on a password-protected device to ensure confidentiality and security. Moreover, a backup was created and synced to OneDrive. Missing and invalid anthropometric measurements were dropped from the dataset. Invalid measurements included those that fell outside the established age and weight parameters and were coded "9998" in the primary dataset. The sampling weight variable was generated by dividing the sample weight (V005) by one million, as recommended by the DHS (Croft, Trevor N., Allen, Courtney K., Zachary, Blake W., et al., 2023). Stunting, wasting and underweight were generated as indicators of undernutrition while being overweight was generated as an indicator of overnutrition. Children with neither undernutrition nor overnutrition were labelled as "wellnourished." To generate the outcome variable, "childhood malnutrition," the three indicators were collapsed into a three-level outcome variable.

The mother's age was recategorised and recoded as 1="15-24", 2="25-34" and 3="35-49. The highest educational level (v106) was also recategorised and coded 1= no/primary education (no education, primary) and 2= secondary and above (secondary, higher). Similarly, household factors such as the source of drinking water (v113) were also recategorised and coded 1=improved source and 2= unimproved source and the type of toilet facility (v116) was coded 1= improved toilet

facility and 2= unimproved toilet facility. The classification of improved and unimproved sources and facilities was based on the definitions provided by the WHO/UNICEF Joint Monitoring Programme for water supply, sanitation, and hygiene (WHO & UNICEF, 2023). The "wealth index" variable (v190) was recategorised into three levels: 1= poor (poorest, poor), 2= Middle (middle) and 3= rich (richer, richest).

The dataset also consisted of continuous variables; the child's age (b8) and birth order (bord) were retained as continuous variables. However, the frequency of ANC visits (m14) was recoded from continuous to 1=suboptimal attendance (1-3 visits) and 2=optimal attendance (4+ visits). This was based on WHO's recommendation for ANC visits to be at least four during pregnancy (WHO, 2024). A weighted number of mothers (n=18) did not attend ANC, and a substantial number (n=355) were missing values. Although these missing values were included in the descriptive analysis, they were excluded from further analyses.

Due to the incompleteness of the data, birth size was used as a proxy for birthweight and categorised into three levels: 1 = small (smaller than average, very small), 2 = normal (average), and 3 = large (larger than average, very large). Mothers who did not know a child's birth size (n=2) as well as missing values for variables birth size and child breastfed were also included in the descriptive analysis. However, they were excluded from further analyses.

Child factors such as sex (b4) and geographic factors such as region (v024) and type of place of residence (v025) were operationalised in the same manner as the primary study. However, all the variables from the primary study were renamed for clarity and to improve interpretability.

Table 3.1 presents variable definitions and how they were recoded from the primary dataset.

3.9 Data Analysis

The "svyset" command was implemented in STATA 17 to factor in the two-stage cluster sampling method used in the primary survey. This command was also essential for calculating significance testing. Furthermore, the weighting variable was generated and applied to adjust for all analyses in this study by employing the sample weight from the primary survey.

The analysis began with a depiction of descriptive statistics. Categorical exposure variables were summarised and presented in frequencies and percentages with respect to the outcome variable.

Continuous variables (child's age and birth order) were tested for normality. Several transformation techniques were employed to normalise the data, specifically the cubic, square, identity, square root, log, 1/ (square root), inverse, 1/square and 1/cubic transformations using the "ladder" command. Despite various attempts at transformation, the data remained skewed, as none of the transformations successfully normalised the distribution. Therefore, the median and interquartile range (IQR) were used to describe the child's age and birth order.

3.9.1 Objective One

- To determine the prevalence of childhood malnutrition in Lesotho, 2018-2024.

The prevalence of childhood malnutrition was estimated by a cross-tabulation of all the exposure variables by the outcome variable. This was done by running Pearson's chi-squared test to examine whether there was a significant association between a child's characteristics and childhood malnutrition. Given that the continuous variables did not follow a normal distribution, the Kruskal-Wallis test was used to estimate the prevalence within the three categories of childhood malnutrition.

3.9.2 Objective Two

- To identify factors associated with childhood malnutrition in Lesotho, 2018-2024.

Univariable and multivariable multinomial logistic regression analysis was conducted to identify the factors associated with childhood malnutrition, specifically to examine the association between all the explanatory variables and the outcome variable childhood malnutrition, within the three levels: undernutrition, well-nourished and overnutrition. Well-nourished was used as the baseline category for these analyses. For the univariable analysis, referred to as Model 1, the association between the child's characteristics and childhood malnutrition were reported by the unadjusted odds ratios and the 95% confidence intervals. For the multinomial logistic regression analysis, referred to as Model 2, the results were reported by adjusted odds ratios and 95% confidence intervals. The significance level was determined by a p-value of 0.05.

3.10 Limitations

MoH [Lesotho] and ICF (2024) reported that during anthropometry measurements, one percent of children was heavily clothed or wore large and fixed accessories that altered weight measurement, while six percent had hairstyles or accessories that altered height measurement. Additionally, some anthropometric measurements, specifically weight and height, fell outside the valid range, resulting in unusable data that had to be excluded from the dataset. Consequently, this resulted in a reduced sample size. Furthermore, some variables of interest, such as access to healthcare facilities, availability of healthcare resources, and access to trained healthcare staff, were not included in the original dataset (2023-24 LDHS). Finally, due to the incomplete data for the variable 'birth weight,' 'birth size' was used as a proxy measure.

3.11 Ethical Consideration

The study has adhered to ethical regulations per the University of the Witwatersrand Human Research Ethics Committee (Medical) guidelines. The awarded ethics clearance certificate number is M240536 M240628-A-0005 (APPENDIX D). Furthermore, the Institutional Review Board of ICF International and the Lesotho Ministry of Health Research and Ethics Committee evaluated and approved the 2023-24 LDHS protocol.

CHAPTER 4: RESULTS

This chapter provides the study's findings and addresses the objectives as outlined. It begins with a descriptive analysis of the characteristics of the sample population by their malnutrition status (Table 4.1). Following this overview, the results are presented to address the two objectives of the study. Firstly, the distribution of childhood malnutrition weighted prevalence among the study population, stratified by their respective characteristics, is presented in Table 4.2. Secondly, the factors associated with childhood malnutrition among the study population were identified by running a univariable and a multivariable multinomial logistic regression model as shown in Table 4.3.

4.1 Descriptive Analysis of Study Population

The study population consisted of 1,089 children. After applying the weighting variable, the weighted total of 980 children was included in the analysis, as shown in Table 4.1. Of this total sample, 316 (32.3%) were under-nourished, 587 (59.9%) were well-nourished, and 77 (7.8%) were over-nourished. The sex distribution was relatively balanced between males at 50.5% and females at 49.5%. More males were undernourished compared to females (56.5% vs 43.5% respectively). Similarly, overnutrition was greater among males than their female counterparts, at 54.6% versus 45.4%.

The median age for undernourished children was two years (IQR: 1-3) whereas for overnourished children, the median was zero years (IQR:0-1). The median birth order across all malnutrition categories was two. Among children with undernutrition, the IQR was 0–3, while for those with overnutrition, the IQR was 0–2.

Undernutrition was higher among children born to mothers aged 15-24 (39.4%), while overnutrition was higher among children of mothers aged 25-34 (52.0%). However, undernutrition and overnutrition were the lowest among children of mothers aged 35-49 (22.2% and 18.9% respectively). Children of mothers with secondary and above education were more undernourished at 66.0%. Similarly, the majority of children born to mothers with secondary and above were overnourished at 82.5%.

Undernutrition and overnutrition were higher among children whose mother's first ANC was in the first trimester (34.2% and 39.8% respectively). Similarly, undernutrition and overnutrition were higher among children whose mothers had optimal ANC attendance (55.8% and 65.7%, respectively).

Over half of undernourished children (56.3%) were from poor households. Conversely, the majority of overnourished children were from rich households (49.7%). However, undernutrition and overnutrition were lower among children from middle-class families (20.0 % and 24.3%, respectively).

A notable disparity was observed between urban and rural areas, with rural housing a significantly larger number of children (64.2%) than urban (35.8%). A substantial majority of both undernourished (70.8%) and overnourished (66.8%) children were from rural areas. At the district level, 22.7% of undernourished children and 42.2% of overnourished children were from ButhaButhe while 4.3% of undernourished children were from Qacha's Nek and 2.3% were from Quthing.

Table 4.1: Distribution of studied children by Nutritional Status

Variable name	**Nutritional Status**			**Total**
	Undernutrition Weighted N (%)	**Well-nourished Weighted N (%)**	**Overnutrition Weighted N (%)**	
	316 (32.3)	**587 (59.9)**	**77 (7.8)**	980
		Child Factors		
Sex of child				
Male	179(56.5)	274(46.8)	42(54.6)	495
Female	138(43.5)	312(53.2)	35(45.4)	485
Age of child				
Median (IQR)	2 (1-3)	2 (1-3)	0 (0-1)	
Birth Size				
Small	43(13.7)	40(6.8)	8(10.2)	91
Normal	143(45.1)	214(36.4)	39(51.5)	396
Large	41(13.0)	99(16.7)	19(25.1)	159
Don't know/Missing	89(28.1)	235(40.0)	10(13.2)	334
Birth order				
Median (IQR)	2 (1-3)	2 (1-3)	2 (1-2)	
Child breastfed				
Never breastfed	12(3.8)	16(2.7)	1(1.1)	29
Ever breastfed	216(68.1)	336(57.3)	66(85.7)	618
Missing	89(28.1)	235(40.0)	10(13.2)	334
Recent diarrhoea				

No	259(81.9)	464(79.1)	68(88.2)	791
Yes	57 (18.1)	123(20.9)	9(11.8)	189
Maternal Factors				
Mother's age				
15-24	125(39.4)	216(36.7)	22(29.1)	363
25-34	121(38.4)	274(46.8)	40(52.0)	435
35-49	70(22.2)	97(16.5)	15(18.9)	182
Education completed				
No/Primary	108(34.0)	142(24.2)	13(17.5)	263
Secondary and above	209(66.0)	445(75.8)	63(82.5)	717
Marital status				
Never in union	46(14.5)	97(16.5)	12(15.3)	155
Currently in union/ living with a man	229(72.5)	432(73.6)	57(74.2)	718
Formerly in union	41(13.0)	58(9.9)	8(10.5)	107
Timing of ANC attendance				
1st trimester	108(34.2)	194(33.0)	31(39.8)	333
2nd trimester	84(26.7)	118(20.1)	28(36.4)	230
3rd trimester	19(6.0)	19(3.3)	6(7.4)	44
No attendance	4(1.0)	12(2.2)	2(2.0)	18
Missing	102(32.1)	243(41.4)	10(14.4)	355
Frequency of ANC attendance				
Suboptimal	34(10.7)	39(6.8)	14(17.8)	88
Optimal	176(55.8)	292(49.7)	51(65.7)	519
No attendance	4(1.4)	12(2.1)	2(2.1)	18
Missing	102(32.1)	243(41.4)	10(14.4)	355
Household Factors				
Source of drinking water				
Improved source	253(80.1)	493(83.9)	67(87.2)	813
Unimproved source	63(19.9)	94(16.1)	10(12.9)	167
Type of toilet facility				
Improved facility	172(54.4)	379(64.6)	54(70.3)	605
Unimproved facility	144(45.6)	208(35.4)	23(29.7)	375
Wealth index				
Poor	178(56.3)	207(35.3)	20(26.0)	405
Middle	63(20.0)	117(20.0)	19(24.3)	199
Rich	75(23.7)	263(44.7)	38(49.7)	376
Geographic Factors				
Type of residence				
Urban	92(29.2)	233(39.7)	26(33.2)	351
Rural	224(70.8)	354(60.3)	51(66.8)	629
Districts				
Maseru	18(5.7)	38(6.4)	4(5.4)	60
Leribe	46(14.5)	118(20.1)	12(15.6)	176
Berea	50(15.9)	100(17.1)	11(13.0)	161
Butha-Buthe	71(22.7)	167(28.4)	32(42.2)	270
Mafeteng	18(5.5)	30(5.2)	4(4.2)	52
Mohale's Hoek	25(7.8)	28(4.7)	4(5.1)	57

Quthing	17(5.5)	20(3.4)	2(2.3)	39
Qacha's Nek	14(4.3)	20(3.3)	4(5.5)	37
Mokhotlong	19(6.0)	24(4.1)	3(4.0)	46
Thaba-Tseka	37(11.8)	43(7.3)	2(2.7)	82

4.2 Prevalence of Childhood Malnutrition

The prevalence of childhood malnutrition was assessed across three nutritional categories: undernutrition, well-nourished, and overnutrition, stratified by various characteristics, as shown in Table 4.2.

Approximately 32.3 of the children were classified as undernourished, 59.9 were well-nourished, and the lowest prevalence was observed in the overnutrition category (7.8). The prevalence of undernutrition was higher among males, at 36.1, compared to females, at 28.4. Conversely, the prevalence of overnutrition was slightly higher among females, at 8.5 compared to males, at 7.2. However, these differences were not statistically significant.

A statistically significant difference in nutritional status was observed across the age range (p=0.0001). The prevalence of undernutrition was higher among children aged two years (IQR: 13), whereas overnutrition was higher among children aged one year (IQR: 0-1). Additionally, the prevalence of undernutrition was higher among second-born children (IQR: 1–3), whereas overnutrition was higher among first-born children (IQR: 1–2).

Maternal factors also play a significant role in children's nutritional status. The highest prevalence of undernutrition was observed among children of mothers with no or primary education (41.0), while overnutrition was higher among children of mothers with secondary or higher education (8.8). The type of toilet facility was also found to be significantly associated with a child's nutritional status. Children from households with unimproved toilet facilities exhibited a higher prevalence of undernutrition than those from households with improved toilet facilities, with rates of 38.5 and 28.4, respectively. The wealth index was another crucial factor in nutritional status. The prevalence of undernutrition was notably higher among children from poor households (43.9), and the lowest among rich households (20.0). Conversely, overnutrition was most prevalent among children from rich households (10.2), followed by children from middle-class households (9.4), and was least prevalent among children from poor households (4.9).

Thaba-Tseka recorded the highest prevalence of undernutrition (45.6), while Leribe had the lowest prevalence (26.0). Additionally, Butha-Buthe reported the highest prevalence of overnutrition (12.0), while Thaba-Tseka had the lowest prevalence of overnutrition (2.5).

Table 4.2: Prevalence of childhood malnutrition

Variable name	Nutritional Status			p-value
	Undernutrition N (%) 316 (32.3)	Well-nourished N (%) 587 (59.9)	Overnutrition N (%) 77 (7.8)	
Child Related Factors				
Sex of child				*0.126*
Male	179(36.1)	274(55.4)	42(8.5)	
Female	138(28.4)	312(64.4)	35(7.2)	
Age of child				*<0.001****
Median (IQR)	2 (1-3)	2 (1-3)	1 (0-1)	
Birth Size				*0.239*
Small	43(47.6)	40(43.8)	8(8.6)	
Normal	143(36.0)	214(54.0)	39(10.0)	
Large	41(26.0)	99(61.9)	19(12.1)	
Birth order				*0.006***
Median (IQR)	2 (1-3)	2 (1-3)	1 (1-2)	
Child breastfed				*0.293*
Never breastfed	12(42.0)	16(54.9)	1(3.0)	
Ever breastfed	216(34.9)	336(54.5)	66(10.6)	
Recent diarrhoea				*0.217*
No	259(32.8)	464 (58.7)	68(8.6)	
Yes	57(30.3)	123(64.9)	9(4.8)	
Maternal Factors				
Mother's age				*0.410*
15-24	125(34.3)	216(59.5)	22(6.2)	
25-34	121(27.9)	274(63.0)	40(9.1)	
35-49	70(38.7)	97(53.3)	15(8.0)	
Education completed				*0.004***
No/primary	108(41.0)	142(53.9)	13(5.1)	
Secondary and above	209(29.1)	445(62.1)	63(8.8)	
Marital status				*0.789*
Never in union	46(29.8)	97(62.6)	12(7.6)	
Currently in union/ living with a man	229(31.9)	432(60.2)	57(7.9)	
Formerly in union	41(38.2)	58(54.2)	8(7.6)	
Timing of ANC attendance				*0.597*
1st trimester	108(32.5)	194(58.3)	31(9.2)	
2nd trimester	84(36.6)	118(51.3)	28(12.1)	
3rd trimester	19(42.8)	19(44.4)	6(12.8)	
Frequency of ANC attendance				*0.414*
Suboptimal	34(38.9)	39(45.4)	14(15.7)	

Optimal	176(34.0)	292(56.3)	50(9.7)	
Household Factors				
Source of drinking water				*0.347*
Improved source	253(31.2)	493(60.6)	67(8.2)	
Unimproved source	63(37.6)	94(56.5)	10(5.9)	
Type of toilet facility				*0.040**
Improved facility	172(28.4)	379(62.7)	54(8.9)	
Unimproved facility	144(38.5)	208(55.4)	23(6.1)	
Wealth index				*<0.001***
Poor	178(43.9)	207(51.2)	20(4.9)	
Middle	63(31.7)	117(58.9)	19(9.4)	
Rich	75(20.0)	263(69.8)	38(10.2)	
Geographic Factors				
Type of residence				*0.099*
Urban	92(26.3)	233(66.4)	26(7.3)	
Rural	224(35.6)	354(8.2)	51(8.2)	
Districts				*0.024**
Maseru	18(30.2)	38(62.8)	4(7.0)	
Leribe	46(26.0)	118(67.2)	12(6.8)	
Berea	50(31.3)	100(62.5)	11(6.2)	
Butha-Buthe	71(26.4)	167(61.6)	32(12.0)	
Mafeteng	18(35.2)	30(58.6)	4(6.3)	
Mohale's Hoek	25(43.9)	28(49.2)	4(6.9)	
Quthing	17(44.3)	20(51.3)	2(4.5)	
Qacha's Nek	14(36.9)	20(51.8)	4(11.3)	
Mokhotlong	19(41.5)	24(51.9)	3(6.6)	
Thaba-Tseka	37(45.6)	43(51.8)	2(2.5)	

****p<0.0001; **p<0.01; *p<0.05*

4.3 Factors Associated with Childhood Malnutrition

Table 4.3 shows the results of the univariable and multivariable multinomial logistic regression analyses of childhood malnutrition and selected child, maternal, household, and geographical factors.

In the univariable analysis, several factors were significantly associated with undernutrition while only age was significantly associated with overnutrition. Specifically, the odds of overnutrition decreased 0.53 times, for every year increase in age [OR: 0.53 (95 CI: 0.37-0.76)]. Regarding undernutrition, the odds among females were 0.68 times those of males [OR: 0.68 (95 CI:0.49-0.94)]. Additionally, the odds of undernutrition among children born large were 0.39 times those of children born small [OR: 0.39 (95 CI:0.19-0.77)]. Furthermore, maternal education was significantly associated with undernutrition; the odds of undernutrition among children of mothers who had secondary and above education were 0.62 times those of mothers with no/primary

education [OR: 0.62 (95 CI: 0.44-0.85)]. Similarly, the odds of undernutrition among children from rich households were 0.33 times those of children from poor households [OR: 0.33 (95 CI: 0.22-0.51)].

On the other hand, factors with increased odds of undernutrition included birth order, type of toilet facility, type of residence, and living in Mohale's Hoek, Quthing and Thaba-Tseka. Notably, the odds of undernutrition increased 1.3 times for every additional child [OR: 1.30 (95 CI: 1.161.46)]. In addition, the odds of undernutrition among children from households with unimproved toilet facilities were 1.53 times those of children from households with improved toilet facilities [OR: 1.53 (95 CI: 1.07-2.18)]. Moreover, the odds of undernutrition among children from rural areas were 1.60 times those of urban areas [OR: 1.60 (95 CI:1.13-2.27)]. Lastly, the odds of undernutrition were significantly higher among children living in Mohale's Hoek [OR: 1.86 (95 CI: 1.06-3.25)], Quthing [OR: 1.80 (95 CI: 1.04-3.11)], and Thaba-Tseka [OR: 1.83 (95 CI: 1.12-3.00)] compared to those of children living in Maseru.

In the multivariable analysis, factors with significantly decreased odds of undernutrition included sex, birth size, diarrhoea, maternal age, and wealth index. Regarding the child's sex, the odds of undernutrition among females were 0.53 times those of males [aOR: 0.53 (95 CI:0.32-0.87)]. Additionally, the odds of undernutrition were significantly lower among normal-size children [aOR: 0.50 (95 CI: 0.28-0.88)] and children born large [aOR: 0.35 (95 CI:0.16-0.74)] compared to those who were born small. Furthermore, the odds of undernutrition among children who had diarrhoea were 0.55 times of those who did not have diarrhoea [aOR: 0.55 (95 CI: 0.31-0.96)]. Regarding maternal factors, the odds of undernutrition among children born to mothers aged 25-34 were 0.51 times those of children born to mothers aged 15-24 years [aOR: 0.51 (95 CI: 0.29-0.91)]. Finally, household factors indicated that the odds of undernutrition among children from rich households were 0.34 times those of children from poor households [aOR: 0.34 (95 CI: 0.16-0.72)].

However, age and birth order had increased odds of undernutrition. The odds of undernutrition increased 2.11 times for every year increase in age [aOR: 2.11 (95 CI: 1.51-2.95)]. Furthermore, the odds of undernutrition increased 1.41 times for every additional child [aOR: 1.41 (1.12-1.76)].

Table 4.3: Factors associated with childhood malnutrition.

Variable name	Unadjusted OR (95 CI)		Adjusted aOR (95 CI)	
	Undernutrition	Overnutrition	Undernutrition	Overnutrition
Child Factors				
Sex of child				
Male (ref)	1.00	1.00	1.00	1.00
Female	0.68* (0.49-0.94)	0.73 (0.34-1.55)	0.53* (0.32-0.87)	1.08 (0.54-2.16)
Age of child	0.94 (0.84-1.05)	0.53** (0.37-0.76)	2.11***(1.51-2.95)	0.55 (0.30-1.01)
Birth size				
Small(ref.)	1.00	1.00	1.00	1.00
Normal	0.61 (0.36-1.04)	0.94 (0.22-4.06)	0.50* (0.28-0.88)	0.95 (0.27-3.29)
Large	0.39** (0.19-0.77)	0.99 (0.24-4.20)	0.35** (0.16-0.74)	0.94 (0.27-3.32)
Birth order	1.30*** (1.16-1.46)	1.03 (0.88-1.22)	1.41** (1.12-1.76)	0.86 (0.57-1.30)
Child breastfed				
Never breastfed (ref)	1.00	1.00	1.00	1.00
Ever breastfed	0.80 (0.35-1.87)	3.53 (0.73-17.10)	0.82 (0.35-1.92)	2.62 (0.41-16.82)
Recent diarrhoea				
No (ref)	1.00	1.00	1.00	1.00
Yes	0.84 (0.54-1.30)	0.50 (0.24-1.07)	0.55* (0.31-0.96)	0.51 (0.22-1.18)
Maternal Factors				
Mother's age				
15-24 (ref)	1.00	1.00	1.00	1.00
25-34	0.77 (0.54-1.08)	1.40 (0.61-3.23)	0.51* (0.29-0.91)	2.10 (0.76-5.81)
35-49	1.26 (0.76-2.09)	1.44 (0.36-5.78)	0.64 (0.24-1.71)	2.02 (0.32-12.64)
Education completed				
No/primary (ref)	1.00	1.00	1.00	1.00
Secondary and above	0.62** (0.44-0.85)	1.50 (0.75-3.00)	1.32 (0.80-2.19)	1.30 (0.44-3.86)
Marital Status				
Never in union (ref)	1.00	1.00	1.00	1.00
Currently in union	1.11 (0.75-1.66)	1.09 (0.41-2.89)	1.07 (0.57-2.01)	0.88 (0.30-2.59)
Formerly in union	1.48 (0.84-2.60)	1.14 (0.34-3.86)	0.81 (0.33-1.96)	1.13 (0.24-5.34)
Timing of ANC attendance				
1st trimester (ref)	1.00	1.00	1.00	1.00
2nd trimester	1.28 (0.83-1.97)	1.50 (0.60-3.72)	1.00 (0.60-1.68)	1.47 (0.68-3.20)
3rd trimester	1.72 (0.77-3.85)	1.83 (0.41-8.26)	1.84 (0.64-5.32)	1.08 (0.22-5.21)
Frequency of ANC attendance				
Suboptimal (ref)	1.00	1.00	1.00	1.00
Optimal	0.71 (0.39-1.29)	0.50 (0.15-1.70)	1.15 (0.53-2.48)	0.65 (0.17-2.46)
Household Factors				
Source of drinking water				
Improved source (ref)	1.00	1.00	1.00	1.00
Unimproved source	1.30 (0.86-1.96)	0.77 (0.32-1.85)	1.06 (0.56-2.01)	0.78 (0.29-2.06)
Type of toilet facility				

Improved facility (ref)	1.00	1.00	1.00	1.00
Unimproved facility	1.53* (1.07-2.18)	0.77 (0.37-1.60)	1.03 (0.64-1.67)	0.85 (0.36-2.04)
Wealth index				
Poor (ref)	1.00	1.00	1.00	1.00
Middle	0.63 (0.39-1.02)	1.65 (0.77-3.57)	0.65 (0.34-1.24)	1.12 (0.39-3.28)
Rich	0.33*** (0.22-0.51)	1.51 (0.69-3.30)	0.34** (0.16-0.72)	1.73 (0.42-7.13)
	Geographic Factors			
Type of residence				
Urban (ref)	1.00	1.00	1.00	1.00
Rural	1.60** (1.13-2.27)	1.33 (0.60-2.93)	0.72 (0.38-1.38)	2.41 (0.65-8.97)
Districts				
Maseru (ref)	1.00	1.00	1.00	1.00
Leribe	0.80 (0.46-1.41)	0.92 (0.35-2.40)	0.96 (0.41-2.22)	0.58 (0.16-2.16)
Berea	1.04 (0.62-1.77)	0.90 (0.36-2.21)	1.50 (0.67-3.79)	0.72 (0.21-2.44)
Butha Buthe	0.89 (0.50-1.58)	1.75 (0.65-4.76)	1.55 (0.63-3.79)	1.65 (0.48-5.60)
Mafeteng	1.25 (0.70-2.22)	0.96 (0.29-3.24)	1.69 (0.65-4.36)	0.45 (0.08-2.68)
Mohale's Hoek	1.86* (1.06-3.25)	1.28 (0.42-3.84)	2.24 (0.98-5.15)	1.29 (0.34-4.91)
Quthing	1.80* (1.04-3.11)	0.78 (0.23-2.67)	1.72 (0.70-4.26)	1.11 (0.29-4.29)
Qacha's Nek	1.49 (0.81-2.74)	1.97 (0.68-5.71)	1.58 (0.69-3.59)	2.25 (0.58-8.67)
Mokhotlong	1.66 (0.91-3.02)	1.15 (0.42-3.11)	1.20 (0.47-3.08)	0.98 (0.26-3.69)
Thaba-Tseka	1.83* (1.12-3.00)	0.44 (0.12-1.69)	1.57 (0.70-3.49)	0.48 (0.11-2.13)

****p<0.0001; **p<0.01; *p<0.05*

CHAPTER 5: DISCUSSION

This study sought to determine the prevalence of childhood malnutrition in Lesotho and identify the associated factors. In this chapter, significant factors are discussed in relation to the study's objectives. Their alignment and divergence with existing literature are also examined, identifying similarities and differences. The discussion concludes by highlighting this study's strengths and limitations.

5.1 Prevalence of Childhood Malnutrition

This study highlights that undernutrition is particularly prevalent among children aged two. Similar findings were reported in a study conducted in Uganda, which documented a high prevalence of undernutrition in two-year-olds (Mawa, 2018). In Pakistan, undernutrition was found to be approximately 1.2 times more common in one-year-olds compared to four-year-olds (Ahmad et al., 2020), likely due to the transition from breastfeeding to supplementary feeding. Breastfeeding offers numerous protective benefits, including a reduced risk of undernutrition in children (Campos et al., 2020). However, a systematic review found that undernutrition prevalence among children under five increases with age (Katoch, 2022).

Undernutrition was found to be prevalent among second-born children. These findings corroborate with those found in India, showing that about one-third of children in the first birth order had the lowest rate of undernutrition, while nearly half of children aged four experienced the highest rates of some form of undernutrition (Prasad et al., 2021). Furthermore, a systematic review indicated that 16 of studies reported an increase in the prevalence of malnutrition with rising birth order and undernutrition consistently increases across all measures of child undernutrition as birth order rises (Katoch, 2022).

Maternal education has been identified as a significant factor influencing child malnutrition. A study conducted in Bangladesh similarly found that higher levels of maternal education were associated with lower prevalence rates of undernutrition among children. Specifically, the prevalence of undernutrition was 48.4 among children whose mothers had no formal education, 43.9 for those with primary education, and 27.8 for those with secondary education (Nahar & Zahangir, 2024). This may be attributed to the role of maternal education in improving a child's

nutritional status, as educated mothers tend to have a better understanding of proper nutrition and access to child healthcare services (Katoch, 2022).

Studies have indicated that the prevalence of undernutrition is disproportionately higher among children from the lowest wealth tertiles. For instance, in Ethiopia, rates of some form of undernutrition among children from poorer families ranged from 44.0 to 54.0 (Tesfaw & Dessie, 2022). children from higher-income families had lower levels of undernutrition, which decreased significantly as the wealth index increased (Poda et al., 2017; Nahar & Zahangir, 2024). This disparity can be attributed to limited access to nutritious food, lack of access to healthcare, and poor living conditions, which collectively exacerbate the risk of malnutrition (Govender et al., 2021).

5.2 Factors Associated with Childhood Malnutrition

This study highlighted significant differences in malnutrition among male and female children. These findings were comparable to a study conducted in Pakistan where the odds of undernutrition among males were over 1.2 times those of females (Ahmad et al., 2020). Additionally, research conducted in SSA revealed that female children had a significantly lower risk of being undernourished than their male counterparts (Garenne et al., 2022; Obasohan et al., 2024). The proposed theories to explain this variation have been linked to differences in energy requirements, body composition, vulnerability to communicable diseases, and intrauterine development between males and females (Garenne et al., 2022).

In contrast to undernutrition, overnutrition is also influenced by age among children under five. In a study conducted in Panama, the odds of overnutrition among infants were 1.21 times those of children above 12 months (Pedreschi et al., 2024). A similar trend was observed in East Africa, where children under 24 months had higher odds of overnutrition than older children (Pedreschi et al., 2024). Interestingly, some studies have reported opposing results. A study in Bangladesh found that the odds of stunting among children aged 12 to 23 months were 4.23 times those of children under 12 months (Rahman, 2016). Similarly, the odds of stunting among children aged 24 to 35 months were 1.84 times that of children under 12 months (Rahman, 2016). A study highlighted that children aged 36 months and older were significantly more likely to experience overnutrition compared to younger cohorts (Nikolić et al., 2022). Factors contributing to this trend may include

changes in dietary habits, decreased physical activity, and increased consumption of high-calorie foods (Govender et al., 2021).

This study highlighted a significant association between birth order and undernutrition among children under five indicating that undernutrition increases with each subsequent birth order. Similar findings were observed in a study conducted in Bangladesh which demonstrated that children born later in the birth order are at a higher risk of stunting. The odds of stunting among children born third, fourth, and fifth range from 1.24 to 1.72 times those of first-born children (Rahman, 2016). Rahman (2016) proposed two potential explanations for the relationship. First, higher-order births are often perceived as less desirable, leading to reduced parental attention and care. As a result, both antenatal and postnatal care, as well as routine health check-ups for children, tend to decline with increasing birth order. Second, the distribution of food and supplies within a household diminishes as the number of births increases.

5.3 Strengths and Limitations

With robust data analysis techniques, the study estimated the prevalence of childhood malnutrition and identified the associated factors. Using globally standardised indicators of malnutrition facilitated comparability with findings from other studies. Additionally, it incorporated diverse variables, including child, maternal, household, and geographic factors, allowing for a comprehensive analysis of malnutrition and its determinants.

Children under five are particularly vulnerable to negative health outcomes. This research gave a comprehensive understanding of malnutrition by examining both undernutrition and overnutrition. Many studies focus solely on undernutrition despite the recent surge of overnutrition among children under five in LMICs. An integrated approach is essential for understanding the multifaceted nature of malnutrition, which is crucial for informing policies and implementing effective interventions.

However, the study presents certain limitations that should be considered. Firstly, as a secondary data analysis, the presence of incomplete records for certain variables may impact overall data quality. Secondly, heavy material and fixed accessories worn by some participants during height and weight measurement can introduce errors in the data, which in turn may compromise the

validity of the findings. Finally, using birth size as a proxy may not capture the nuances of birth weight due to its broad categories, leading to a lack of precision in estimating birth weight.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

This study provided valuable insights into the prevalence and factors of child malnutrition by identifying critical factors associated with undernutrition and overnutrition among children under five. The findings showed that sex, age, birth order, birth size, diarrhoea, maternal education, type of toilet facility, wealth index and type of residence were significantly associated with undernutrition. Age was also significantly associated with overnutrition, emphasising its dual role in influencing malnutrition outcomes.

The association between sex and undernutrition suggests potential gender disparities. Similarly, birth order, birth size and diarrhoea indicate the importance of maternal and child health during pregnancy and early childhood. The significance of the wealth index also emphasises its role in shaping nutritional outcomes. Moreover, the relationship between age and overnutrition highlights feeding practices that may contribute to excess weight gain in infants. These findings highlight the importance of addressing the factors associated with childhood malnutrition to improve child health.

By identifying factors associated with childhood malnutrition, the results support evidence-based strategies for reducing malnutrition, which in turn supports SDG 3 as it aims to improve health for all. The findings also highlight areas where targeted prevention of childhood malnutrition and health promotion efforts in Lesotho can improve child health outcomes.

Recommendations

The findings of this study show high levels of undernutrition among children under five years. Based on these findings, there is a need for targeted interventions. Programs aimed at reducing child undernutrition should incorporate gender-sensitive strategies to address disparities in nutritional outcomes between male and female children. Nutritional programs should train caregivers and healthcare workers to promote equitable feeding and care practices. Additionally, policies should include gender-specific indicators to ensure that both male and female children benefit equally from nutrition services.

Support should be focused on children from larger households, specifically those from lower socioeconomic backgrounds. Routine food supplementation programs during postnatal visits will

not only improve attendance but will help improve nutrition among children from lower wealth tertiles.

Strengthening maternal education is crucial, as it plays a significant role in improving child nutrition. Health education initiatives should emphasise proper feeding practices and early childhood care. These interventions will assist mothers in making informed decisions regarding their children's nutritional health, ensuring optimal growth and development. The significant association between age and overnutrition also calls for interventions to promote healthy complementary feeding practices as children transition into older age groups.

REFERENCES

Aboagye, R. G., Ahinkorah, B. O., Seidu, A. A., Frimpong, J. B., Archer, A. G., Adu, C., Hagan, J. E., Amu, H., & Yaya, S. (2022). Birth weight and nutritional status of children under five in sub-Saharan Africa. PLoS ONE, 17(6), 1–19. https://doi.org/10.1371/journal.pone.0269279

Adedokun, S. T., & Yaya, S. (2021). Factors associated with adverse nutritional status of children in sub-Saharan Africa: Evidence from the Demographic and Health Surveys from 31 countries. Maternal and Child Nutrition, 17(3). https://doi.org/10.1111/mcn.13198

Ahmad, D., Afzal, M., & Imtiaz, A. (2020). Effect of socioeconomic factors on malnutrition among children in Pakistan. Future Business Journal, 6(1). https://doi.org/10.1186/s43093-020-00032-x

Akombi, B. J., Agho, K. E., Merom, D., Renzaho, A. M., & Hall, J. J. (2017). Child malnutrition in subSaharan Africa: A meta-analysis of demographic and health surveys (2006-2016). PLoS ONE, 12(5). https://doi.org/10.1371/journal.pone.0177338

Akombi, B. J., Agho, K. E., Hall, J. J., Wali, N., Renzaho, A. M. N., & Merom, D. (2017). Stunting, wasting and underweight in Sub-Saharan Africa: A systematic review. In International Journal of Environmental Research and Public Health (Vol. 14, Issue 8). MDPI. https://doi.org/10.3390/ijerph14080863

Alaba, O. A., Chiwire, P., Siya, A., Saliu, O. A., Nhakaniso, K., Nzeribe, E., Okova, D., & Lukwa, A. T. (2023). Socio-Economic Inequalities in the Double Burden of Malnutrition among under-Five Children: Evidence from 10 Selected Sub-Saharan African Countries. International Journal of Environmental Research and Public Health, 20(8). https://doi.org/10.3390/ijerph20085489

Amadu, I., Seidu, A. A., Duku, E., Boadu Frimpong, J., Hagan Jnr., J. E., Aboagye, R. G., Ampah, B., Adu, C., & Ahinkorah, B. O. (2021). Risk factors associated with the coexistence of stunting, underweight, and wasting in children under 5 from 31 sub-Saharan African countries. BMJ Open, 11(12). https://doi.org/10.1136/bmjopen-2021052267

Amare, Z. Y., Ahmed, M. E., & Mehari, A. B. (2019). Determinants of nutritional status among children under age 5 in Ethiopia: Further analysis of the 2016 Ethiopia demographic and health survey. Globalization and Health, 15(1). https://doi.org/10.1186/s12992-019-0505-7

Amir-ud-Din, R., Fawad, S., Naz, L., Zafar, S., Kumar, R., & Pongpanich, S. (2022). Nutritional inequalities among under-five children: a geospatial analysis of hotspots and cold spots in 73 low-

and middle-income countries. International Journal for Equity in Health, 21(1). https://doi.org/10.1186/s12939-022-01733-1

Ansuya, Nayak, B. S., Unnikrishnan, B., George, A., Shashidhara, N. Y., Mundkur, S. C., & Guddattu, V. (2018). Risk factors for malnutrition among preschool children in rural Karnataka: A casecontrol study. BMC Public Health, 18(1). https://doi.org/10.1186/s12889-018-5124-3

Benedict, L., Hong, S. A., Winichagoon, P., Tejativaddhana, P., & Kasemsup, V. (2021). Double burden of malnutrition and its association with infant and young child feeding practices among children under-five in Thailand. Public Health Nutrition, 24(10), 3058–3065. https://doi.org/10.1017/S1368980020003304

Biracyaza, E., Habimana, S., Rusengamihigo, D., & Evans, H. (2021). Regular antenatal care visits were associated with low risk of low birth weight among newborns in Rwanda: Evidence from the 2014/2015 Rwanda Demographic Health Survey (RDHS) Data. F1000Research, 10, 402. https://doi.org/10.12688/f1000research.51969.1

Bishwajit, G., & Yaya, S. (2020). Overweight and obesity among under-five children in South Asia. Child and Adolescent Obesity, 3(1), 105–121. https://doi.org/10.1080/2574254x.2020.1769992

Bryden, B., Bryden, M., Steer-Massaro, J., & Malope, S. (2021). Family Medicine Training in Lesotho: A Strategy of Decentralized Training for Rural Physician Workforce Development. *Frontiers in Medicine*, *7*(January), 1–4. https://doi.org/10.3389/fmed.2020.582130

Caleyachetty, R., Kumar, N. S., Bekele, H., & Manaseki-Holland, S. (2023). Socioeconomic and urbanrural inequalities in the population-level double burden of child malnutrition in the East and Southern African Region. PLOS Global Public Health, 3(4). https://doi.org/10.1371/journal.pgph.0000397

Campos, A. P., Vilar-Compte, M., & Hawkins, S. S. (2020). Association between breastfeeding and child stunting in Mexico. Annals of Global Health, 86(1), 1–14. https://doi.org/10.5334/aogh.2836

Croft, Trevor N., Allen, Courtney K., Zachary, Blake W., et al. 2023. Guide to DHS Statistics. Rockville, Maryland, USA: ICF.

Dehghan-Haghighi, J., Ayubi, E., Sadeghi-Bojd, S., & Narouei, B. (2022). Malnutrition and its Related Factors among Children under Five Years of Age. Int J Pediatr, 10(2). https://doi.org/10.22038/IJP.2021.55670.4384

Dick-Sagoe, C., Hope, K. N., & Asare-Nuamah, P. (2023). Perceived impact of climate variability and change on livelihoods of smallholder farmers in Lesotho. African Journal of Science, Technology, Innovation and Development, 15(2), 175–184. https://doi.org/10.1080/20421338.2022.2058339

Djoumessi, Y. F. (2022). The impact of malnutrition on infant mortality and life expectancy in Africa. In Nutrition (Vols. 103–104). Elsevier Inc. https://doi.org/10.1016/j.nut.2022.111760

Fagbamigbe, A. F., Kandala, N. B., & Uthman, O. A. (2020). Severe acute malnutrition among under5 children in low- and middle-income countries: A hierarchical analysis of associated risk factors. Nutrition, 75–76. https://doi.org/10.1016/j.nut.2020.110768

Food and Agriculture Organization, (2023). Family Farming Knowledge Platform. Available: https://www.fao.org/family-farming/countries/lso/en/ [Accessed: 14.10.2023]

Gaston, R. T., Ramroop, S., & Habyarimana, F. (2021). Modelling for Anaemia and Malnutrition in Children Less Than Five Years of Age in Lesotho*: A Case Study of a Cross-Sectional Dataset Using Multivariate Joint Model.* https://doi.org/10.21203/rs.3.rs-403762/v1

Ghosh, S. (2020). Factors responsible for childhood malnutrition: *A review of the literature. In Current Research in Nutrition and Food Science* (Vol. 8, Issue 2, pp. 360–370). Enviro Research Publishers. https://doi.org/10.12944/CRNFSJ.8.2.01

Global Nutrition, (2022). Global Nutrition Report. The burden of malnutrition at a glance. Lesotho. Available: https://globalnutritionreport.org/resources/nutrition-profiles/africa/southernafrica/lesotho/ [Accessed: 01.09.2023]

Govender, I., Rangiah, S., Kaswa, R., & Nzaumvila, D. (2021). Malnutrition in children under the age of 5 years in a primary health care setting. South African Family Practice, 63(1). https://doi.org/10.4102/safp.v63i1.5337

Gudu, E., Obonyo, M., Omballa, V., Oyugi, E., Kiilu, C., Githuku, J., Gura, Z., & Ransom, J. (2020). Factors associated with malnutrition in children < 5 years in western Kenya: a hospital-based unmatched case-control study. BMC Nutrition, 6(1). https://doi.org/10.1186/s40795-020-00357-4 Haq, I., Hossain, Md. I., Parvin, Mst. M., Saleheen, A. A. S., Habib, Md. J., & Chowdhury, I.-A.-Q. (2022). Gender differences in child nutrition status of Bangladesh: a multinomial modeling approach. *Journal of Humanities and Applied Social Sciences*, *4*(5), 379–392. https://doi.org/10.1108/jhass-02-2021-0030

Humbwavali, J. B., Giugliani, C., da Silva, I. C. M., & Duncan, B. B. (2018). Temporal trends in the nutritional status of women and children under five years of age in sub-Saharan African countries: Ecological study. Sao Paulo Medical Journal, 136(5), 454–463. https://doi.org/10.1590/1516-3180.2017.0267261117

Ibrahim, M. K., Zambruni, M., Melby, C. L., & Melby, P. C. (2017). Impact of childhood malnutrition on host defense and infection. In *Clinical Microbiology Reviews* (Vol. 30, Issue 4, pp. 919–971). American Society for Microbiology. https://doi.org/10.1128/CMR.00119-1

Iddrisu, I., Monteagudo-Mera, A., Poveda, C., Pyle, S., Shahzad, M., Andrews, S., & Walton, G. E. (2021). Malnutrition and gut microbiota in children. In Nutrients (Vol. 13, Issue 8). MDPI. https://doi.org/10.3390/nu13082727

Jana, A., Dey, D., & Ghosh, R. (2023). Contribution of low birth weight to childhood undernutrition in India: evidence from the national family health survey 2019–2021. BMC Public Health, 23(1). https://doi.org/10.1186/s12889-023-16160-2

John, C., Poh, B. K., Jalaludin, M. Y., Michael, G., Adedeji, I., Oyenusi, E. E., Akor, B., Charles, N. C., Buthmanaban, V., & Muhardi, L. (2023). Exploring disparities in malnutrition among under-five children in Nigeria and potential solutions: a scoping review. In *Frontiers in Nutrition* (Vol. 10). Frontiers Media SA. https://doi.org/10.3389/fnut.2023.1279130

Kapral, N., Miller, S. E., Scharf, R. J., Gurka, M. J., & DeBoer, M. D. (2018). Associations between birthweight and overweight and obesity in school-age children. *Pediatric Obesity*, *13*(6), 333–341. https://doi.org/10.1111/ijpo.12227

Katoch, O. R. (2022). Determinants of malnutrition among children: A systematic review. In *Nutrition* (Vol. 96). Elsevier Inc. https://doi.org/10.1016/j.nut.2021.111565

Khaliq, A., Wraith, D., Miller, Y., & Nambiar, S. (2022). Association of Infant Feeding Indicators and Infant Feeding Practices with Coexisting Forms of Malnutrition in Children under Six Months of Age. Nutrients, 14(20). https://doi.org/10.3390/nu14204242

Khandelwal, N., Mandliya, J., Nigam, K., Patil, V., Mathur, A., & Pathak, A. (2020). Determinants of motor, language, cognitive, and global developmental delay in children with complicated severe acute malnutrition at the time of discharge: An observational study from Central India. *PLoS ONE*, *15*(6). https://doi.org/10.1371/journal.pone.0233949

Kofinti, R. E., Koomson, I., Paintsil, J. A., & Ameyaw, E. K. (2022). Reducing children's malnutrition by increasing mothers' health insurance coverage: A focus on stunting and underweight across 32 sub-Saharan African countries. Economic Modelling, 117. https://doi.org/10.1016/j.econmod.2022.106049

Kuse, K. A., & Debeko, D. (2023). Spatial distribution and determinants of stunting, wasting and underweight in children under five in Ethiopia. BMC Public Health, 23(1), 641. https://doi.org/10.1186/s12889-023-15488-z

Lerm, B. R., Crochemore-Silva, I., Costa, J. C., & Victora, C. G. (2021). The double burden of malnutrition in under-five children at national and individual levels: Observed and expected prevalence in ninety-three low- And middle-income countries. Public Health Nutrition, 24(10), 2944–2951. https://doi.org/10.1017/S1368980020001226

Lesotho News Agency. (2023). Rolling back malnutrition. Available: https://www.lena.gov.ls/rollingback-malnutrition/ [Accessed:21.01.2025]

Liben, M. L., Haile, Y., Liben, M. L., & Abuhay, T. (2016). Determinants of Child Malnutrition among Agro Pastorals in Northeastern Ethiopia: A Cross-Sectional Study Continuum of care in maternal and newborn health in Wolayta zone, Ethiopia View project Prevalence and Associated Risk Factor for Pulmonary Tuberculosis Patients in Southwestern Ethiopia: A Three-Year Retrospective Study View project Determinants of Child Malnutrition among Agro Pastorals in Northeastern Ethiopia: A Cross-Sectional Study. In *Article in Health Science Journal*. www.hsj.gr/archive

Linono, M., Sebotsa, D., Dannhauser, A., Jooste, P. L., & Joubert, G. (2007). Assessment of the sustainability of the iodine-deficiency disorders control program in Lesotho. *Food and Nutrition Bulletin*, 28(3), 337-347. https://doi.org/10.1177/156482650702800310

Ma, J., Qiao, Y., Zhao, P., Li, W., Katzmarzyk, P. T., Chaput, J. P., Fogelholm, M., Kuriyan, R., Lambert, E. V., Maher, C., Maia, J., Matsudo, V., Olds, T., Onywera, V., Sarmiento, O. L., Standage, M., Tremblay, M. S., Tudor-Locke, C., & Hu, G. (2020). Breastfeeding and childhood obesity: A 12country study. *Maternal and Child Nutrition*, *16*(3). https://doi.org/10.1111/mcn.12984

Mawa, R. (2018). Malnutrition Among Children Under Five Years in Uganda. *American Journal of Health Research*, *6*(2), 56. https://doi.org/10.11648/j.ajhr.20180602.14

Mekonen, E. G., Zegeye, A. F., & Workneh, B. S. (2024). Complementary feeding practices and associated factors among mothers of children aged 6 to 23 months in Sub-saharan African countries: a multilevel analysis of the recent demographic and health survey. *BMC Public Health*, *24*(1). https://doi.org/10.1186/s12889-023-17629-w

Mina, Mst. N., Nuruzzaman, M., Habib, M. N., Rahman, M., Chowdhury, F. M., Ahsan, S. N., Ahmed, F. F., Azizi, S., Mubin, N., Kibria, A. H. M. G., & Shuchi, F. A. (2023). The Effectiveness of Adequate Antenatal Care in Reducing Adverse Perinatal Outcomes: Evidence from a Low- or Middle-Income Country. Cureus. https://doi.org/10.7759/cureus.51254

Ministry of Health [Lesotho] and ICF International. (2016). *Lesotho Demographic and Health Survey 2014*. Maseru, Lesotho: Ministry of Health and ICF International.

Ministry of Health [Lesotho] and ICF (2024). Lesotho Demographic and Health Survey 2023–24: Final Report. Maseru, Lesotho, and Rockville, Maryland, USA: Ministry of Health and ICF.

Moeletsi, M. E., & Walker, S. (2013). Agroclimatological suitability mapping for dryland maize production in Lesotho. *Theoretical and Applied Climatology*, *114*(1–2), 227–236. https://doi.org/10.1007/s00704-012-0829-1

Mokwena, K., & Kachabe, J. (2022). Profile of mothers whose children are treated for malnutrition at a rural district hospital in the North West province, South Africa. South African Journal of Clinical Nutrition, 35(1), 17–22. https://doi.org/10.1080/16070658.2021.1921899

Nahar, M. Z., & Zahangir, M. S. (2024). The role of parental education and occupation on undernutrition among children under five in Bangladesh: A rural-urban comparison. PLoS ONE, 19(8). https://doi.org/10.1371/journal.pone.0307257

Nikolić, D., Gadzic, A., & Stamenković, S. (2022). OVERNUTRITION AND OBESITY OF PRESCHOOL CHILDREN. Facta Universitatis. Series, Teaching, Learning and Teacher Education, 6, 197–217. https://doi.org/10.22190/FUTLTE221005015N

Nkoko, N., Cronje, N., & Swanepoel, J. W. (2023). Determinants of dietary diversity for women of reproductive age (WRA) and under-five children from small-holder farming households in Lesotho. Cogent Food and Agriculture, 9(1). https://doi.org/10.1080/23311932.2023.2231688

Obasohan, P. E., Walters, S. J., Jacques, R., & Khatab, K. (2024). Socio-economic, demographic, and contextual predictors of malnutrition among children aged 6–59 months in Nigeria. BMC

Nutrition, 10(1). https://doi.org/10.1186/s40795-023-00813-x

Pedreschi, A. S., Fontes, F., Roa, R., Quintana, H., & Mendoza, R. M. (2024). Malnutrition among Children under Age Five in Panama: Results of the ENSPA 2019. Annals of Global Health, 90(1), 51. https://doi.org/10.5334/aogh.4409

Poda, G. G., Hsu, C. Y., & Chao, J. C. J. (2017). Factors associated with malnutrition among children <5 years old in Burkina Faso: Evidence from the Demographic and Health Surveys IV 2010. International Journal for Quality in Health Care, 29(7), 901–908. https://doi.org/10.1093/intqhc/mzx129

Rahman, M. S., Howlader, T., Masud, M. S., & Rahman, M. L. (2016). Association of low-birth weight with malnutrition in children under five years in Bangladesh: Do mother's education, socioeconomic status, and birth interval matter? PLoS ONE, 11(6). https://doi.org/10.1371/journal.pone.0157814

Roche, C. (2023). Breaking the cycle of chronic child malnutrition in Sub-Saharan Africa. https://impact.economist.com/perspectives/sites/default/files/economist_impact_breaking_the_cycle_of_chronic_malnutrition_in_ssa_feb_23.pdf

Saha, S., Saxena, D., Puwar, T., & Pandya, A. (2022). Addressing determinants of malnutrition: A protocol of project Tushti. *Journal of Family Medicine and Primary Care*, *11*(11), 6745. https://doi.org/10.4103/jfmpc.jfmpc_925_21

Sarkar, S. (2016). Cross-sectional study of child malnutrition and associated risk factors among children aged under five in West Bengal, India. *International Journal of Population Studies*, *2*(1), 89–102. https://doi.org/10.18063/ijps.2016.01.003

Shinsugi, C., Gunasekara, D., Gunawardena, N. K., Subasinghe, W., Miyoshi, M., Kaneko, S., & Takimoto, H. (2019). Double burden of maternal and child malnutrition and socioeconomic status in urban Sri Lanka. PLoS ONE, 14(10). https://doi.org/10.1371/journal.pone.0224222

Shyam, A., Fuller, N., & Shah, P. (2020). Is child undernutrition associated with antenatal care attendance in Madhya Pradesh, India? Journal of Family Medicine and Primary Care, 9(3), 1380. https://doi.org/10.4103/jfmpc.jfmpc_1041_19

Siddiqui, F., Salam, R. A., Lassi, Z. S., & Das, J. K. (2020). The Intertwined Relationship Between Malnutrition and Poverty. In Frontiers in Public Health (Vol. 8). Frontiers Media S.A. https://doi.org/10.3389/fpubh.2020.00453

Simwanza, N. R., Kalungwe, M., Karonga, T., Mtambo, C. M. M., Ekpenyong, M. S., & Nyashanu, M. (2023). Exploring the risk factors of child malnutrition in Sub-Sahara Africa: A scoping review. In Nutrition and Health (Vol. 29, Issue 1, pp. 61–69). SAGE Publications Ltd. https://doi.org/10.1177/02601060221090699

Ssentongo, P., Ssentongo, A. E., Ba, D. M., Ericson, J. E., Na, M., Gao, X., Fronterre, C., Chinchilli, V. M., & Schiff, S. J. (2021). Global, regional and national epidemiology and prevalence of child stunting, wasting and underweight in low- and middle-income countries, 2006–2018. Scientific Reports, 11(1). https://doi.org/10.1038/s41598-021-84302-w

Tesfaw, L. M., & Dessie, Z. G. (2022). Multilevel multivariate analysis on the anthropometric indicators of under-five children in Ethiopia: EMDHS 2019. BMC Pediatrics, 22(1). https://doi.org/10.1186/s12887-022-03172-x

Tomlinson, M., Skeen, S., Marlow, M., Cluver, L., Cooper, P., Murray, L., Mofokeng, S., Morley, N., Makhetha, M., Gordon, S., Esterhuizen, T., & Sherr, L. (2016). Improving early childhood care and development, HIV-testing, treatment and support, and nutrition in Mokhotlong, Lesotho: Study protocol for a cluster randomized controlled trial. *Trials*, *17*(1). https://doi.org/10.1186/s13063-016-1658-9

United Nations. (2015). Transforming Our World: The 2030 Agenda for Sustainable Developement. https://doi.org/https://sustainabledevelopment.un.org/content/documents/2125203020Agenda20for20Sustainable20Development20web.pdf

United Nations Children's Fund. (2018). Early Childhood Development in the UNICEF Strategic Plan 2018-2021. Available: https://www.unicef.org/sites/default/files/2019-05/Early20Childhood20Development20in20the20UNICEF20Strategic20Plan202018-2021.pdf [Accessed:18.12.24]

United Nations Children's Fund. (2021). UNICEF conceptual framework on Maternal and Child Nutrition. Available: https://www.unicef.org/media/113291/file/UNICEF20Conceptual20Framework.pdf. [Accessed: 09.12.2023]

UNICEF. (2020). Update on the context and situation of children. Country Office Annual Report 2020.

Lesotho. Available: https://www.unicef.org/media/100361/file/Lesotho-2020-COAR.pdf [Accessed: 21.01.2025]

United Nations Children's Fund and the World Health Organization. UNICEF-WHO (2023) low birthweight estimates: Levels and trends 2000–2020. New York: UNICEF; https://iris.who.int/bitstream/handle/10665/370937/9789240077027eng.pdf?sequence=1&isAllowed=y [Accessed: 30.06.2024]

United Nations Children's Fund (UNICEF), World Health Organization (WHO), International Bank for Reconstruction and Development/The World Bank. (2023). Levels and trends in child malnutrition: UNICEF / WHO / World Bank Group Joint Child Malnutrition Estimates: Key findings of the 2023 edition. New York.

United Nations Lesotho. (2024). The Sustainable Development Goals in Lesotho. Available: https://lesotho.un.org/en/sdgs/3 [Accessed: 30.06.2024]

Vassilakou, T. (2021). Childhood malnutrition: *Time for action. In Children* (Vol. 8, Issue 2). MDPI. https://doi.org/10.3390/children8020103

World Bank. (2018). It's time to end malnutrition in South Asia. Available: https://blogs.worldbank.org/en/endpovertyinsouthasia/it-s-time-end-malnutrition-south-asia [Accessed:27.10.2025]

World Bank. (2020). Current Climate Lesotho. Climatology. Available: https://climateknowledgeportal.worldbank.org/country/lesotho/climate-data-historical#:~:text=Lesotho's20climate20is20generally20classified,due20to20the20higher20elevations [Accessed: 14.10.2023]

World Food Programme. (2016). The cost of hunger in Africa: The social and economic impact of child undernutrition on Lesotho vision 2020. Available: https://www.unicef.org/esa/sites/unicef.org.esa/files/2019-04/Cost-of-Hunger-in-Lesotho-28201829.pdf [Accessed: 10.09.2023]

World Health Organization. (2017). Report of the Commission on Ending Childhood Obesity. Implementation plan: executive summary. Licence: CC BY-NC-SA 3.0 IGO. Geneva.

World Health Organization. (2021). Levels and trends in child malnutrition: UNICEF/WHO/The World Bank Group joint child malnutrition estimates key findings of the 2021 edition. Washington DC.

World Health Organization. (2022). Annual Report Lesotho. Available: https://www.afro.who.int/countries/lesotho/publication/who-annual-report-2022 [Accessed:12.09.2023]

World Health Organization. (2024). Malnutrition. Available: https://www.who.int/news-room/factsheets/detail/malnutrition [Accessed: 14.10.23]

World Health Organization. (2024). Health Service Coverage. Available: https://www.who.int/data/gho/indicator-metadata-registry/imr-details/80 [Accessed: 24.09.24]

World Health Organization, & United Nations Children's Fund. (2023). Progress on household drinking water, sanitation and hygiene 2000-2022: special focus on gender. Available: https://washdata.org [Accessed: 05.11.24]

Zondi, M., G Mwambi, H., & Melesse, S. (2023). Spatio-temporal modelling of under-five mortality in Lesotho using demographic and health survey data. African Health Sciences, 23(3). https://doi.org/10.4314/ahs.v23i3.21

APPENDICES

Appendix A: Plagiarism Declaration



PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I Lintle Bernadina Potiane (Student number: 1052138) am a student registered for the degree of MSc.

In Epidemiology (Implementation Science) in the academic year 2024.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.
- I have included as an appendix a report from "Turnitin" (or other approved plagiarism detection) software indicating the level of plagiarism in my research document.

Signature:  Date: 27th February 2025

Appendix B: Plagiarism Report

Student: Lintle Potiane 

Supervisor: Professor Latifat Ibisomi:

Satisfactory



15/03/2025

1052138_Potiane_Research Report_ETNM_ Reviewed_Feb 2025_LI-1.docx

ORIGINALITY REPORT

5	2	1	5
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to University of Witwaters rand Student Paper	5 <1 <1
2	opus.lib.uts.edu.au Internet Source	
3	spccfpstor e1.blob.core.window s.net Internet Source	

Appendix C: Data Authorisation Letter



Sep 13, 2023

Lintle Potiane
University of the Witwatersrand South Africa Request
Date: 09/12/2023 Dear Lintle Potiane:
This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Correlates and prevalence of childhood malnutrition in Lesotho, 2009-2014":

Lesotho

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Also, be aware that re-distribution of any DHS micro-level data, either directly or within any tool/dashboard, is not permitted. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. However, if you have coresearchers registered in your account for this research paper, you are authorized to share the data with them. All data users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: references@dhsprogram.com.

Sincerely,

Bridgette Wellington

Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program

530 Gaither Road, Suite 500, Rockville, MD 20850 USA +1.301.407.6500 +1.301.407.6501 fax icf.com

Appendix D: Ethics Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Miss Lintle Potiane

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M240536 M240628-A-0005

NAME: (**Principal Investigator**)	Miss Lintle Potiane	**DEGREE:** MSc - Epidemiology
STUDENT NUMBER:	1052138	
DEPARTMENT:	School of Public Health Division of Epidemiology and Biostatistics	
TITLE:	Prevalence and correlates of childhood malnutrition in Lesotho, 2009-2014	
DATE CONSIDERED:	24-May-2024	
DECISION:	Approved unconditionally	
CONDITIONS:	N/A	
NOTE:	Application Number: MED24-04-492	
SUPERVISOR:	Prof Latifat Ibisomi	
APPROVED BY:	Prof P. Ruff, Chairperson, HREC (Medical)	
DATE OF APPROVAL:	28-Jun-2024	**EXPIRY DATE:** 27-Jun-2029

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATOR(S)

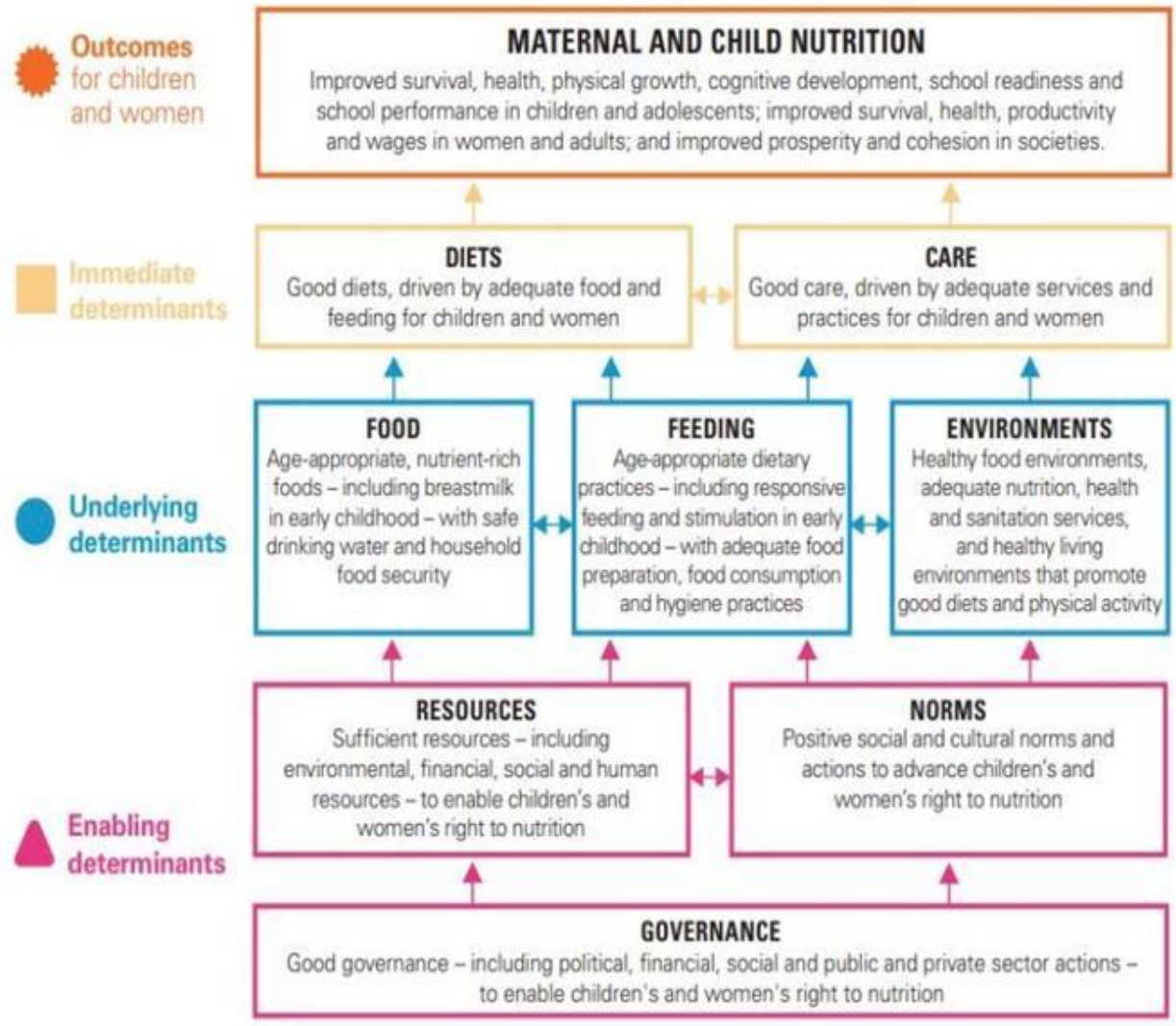
I/we fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report** in the month date of convened meeting each year until study is closed. Failure to submit annual report will result in ethics clearance certificate suspension. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. Unreported changes to the application may invalidate the clearance given by the HREC (Medical). Email a signed copy of ethics clearance certificate to HREC-Medical.ResearchOffice@wits.ac.za

Signature of Principal Investigator

Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix E: Maternal and Child Nutrition Conceptual Framework UNICEF, 2020



UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition, 2020.
A framework for the prevention of malnutrition in all its forms.

Appendix F: Search Strategy

Database/Sources	Keywords	timeframe
Pubmed	child malnutrition AND stunt* AND wast* AND underweight AND sub-Saharan Africa AND "child mortality"	2000-2024
	child malnutrition OR child undernutrition AND stunt* AND wast* AND underweight AND sub-Saharan Africa	2016-2024
Google Scholar	Child malnutrition, stunting, wasting, underweight, overweight, Lesotho	2016-2024
	Child malnutrition, stunting, wasting, underweight, Lesotho, "child mortality"	2016-2024
Science Direct	Child malnutrition, stunting, wasting, underweight, Lesotho, "child mortality",	2010-2024
Connected papers	child malnutrition AND stunt* AND wast* AND underweight AND sub-Saharan Africa AND "child mortality"	2010-2024
Peer-reviewed articles DHS report/website Organisation reports	child malnutrition AND stunt* AND wast* AND underweight AND sub-Saharan Africa AND "child mortality" Undernutrition AND Overnutrition AND worldwide OR global child malnutrition Undernutrition AND Overnutrition AND under five in Africa Overweight OR obesity AND child malnutrition	2000-2024