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Predictors of Stunting in Children Under 5 Years of Age in Zimbabwe

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Walden University
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Abstract

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MSc, University of Zimbabwe, 2001

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health

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Abstract

Stunting is the most common form of undernutrition globally and is a major public health concern. Child stunting has both short-term negative effects on children's health and long-term negative effects on adult health and human capital. Zimbabwe has a high prevalence of stunting, 27% in 2015. Although some of the factors associated with stunting are known, there is a gap on comprehensive evidence on the significant factors associated with persistent high levels of child stunting. The UNICEF conceptual framework for malnutrition was used to guide a cross-sectional study using the 2015 Zimbabwe Demographic and Health Survey data to identify and describe the risk factors that drive stunting in children under 5 years of age in Zimbabwe and to assess if there is any interplay between these risk factors and stunting. Analysis was done using binary and multiple logistical regression. Education, income, source of drinking water, sanitary facilities, child's age, sex, size at birth, diarrhea, acute respiratory infection, minimum acceptable diet, and immunization were found to be statistically associated with stunting. Using stepwise multiple logistical regression, education, income, size of household, child's age, sex, size at birth, diarrhea, acute respiratory infection, minimum acceptable diet, and immunization were found to be the most predicting factors to stunting. Child nutrition status can be improved by addressing significant predictors of stunting, which could lead to positive social change for communities and economies in Zimbabwe.

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Dedication

This research is dedicated to my mother, Manditeya Felistas Matema (1938–2018), for her unconditional love and encouragement. She was a strong woman who believed in the power of educated women. It is also dedicated to my children, Kudzai, William, Nyasha, and Simon, for their love, patience, and support throughout the doctoral study process and my grandchildren, Tiyani Anashe and Osemanake Zuva, who understood that grandmama would play with them later when school assignments were completed.

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I would like to acknowledge the favor and grace that God bestowed upon me throughout my study and the writing of this dissertation. He gave me strength to go on in the face of many challenges.

My gratitude also goes to my family, friends, and colleagues, who gave me unwavering support and encouragement throughout my studies. Your words of encouragement motivated me to keep going when I was struggling to balance the many balls I was juggling.

The desire for this journey started a long time ago, but it would not have begun when it did, had it not been for Karen Lamb, an author from the United Kingdom whose quote resonated with me: “A year from now, you will wish you had started today.” Thank you, Karen Lamb, for pushing me to finally enroll for my PhD.

My sincere gratitude goes to my committee members, Professor Raymond Panas, Dr. Tina D. Cunningham, and Dr. James Dockins (former chair), for their guidance and unwavering support and for helping to ensure that my study is of high quality. I also want to thank Dr. Simone Salandy for serving as my university research reviewer. My thanks go to Dr. Zin and Robert Ntozini for helping and guiding my statistical analysis.

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Chapter 1: Introduction to the Study

Introduction

Malnutrition is prevalent globally and is the underlying cause in many health conditions and mortality. Malnutrition includes both undernutrition (stunting and wasting), overweight (including obesity), and micronutrient deficiency. The people most at risk of malnutrition are young children, adolescent girls, pregnant and lactating women, older people, people who are ill or immune compromised, and poor people (Development Initiative, 2018). Many developing countries bear this triple burden of malnutrition, affecting children, adolescents, and women of childbearing age. According to the 2018 Global Nutrition Report, 150.8 million children are stunted, 50.5 million children are wasted, 38.3 million are obese, and 20 million children are born with low birth weight (Development Initiatives, 2018). In addition, 33% of the women of reproductive age suffer from anemia and 15.4% are underweight. According to the World Health Organization (WHO, 2019), a double burden of malnutrition, which is characterized by coexistence of undernutrition and overweight, obesity or diet related non-communicable disease can occur at individual, household, community, and national level.

Stunting is the most common form of undernutrition globally and is a major public health concern (Prendergast & Humphrey, 2014). Studies have shown that the burden of stunting is higher in low- and middle-income countries, with a higher prevalence in the poorest of the population (Demirchyan et al., 2016). Globally, 37% of stunted children live in Africa (United Nations Children’s Fund [UNICEF] et al., 2016).

Stunting prevalence in the African region is estimated to have decreased from 38% in the year 2000 to 32% in 2015; however, the number of stunted children increased by 16% (UNICEF et al., 2016). Stunting is when children have a height for age Z score that is more than two standard deviations below the population median (HAZ > –2 SD) (Prendergast & Humphrey, 2014). The most important pathways for stunting are inadequate nutrition intake and infection or inflammation (Demirchyan et al., 2016; Harper et al., 2018; UNICEF, 2017). Bourke et al. (2016) noted that children with undernutrition such as stunting die of common infections or their immunity is impaired, which makes them vulnerable to common infections. This supports Rytter et al. (2014) who identified a confounding relationship between undernutrition and infection; undernutrition increases susceptibility to infection while infections worsen undernutrition through reduction of appetite and/or increased demands for nutrients. The authors also noted that the immune function is an important link between undernutrition, infection, and death (Rytter et al., 2014).

Approximately 6.3 million children under age 5 died in 2015 (UNICEF et al., 2016) and undernutrition is linked to almost half of all child deaths (UNICEF, 2019). Child stunting has both short- and long-term negative effects, such as exposure to infection and death; poor cognitive development and academic performance with later effects on economic productivity (Woldehanna et al., 2017); reproductive health issues; and increased risk of nutrition-related chronic diseases such as diabetes mellitus (McGovern et al., 2017). Reviewing evidence linking child stunting to economic growth, McGovern et al. (2017) reported that stunting was associated with reduced height in adulthood, which was linked to lower social status, occupational status, wages, and other standards of living indices. Apart from the impact at the individual level, stunting has been found to have an impact on the economic growth of a country, as low- and middle-income countries lose as much as 12% of gross domestic product annually. This loss occurs through the increase in morbidity, mortality, and health expenditure and reductions in human and physical capital investments and labor supply.

Through its conceptual framework, UNICEF (1990) identified that malnutrition including stunting occurs because of interlinked factors at three levels: (a) immediate causes, (b) underlying causes, and (c) basic causes. The immediate causes of malnutrition include inadequate food intake and the child’s health status. These causes are influenced by underlying causes, which in turn are influenced by basic causes of malnutrition (UNICEF, 2013). The underlying causes include inadequate or poor care and feeding practices and living in an unhealthy environment, and the basic causes include structural and political processes that influence distribution of the country’s financial or societal resources (Reinhardt & Fanzo, 2014).

Zimbabwe has a high prevalence of stunting, though it has reduced marginally from 31% in1988 to 27% in 2015, and remains higher than any other type of malnutrition (Zimbabwe National Statistics Agency [ZIMSTAT] & Inner-City Fund [ICF] International, 2016). Zimbabwe is among the 25 countries in Africa with stunting prevalence between 20% and 30% (WHO Regional Office for Africa, 2017). Although the prevalence of stunting has somewhat decreased in Zimbabwe, it remains higher than the internationally accepted threshold of less than 10% (Frempong & Annim, 2017).

Literature has provided evidence and a framework for understanding the determinants for stunting; however, there is limited understanding of the most significant predictors that drive the levels of stunting in Zimbabwe. I used data from the Zimbabwe Demographic and Health Survey (ZDHS) of 2015 to identify these predictors, and the results may inform policy and planning of interventions. Stunting must be addressed early, during a period where nutrition interventions can have the greatest impact and reduce the long-term negative effects on adult health and human capital (Woodruff, 2017).

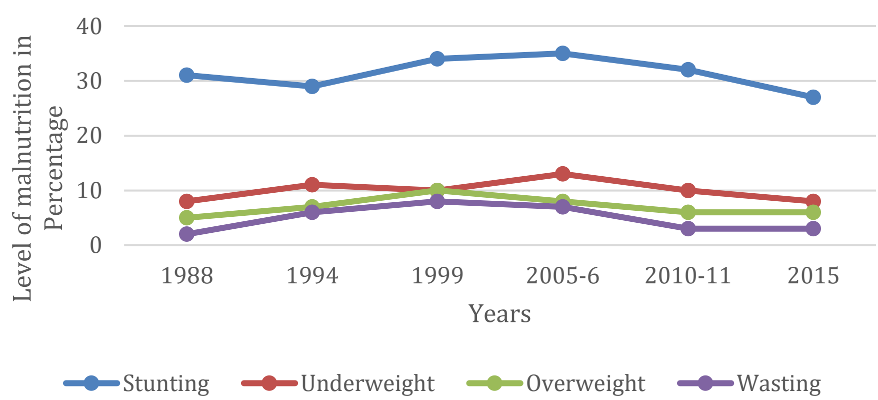
Problem Statement

Childhood stunting is one of the most challenging public health concerns with significant implications to human development (WHO, 2014). There is strong evidence that stunting is associated with increased illness and deaths, impaired cognitive and psychomotor development (Walker et al., 2015; Woldehanna et al., 2017), poor performance at school (Silva et al., 2018), reduced work and reproductive capacity (El Kishawi et al., 2017), intrafamily generational poverty and economic development of countries (de Onis & Branca, 2016). Mohseni et al. (2019), posited that undernutrition is the underlying cause for about 50% of deaths among children under 5, and the deaths are higher in low- and middle-income countries. In 2015, about 24% of children under 5 years old had stunted growth globally, with 37% being in Eastern Africa; 27% of Zimbabwe's children were stunted (UNICEF et al., 2016).

The Ministry of Health and Child Care (MOHCC, 2014) in Zimbabwe has identified malnutrition as one of the most serious health problems affecting infants, children, and women of reproductive age. Among children under 5 years of age, Zimbabwe has a high child mortality rate of 75 deaths per 1,000 live births, which is largely driven by malnutrition, HIV and AIDS, tuberculosis, and malaria (ZIMSTAT, 2015). The government, through the MOHCC, has been implementing high impact interventions such as nutrition care, education and support, maternal and child micronutrient supplementation, use of insecticide-treated mosquito nets, and family planning to reduce the malnutrition burden; however, the burden of childhood stunting remains high at 27% as shown in Figure 1.

Figure 1

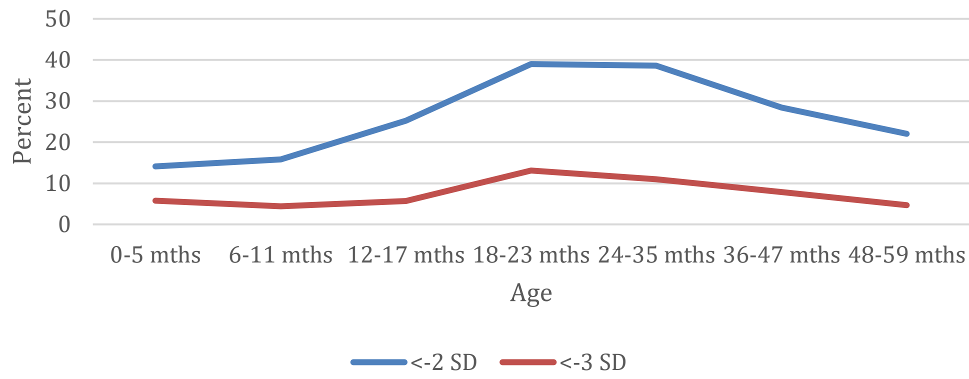
Trends of Malnutrition in Children Under 5 Years Age in Zimbabwe, 1988–2015



While the proportion of children with stunting is highest between the ages of 18 months and 35 months (Figure 2), about 15% of the children aged 0–5 months are stunted, with 5.8% being severely stunted (ZIMSTAT, 2015). This may indicate long-term maternal undernutrition, as stunted mothers are more likely to have malnourished infants (MOHCC, 2014). Stunting in children 0–5 months old has also been linked to intrauterine growth failure (Martorell & Woodruff 2017).

Figure 2

Trend of Stunting by Age



Malnutrition (including stunting) is caused by inadequate maternal and child intake of safe and nutritious food and poor health status of a child (Gough et al., 2016). Researchers have identified factors at individual, family, community, and national levels associated with stunting; optimal growth and development in early childhood is determined by a complex interplay of child (Beal et al., 2018), maternal (Beal et al., 2018; Rabbi & Karmaker, 2014; Ramos et al., 2015), environmental (Noris et al., 2014; Rabbi & Karmaker, 2014), and socioeconomic factors (Mazengia & Biks, 2018; Noris et al., 2014; Rabbi & Karmaker, 2014; Ramos et al., 2015) that influence nutritional intake. While there is increasing knowledge of the patterns of stunting in Zimbabwe, there is a gap on establishing the predictors of stunting in the Zimbabwean context. Previous studies on stunting of children in Zimbabwe, which have been fragmented and limited in geographical scope, have implicated maternal education and height (Makoka & Masibo, 2015; Gough et al., 2016; De Neve & Subramanian, 2017); infant characteristics such as sex, birth weight, and length (Gough et al., 2016); HIV status (Prendergast et al., 2018); chronic inflammation (Prendergast et al., 2014); and unhygienic environment

(Prendergast et al., 2018) to be associated with stunting. There is, however, no robust understanding of the predictors of childhood stunting, nor have the most significant predictors that drive the high stunting levels among the children in Zimbabwe been identified.

Purpose of the Study

The purpose of this quantitative study was to identify and describe the risk factors that drive stunting in children under 5 years of age in Zimbabwe and to identify the most significant factors that drive stunting. Stunting is associated with poor outcomes in life both immediate and long term (Beal et al., 2018). Children who are stunted have a higher risk of contracting common infections and dying or of poor physical and neurodevelopment, as well as being vulnerable to noncommunicable diseases, low productivity, and lower wage-earning capacity in adult life (Groce et al., 2014; Keunen et al., 2015). Although the prevalence of stunting in Zimbabwe decreased marginally to 27% in 2015, from the 1988 level of 31%, this rate is still high, and the country may not achieve the global transformative goal of sustainable development goal two (SDG2) of 40% reduction of child stunting (ZIMSTAT & ICF, 2016).

Therefore, identifying the risk factors, particularly the most significant factors, is important to characterize the problem of stunting and determine why the prevalence remains high in Zimbabwe. Once the risk factors are identified and understood, these can be used by public health practitioners to develop context-specific interventions for prevention and mitigation. At present, the most significant risk factors and their impact are not documented. Documenting these risk factors will serve evidence-based policy advocacy and adequate strategy formulation for the acceleration of reduction of child stunting in Zimbabwe (Cairney & Oliver, 2017; Mzumara et al., 2018; Pollack Potter et al., 2018).

The identification of the sociodemographic and environmental, child characteristics, and childcare practice risk factors associated with stunting can fill the current gap in understanding the key predictors of childhood stunting. None of the previous studies in Zimbabwe have documented the most significant predictors of stunting that predispose children to a high risk of stunting and drive the high stunting rate among children in Zimbabwe. Evidence from other countries identified strong associations between some risk factors and stunting (Beal et al., 2018; Mazengia & Biks, 2018; Rabbi & Karmaker, 2014; Ramos et al., 2015). The results of this research should help inform the design and implementation of programs aimed at addressing the predictors and drivers of stunting in children under 5 years of age in Zimbabwe.

Using secondary data, a quantitative cross-section survey approach was used to identify the sociodemographic, environmental, child characteristics, and childcare practice risk factors to stunting. Statistical relationships were described and explained and the strong predictors that continue to drive stunting in Zimbabwe were characterized. Data from the Zimbabwe Demographic and Health Survey (2015) were analyzed for this study.

Research Questions and Hypotheses

RQ1: Is there an association between sociodemographic factors (mother's age, marital status, level of education, employment status, income, and area of residence) and stunting in children under age 5?

$H_0$1: There is no association between sociodemographic factors (mother's age, marital status, level of education, employment status, income, and area of residence) and stunting in children under age 5.

H_a1: There is an association between sociodemographic factors (mother's age, marital status, level of education, employment status, income, and area of residence) and stunting in children under age 5.

RQ2: Is there an association between environmental factors (source of drinking water, sanitary facilities, hand washing, and household size) and stunting in children under age 5?

$H_0$2: There is no association between environmental factors (source of drinking water, sanitary facilities, hand washing, and household size) and stunting in children under age 5.

H_a2: There is an association between environmental factors (source of drinking water, sanitary facilities, hand washing, and household size) and stunting in children under age 5.

RQ3: Is there an association between child characteristics (age, sex, size at birth, and health status [diarrhea, acute respiratory infection, and fever]) and stunting in children under age 5?

$H_0$3: There is no association between child characteristics (age, sex, size at birth, preceding birth interval, and health status [diarrhea, acute respiratory infection, and fever]) and stunting in children under age 5.

H_a3: There is an association between child characteristics (age, sex, size at birth, preceding birth interval, and health status [diarrhea, acute respiratory infection, and fever]) and stunting in children under age 5.

RQ4: Is there an association between childcare practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization) and stunting in children under age 5?

$H_0$4: There is no association between childcare practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization) and stunting in children under age 5.

H_a4: There is an association between childcare practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization) and stunting in children under age 5.

RQ5: Are there any significant factors that drive the levels of stunting in children under age 5, controlling for sociodemographic factors, environmental factors, child characteristics, and childcare practices?

$H_0$5: There are no significant factors that drive the levels of stunting in children under age 5, controlling for sociodemographic factors, environmental factors, child characteristics, and childcare practices.

H_a5: There are significant factors that drive the levels of stunting in children under age 5, controlling for sociodemographic factors, environmental factors, child characteristics, and childcare practices.

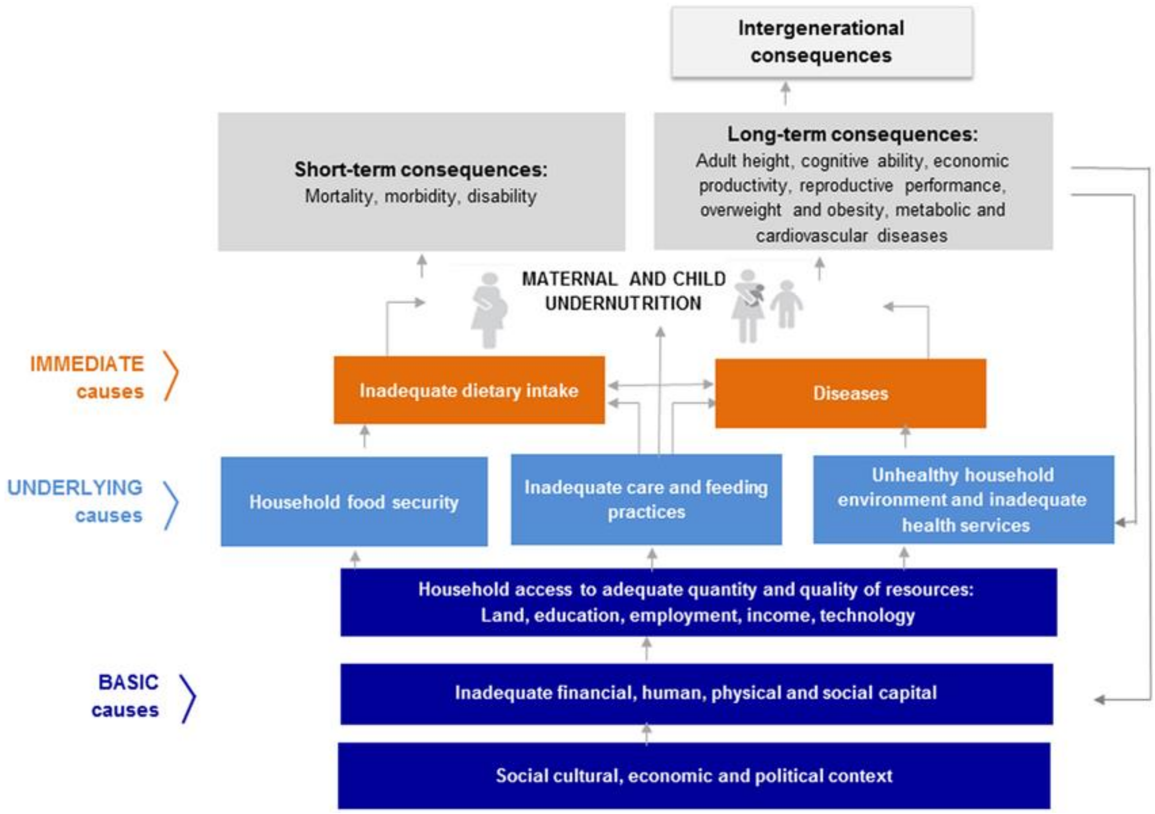
Conceptual Framework for the Study

This quantitative study was guided by the UNICEF conceptual framework for malnutrition in the assessment of the predictors of stunting in children under 5 years of age in Zimbabwe. The framework is based on the understanding that the causes of malnutrition, including stunting, are on three levels: (a) immediate, (b) underlying, and (c) basic. The framework (Figure 3) shows that the causes are multisectoral, multifaceted and interlinked, with one level influencing the other levels (UNICEF, 1990, 2013). The UNICEF conceptual framework was developed as part of the strategy to respond to the high levels of malnutrition in developing countries (UNICEF, 1990, 2013). The framework's three causal levels—immediate, underlying, and basic—interact with each other. The basic causes reflect the social, cultural, economic, and political dimensions or context that cause malnutrition, while the underlying causes focus on household or family issues such as household food security, inadequate care, and feeding practices, unhealthy household environment, and inadequate health services; the immediate causes are the impact of basic and underlying causes at the individual level, manifesting through inadequate food intake and poor health status (Reinhardt & Fanzo, 2014).

The framework identifies basic health services and a healthy environment, and household food security as essential in ensuring adequate health and nutrition status of children under 5 years of age. However, the framework emphasizes the equal importance of a system that guarantees that resources such as food and health services are adequately used for children under 5 years of age.

Figure 3

UNICEF Conceptual Framework for Malnutrition



Source: UNICEF (2013). *Improving child nutrition: The achievable imperative for global progress*, p. 4.

The conceptual framework was modified in 2013 to emphasize policies and programs that support interventions before the age of 2 years and to show how the results of undernutrition feedback to the underlying and basic causes and thereby perpetuate a vicious cycle of undernutrition, poverty, and inequities (UNICEF, 2013). Silveira et al. (2015) found the conceptual framework useful in organizing possible causes of undernutrition and identifying situations where further investigations were needed. This framework was chosen for its relevance in predicting the factors associated with stunting and its ability to identify the drivers of stunting in Zimbabwe, which has remained consistently high over the years.

Nature of the Study

The nature of this study was a quantitative, cross-sectional using secondary data collected from the 2015 ZDHS. The ZDHS was implemented by ZIMSTAT with technical support from ICF International. This study targeted children under the age of 5 to identify the determinants of stunting. The study outcome factor was stunting in children under the age of 5. Other study factors were grouped into four categories: (a) sociodemographic (mother's age, marital status, level of education, employment status, income, and area of residence); (b) environmental (source of drinking water, sanitary facilities, hand washing, and household size); (c) child characteristics (age, sex, size at birth, and health status [diarrhea, acute respiratory infections, fever]); and (d) child care practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization).

Access to these data was through the Demographic Health Survey (DHS) archives. I was granted authorization to download the ZDHS 2015 data on the variables needed to answer the research questions. The DHS collects demographic, socioeconomic, and other data such as household characteristics (which include environmental factors), child characteristics, and nutritional status of children. The data were used in the current study to estimate the prevalence, establish correlations, and calculate odds ratios to quantify the risk of stunting. Stepwise logistical regression analysis was conducted to identify the most significant predictors of stunting. The quantitative cross-sectional study allowed various statistical tests to be conducted to establish frequencies and relationships that facilitated the description of the predictive factors of stunting and to identify those factors that are particularly driving the high stunting rates in Zimbabwe (Burkholder et al., 2016; Salazar et al., 2015; Warner, 2013).

Definitions

Child characteristics: Used in this study to denote a child's age, sex, size at birth, and health status. Health status included having diarrhea, acute respiratory infection, and fever in the 2 weeks preceding the ZDHS 2015.

Childcare practices: A broad term that encompasses initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization.

Environmental factors: Used in this study to encompass source of drinking water, sanitary facilities, hand washing, and size of household.

Sociodemographic factors: A broad term used in this study to include a mother's age, marital status, level of education, employment status, income, and area of residence.

Stunting: When children experience poor linear growth presented as a height for age Z score which is less than –2 standard deviations (HAZ > –2 SD) from the WHO child growth standard median (Beal et al., 2017).

Assumptions

Five assumptions were made in this study. The first assumption was that the participants the data were collected from were honest and truthful in their responses to the questions asked. The second assumption was that responses from the participants were recorded accurately and timely by the interviewers. Third, I assumed the data were collected according to standard ethical guidelines for conducting research with human participants and remained deidentified and stored securely. The fourth assumption was that data entry was done correctly without any errors, followed the codebook, and was stored in a database any researcher can access and interpret. The last assumption was that the data contained the variables of interest to enable the assessment of the research questions in this study.

Scope and Delimitations

In this study, I sought to identify the predictors of stunting in children under the age of 5 years and identify the most significant predictors that drive stunting based on secondary data obtained from a nationally representative sample. The data were collected as part of the five yearly ZDHSs, which inform the country of progress and changes in demographic and health indicators. The 2015 ZDHS is the sixth such survey to be conducted in Zimbabwe and collected demographic and health information with specific topics including nutrition. I analyzed data on stunting collected but not specifically analyzed to identify the predictors of stunting. The results will inform program design and policy development to address stunting and bring about better outcomes for children. The assessment of the most significant predictors of stunting was important as it could bring out an understanding of why stunting was persistently high. While the 2015 ZDHS was collected to look at many different indicators, the data were delimited to focus on health and nutrition data for children under 5 years of age and socioeconomic characteristics of women of childbearing age who are their mothers. According to ZIMSTAT and ICF (2016), the sample yielded information that was representative of the whole country; therefore, the findings of this study would be generalizable to all children under 5 years of age in Zimbabwe. Data collected during demographic and health surveys are reliable, validated, and accurately reflect the population being studied; hence, the data can be readily used for analysis (DHS Program, n.d.).

Limitations

This study was based on a cross-sectional study design, which by its nature cannot determine causal relationship between the exposure and outcome variables under study (Solem, 2015). In addition, the data collected during the ZDHS survey were not meant to address the research questions in this study or to test any particular hypothesis (Cheng & Phillips, 2014). The main objective of the data was to provide policy makers, planners, researchers, and program managers with current demographic and health information. Nonetheless, the objective of this study was to determine associations between the variables that could be considered as significant predictors, and not to establish the cause and effect between the variables. In addition, the age of the data was a limitation. A more recent national nutrition survey was conducted in 2018; however, it was difficult to obtain the database. During data analysis, RQ5 was modified to assess the most significant predictors rather than interaction due to the complexity of interpreting the interaction models.

Significance of the Study

Child malnutrition, especially stunting, impacts child survival, psychomotor and cognitive development, and individual and household wealth, including the economic development of a country. Child stunting in Zimbabwe remains high and without a significant reduction, the country is unlikely to meet the global target of SDG2 by 2030. There has been huge investments and strategies developed to fight child malnutrition and reduce stunting levels (MOHCC, 2014), but the results have been minimal. This study assessed the predictors of stunting and identified the most significant factors that continue to drive stunting in children. Previous studies in the country have been fragmented and have focused on individual districts and cities and indicated the factors associated with malnutrition and stunting such as maternal age (Makoka & Masibo, 2015); maternal stature (Gough et al., 2016); inadequate dietary intake; low socioeconomic status; and water, sanitation, and hygiene issues (Mushonga et al, 2014). In addition, no study has been conducted to determine which are the most significant predictors of stunting that drive the stunting levels in children under 5 years in Zimbabwe.

Given the fragmented nature of studies on the risk factors of stunting, there was a need to identify factors that drive the persistently high prevalence of stunting nationally; an understanding of the most significant factors associated with high levels of stunting is needed if the problem of stunting is to be adequately addressed. Such an understanding could lead to the design and development of targeted interventions to reduce stunting in

Zimbabwe and other countries in sub-Saharan Africa. Stunting is an indicator of children's well-being and a good reflection of social inequities, and the results of this study on child health could bring about positive social change. There is evidence that reducing stunting is critical for development (de Onis & Branca, 2016; Sheekar et al., 2017), and as a developing country, Zimbabwe needs to understand what drives stunting and make efforts to address those drivers.

Social Change

The consequences of stunting have effects at the individual, family, community, and country levels and are chronic and irreversible, especially at an individual level. This study offers opportunities for social change by identifying the most significant predictors of stunting and offering recommendations that call for appropriate interventions to reduce stunting.

Reducing stunting would increase children's height and improve their psychomotor and cognitive development, which in turn would positively impact their academic performance and future earnings. In reducing stunting, the country would achieve better demographic dividend as more children would survive (Shekar et al., 2016); they would be more educated and earning higher income (Alderman et al., 2017), thus reducing poverty and aiding economic growth (McGovern et al., 2017). WHO (2018) posited that reducing stunting positively impacts women's education, and educated mothers can seek information on health and nutrition and use it to prevent stunting in their children. They would also be more productive economically, which will in turn improve household food security because they would be able to buy more nutritious foods for their families. Woldehanna et al. (2017) asserted that household wealth and parental education play an important role in children's nutritional status; therefore, results from this study could be used to advocate for policies that improve household livelihoods and improve the health and nutritional status of children, which in turn would have an impact on the cognitive development, academic performance, future earnings, and economic development of the country. In addition, there is evidence that it is possible to recover from early stunting, and this study may influence interventions that promote catch-up growth over the first few years of life and improve children's physical and intellectual development (Desmond & Casale, 2017; Geordiadis & Penny, 2017). The impact of stunting is intergenerational, which is costly to the country's social and economic development (Walker et al., 2015).

Summary and Transition

Stunting exposes children to poor health and academic outcomes as well as some long-lasting negative health, social, and economic outcomes as adults (Mosites et al., 2017; Woldehanna et al., 2017). Stunted children have a higher mortality risk and are prone to chronic diseases as adults; they do not do well academically and are low wage earners with inadequate funds to buy nutritious foods. This creates a cycle as stunted women have increased risk of poor perinatal outcomes for their children (Black et al., 2013), including the children being stunted as well. Although the global prevalence of stunting remains high, it has been decreasing, including in sub-Saharan Africa (Development Initiatives, 2018). Zimbabwe has seen the prevalence rate of stunting decrease, albeit minimally; nonetheless, it remains higher than the internationally accepted rate of 10%. Despite huge investments in the nutrition program in Zimbabwe, the prevalence rate of stunting remains high. Understanding the factors that sustain the high rate of stunting is important to helping target appropriate interventions.

In this chapter, I provided an overview of the problem of stunting and the nature, purpose, and significance of the study. Furthermore, I indicated the specific research questions for the study and the hypotheses that were tested. The research questions focused on assessing if there were any relationships between socioeconomic, environmental, and child characteristics and childcare practices and stunting in children under 5 years of age. I also described the conceptual framework that was used to guide the study and concluded with the potential contributions of the study to social change. Chapter 2 includes an in-depth review of literature related to stunting and the conceptual framework being used.

Chapter 2: Literature Review

Introduction

Childhood stunting is a major global public health concern and one of the most significant obstacles to human development (WHO, 2014). Zimbabwe has high stunting rates, and in this study, I aimed to identify the predictors of stunting and the most significant of these predictors. The nutritional status of children is an important outcome measure of children's health (Fadare et al., 2019) and a sensitive indicator of a country's economic and health status, especially in developing countries (Mohsena et al., 2017; Rodriguez-Llanes et al., 2016). The burden of malnutrition is unacceptably high and the progress to reduce the burden is low; children under 5 are vulnerable to the triple burden of malnutrition, as 150.8 million are stunted, 50.5 million are wasted, and 38.3 million are overweight (Development Initiatives, 2018). Undernutrition includes stunting, wasting, underweight, and micronutrient deficiency, and results from taking insufficient food or specific types of food compared to the body's needs (WHO Regional Office for Africa, 2017). Undernutrition is the underlying cause of mortality in children under the age of 5 associated with at least 45% of child deaths (Prendergast & Humphrey, 2014). Child stunting is associated with reduced survival and impaired neurodevelopment affecting academic achievement and intellectual capacity (Humphrey et al., 2019, Mosites et al., 2017; Woldehanna et al., 2017).

This section of the study is a review of current literature on predictors of stunting and whether there are any significant predictors that drive stunting levels. The review includes a summary of the problem in the global, regional, and Zimbabwean context; the purpose of the study; its significance, and relevance. In the literature review, I examined what is understood about stunting and the associated consequences in childhood development. I explored literature on the key variables—sociodemographic and environmental factors, child characteristics, and childcare practices—and how these variables have been understood to impact stunting. A literature review on the conceptual framework highlighted the key constructs of the UNICEF conceptual framework for malnutrition and how the framework should guide the study.

Literature Search Strategy

The purpose of the literature search was to present what is known on stunting and the predictors of stunting in children under the age of 5. The literature search includes a summary of the issues and concepts surrounding stunting of children under the age of 5. The literature search was guided by the purpose of the study, the research questions, the research design, and the conceptual framework. I visited different databases in the Walden University Library during the literature search: CINAHL and MEDLINE Combined Search, CINAHL Plus with Full Text, MEDLINE with Full Text, Science Direct, Emerald Insight, Sage journals, Google Scholar, and Google. I reviewed articles of interest accessed through Google or Google Scholar to check if they were open access or a free full article. Lists of related articles that came up when searching for articles in Google or Google Scholar were reviewed, and any relevant article from the list of related articles was downloaded. If the articles were not open access or unavailable, the authors and titles were noted and used to search for the articles in the Walden University Library.

Gray literature was reviewed, and this included governmental and other agencies’ reports, country program strategies, and policy documents, technical papers, and other forms of nonacademic documentation including websites (Enticott et al., 2018; Farrah, & Mierzwinskin-Urban, 2019). ProQuest was visited to search for dissertations from other students related to my topic. Websites of specialized agencies, such as the WHO and UNICEF, and other organizations such as the Centers for Disease Control and Prevention were visited. Gray literature makes an important contribution to a literature review as it provides data not found in peer reviewed sources or indexed in bibliographic databases (Enticott et al., 2018; Paez, 2017); the quality of the gray literature was assessed using Adams et al.'s (2017) guidelines and Tyndall's authority, accuracy, coverage, objectivity, date, and significance (AACODS) checklist (University of Western Australia, 2019).

The search terms used in the literature search were *predictors of stunting in children under five, stunting, malnutrition, undernutrition, UNICEF conceptual framework for malnutrition, maternal factors, parental factors, environmental factors, socioeconomic factors,* and *effects of stunting and Zimbabwe.* These terms were searched individually as well as in various combinations. Most of the articles reviewed were published within 5 years and a number were older than 5 years. The older articles were mostly on the origin and development of the conceptual framework and policy documents from the MOHCC.

Literature Review

Prevalence of Stunting

The Global Nutrition Report for 2018 acknowledged that while steps are being made to address malnutrition, the burden remains high and progress remains slow

(Development Initiatives, 2018). The report highlighted the multiple challenges faced by children under 5 years of age: 150.8 million are stunted, 50.5 million are wasted, 38.3 million are overweight, and 20 million babies are born with low birth weight every year (Development Initiatives, 2018).

Globally, Asia and Africa bear the greatest share of stunting with 55% of the world's stunted children in Asia and 39% in Africa (UNICEF et al., 2018). Beal et al., (2017) reported that the prevalence of stunting is as high as 37% in Indonesia and is attributed to poor socioeconomic status, preterm birth and short birth length, lack of exclusive breastfeeding, and low maternal height and education. Poor environmental factors were also identified as contributory factors. Other factors associated with stunting at a global level include prenatal factors, poor environments, and intragenerational effects (de Onis & Branca, 2016). While Oceania and some countries in the Americas also have a high prevalence of stunting like Asia and Africa, the population is negligible.

In Africa, the proportion of children with stunting is decreasing, from 38.3% to 30.3%, but the actual number of children who are stunted has increased from 50.6 million to 58.7 million; the majority of these children are in Eastern Africa (UNICEF et al., 2018). This confirms the findings of Akombi et al. (2017) in their meta-analysis of demographic and health surveys of sub-Saharan Africa in which East Africa had the highest prevalence rate of stunting at 39%, West Africa 31.8%, Southern Africa 30.6%, and Central Africa at 28.8%.

In Zimbabwe, the rate of children who are stunted has been fluctuating over the years, but with marginal changes. The prevalence of stunting has gradually declined from

31% in 1988 to 27% in 2015, though there was a peak of 35% in 2005–2006, and the highest proportion of children stunted (39%) is among the 24 months-35 months age group and the lowest (13%) is among the 6 months-8 months age group (ZIMSTAT & ICF, 2016). Matabeleland South and Manicaland provinces have the highest rates of stunting (31% and 30%, respectively), while Bulawayo has the lowest at 19% (ZIMSTAT & ICF, 2016).

Few studies on stunting in Zimbabwe have been conducted to understand the factors that predict stunting. In a study to assess the relationship of maternal education and child undernutrition in Malawi, Tanzania, and Zimbabwe, Makoka and Masibo (2015) indicated that the level of maternal education matters in stunting. In another study, a clinical trial in Harare, researchers indicated that stunting was influenced by maternal height and education, infant sex, birth weight, and birth length (Gough et al., 2016). Mbuya and Humphrey (2016) noted the effects of enteric dysfunction due to poor environmental hygiene on children and how it leads to stunting in Zimbabwe. There have been a few studies on the prevalence and factors associated with stunting, but these have been limited in geographic scope and none have reported on the most significant predictors of stunting. In this study, I explored the factors associated with stunting nationally and identified the most significant factors that drive stunting levels in Zimbabwe.

Factors Associated With Stunting in Children Under 5 Years of Age

There are multiple factors related to stunting in children under 5 years of age. These factors are found at individual, household, and societal levels. Some of the factors are related to the environment where children live and their access to health services. Others are related to how resources and access to good nutrition are allocated.

Sociodemographic Factors

Factors, such as mother's age, marital status, education, employment status, income, and area of residence, have been grouped under the broad term of *sociodemographic factors*. These have been widely documented to be associated with stunting in children under 5 years of age.

Mother's Age. The age of the mother matters as it impacts child health outcomes (Chari et al., 2017). Having children at an early age impacts the mother's education because they leave school early, and this affects decision-making processes regarding child health (Chari et al., 2017). Fall et al. (2015) reported that younger mothers might breastfeed for a shorter period and may fail to attend to their child's nutrition and health needs due to their immaturity and low education. Fall et al. (2015) noted that children born to mothers of a younger age and advanced age were at high risk of stunting. Saloojee and Coovadia (2015) also reported similar findings and concluded that both young age and advanced age were hazardous for the child. Other studies in support of these findings include Ramos et al. (2015), Kim et al. (2017), and Efevbera et al. (2017), who noted that mother's age was an important factor in a child's well-being. A young mother's physiological immaturity and her own body's needs for nutrients affect the growth of the fetus, laying the ground for childhood stunting. Both younger and older age are associated with low birthweight and preterm births, and both are associated with childhood stunting.

Marital Status. Ribar (2015) posited that marriage between parents enhances child well-being and development. The author noted that children belonging to parents who are married benefit from a stable environment that fosters physical, cognitive, and emotional well-being (Ribar, 2015). Lord et al. (2014) pointed out that family environment and parenting are important contributions to child health. Adenini et al. (2014) found that, in some cases, married women had limited authority and freedom of movement to seek health care for their children. The authors also noted that children from divorced or widowed mothers were at a higher risk of poor health outcomes, including stunting (Adenini et al., 2014). Ntoimo and Odimegwu (2014) suggested that single motherhood was a risk factor for children's nutritional status. In addition, Rahman (2015) found that unintended pregnancy (mistimed or unwanted) was associated with childhood stunting. The quality of childcare is influenced by a mother's attitude toward the child, and unwanted children could be exposed to neglect and suboptimal care leading to stunting (Rahman, 2015). In Zimbabwe, about 32% of the women experience unintended pregnancies (ZIMSTAT/ICF, 2015), and according to Izugbara (2015), unmarried adolescents are at high risk of unintended pregnancy.

Level of Education. Education has been linked with contributions to human capital through the development of a range of skills and attributes that influence the relation between education and health (Zimmerman et al., 2015). Maternal education has been found to have stronger nutritional impact on children than paternal education (Alderman & Heady, 2017; Vollmer et al., 2017) as educated mothers are more likely to be understand health messages, make decisions, and commit to behavioral changes regarding appropriate health care practices such as breastfeeding, child nutrition, and immunization (Alderman & Heady, 2017; Habibi et al., 2018). In addition, keeping girls longer in school delays the age at marriage and first birth and empowers women to make decisions on family planning, dietary diversity, better methods of feeding, and access to health services, all which contribute to the nutritional status of their children (Alderman & Heady, 2019; Bbaale, 2014;). Pal et al. (2017) posited that maternal education is related to greater productivity, better methods of feeding, and increased awareness of personal hygiene, preventive, and curative health services.

Maternal education empowers mothers to make informed, independent decisions on childcare, and gives them increased chances of employment and income, which improves the family's social status influencing child nutrition. According to Lartey (2015), both the level and duration of maternal education matter; both are associated with stunting. Governments, therefore, should have policies that keep girls in school longer. Most studies have reported on the positive influence of maternal education, but Mesfin et al. (2015) reported that children of educated mothers were more likely to be stunted. This could be due to mothers lacking time to supervise their children's care and nutrition, as they would be engaged in employment or other income-generating activities.

Employment Status. Most women in Zimbabwe and other developing countries have multiple roles. Women are the primary caregivers to their children but are also engaged in income-generating activities either in the informal or formal labor markets. There seems to be controversy as to whether maternal employment is associated with stunting or not. While in developed countries maternal employment is associated with obesity, there are mixed results in developing countries (Burroway, 2017). In developed countries, maternal employment means increased availability of food, including food that is less healthy. On the other hand, in developing countries, maternal employment could mean increased access to nutritious food, thus contributing to good childhood nutrition, or mothers could work long hours, sometimes in physically exhausting jobs, leading to insufficient time and energy to prepare nutritious food and care for children, leading to malnutrition including stunting (Burroway, 2017; Diiro et al., 2017; Garti et al., 2018). Pal et al. (2017) noted that children of working mothers are more likely to be undernourished, supporting the finding by Mesfin et al. (2017).

Working mothers may have no time to prepare nutritious food or supervise their children’s feeding, and substitute care givers might not be readily available in the rural areas or might be too expensive in urban areas, which could force mothers to use young relatives or older siblings who might not provide adequate, quality care (Diiro et al., 2017). Burroway (2017) argued that the type of employment matters, as mothers working in the agricultural sector are significantly associated with stunting in children compared to mothers in professional or other jobs. Women in the agricultural sector may work fewer hours, resulting in low wages and poor household food security (Garti et al., 2018), or they may work longer hours, which reduces their time to adequately care for their children (Komatsu et al., 2018). However, Diiro et al. (2017) noted that children from poor households benefit nutritionally from maternal employment despite the deprivation of quality care and time from the mother.

Income. Corsi et al. (2015) identified households with the lowest wealth quintile as significant factor for stunting in children under 5. Likewise, Pal et al. (2017) identified poverty as a significant risk factor for stunting in children under 5 years of age. Fink et al. (2017) conducted a comparative analysis of national surveys and concluded that absolute income was more sensitive in predicting stunting than wealth quantiles. Van der Meulen Rodgers and Kassens (2018) demonstrated that improving maternal income generating capacities was positively and significantly associated with height for age Z scores. Controlling their own income allowed mothers buy food and services that improved their children's nutritional status.

Area of Residence. The health disparities that exist between rural and urban areas have been documented by various authors (Chen et al., 2017; Liu et al., 2015; Spencer et al., 2018; Widyaningsih, & Khohjah, 2018). Ervin and Bubak (2019) posited that the disparities in stunting that exist between children living in rural and urban areas are driven by the gaps in income, education, and access to water supply. Akseer et al. (2018) reported that stunting was very high in the rural provinces where female illiteracy, and poverty were very high, and access to water and sanitation was very low. In China, stunting is more in the rural areas, but it is made worse by the system put in place to control rural urban migration, making rural communities unable to access better health services in the urban areas (Liu et al., 2015).

Environmental Factors

Water, Sanitation, and Hygiene. Research has proven that nutritional interventions alone are not adequate in reducing stunting (Schmidt, 2014), and need to be integrated with water, sanitation, and hygiene interventions (Aguayo & Menon, 2016). Women often walk long distances to access water and often, the water is unsafe and contaminated (Winkler, 2014). In their review of water, sanitation, and hygiene interventions, Cumming and Caincross (2016) concluded that poor water, sanitation, and hygiene (WASH) negatively affected child growth due to prolonged exposure to enteric pathogens. Time spent fetching water reduces time that can be spent on caring for the children or on activities to generate livelihoods (Geere & Cortobus, 2017) and this has negative impact on the socioeconomic status of women, and the health and nutrition status of children (Cumming & Caincross, 2016; Geere & Cortobus, 2017). Cumming and Caincross (2016) posited that both the quantity and quality of water are important in reducing stunting. Dwivedi et al. 2018 reported high stunting rates among children in communities that practiced open defecation and had poor hygiene practices. On the other hand, Ngure et al. (2014) indicated that the association between improved water supply and sanitation and better growth outcomes has been reported in several studies. The researchers also reported that the synergistic effect of water and sanitation on child growth is affected by the hygienic conditions in which the child grows (Ngure t al., 2014).

Size of Household. Mulugeta et al. (2017) reported that family size was one of the important determinants of stunting, as children born in a family with six children or more were likely to be stunted. Rana and Goli (2017) indicted that children of birth order four and above were of greater risk of stunting than children of a lower birth order. In Zimbabwe, the maximum number of children in most families is four except in a religious sect that does not practice family planning where there would be more than four children in a family.

Child Characteristics. Research has proven that the first 1,000 days of life are a critical period that have impact on a child's health for life (Martorell, 2018). Good nutrition and care during these days influences the child's survival and growth. According to Naik and Smith (2015), having too closely spaced pregnancies and too many children increased the chance of preterm and small for gestational age babies being born. It has been noted that characteristics such as age, sex and health status are significant predictors of stunting in children under the age of 5. Woodruff et al. (2018) noted that the risk of stunting increases with age. Other studies have shown that children aged between 24 months and 59 months have a higher risk of being stunted than the younger age groups (Ntenda & Chuang, 2018; Sarma et al., 2017; Woodruff et al., 2018). While Abeway et al. (2018) and Gebersalassie et al. (2018) found that more girls were stunted than boys, most studies indicate that boys are more at risk of being stunted than girls (Alemayehu et al., 2015; Akram et al., 2018).

The size at birth matters as Ntendo and Chuang (2016) reported that the risk of stunting was higher in children with small birth size compared with children born larger than the average size. Woodruff et al. (2018) reported that birth size was significantly associated with stunting. Another child characteristic that was implicated in childhood stunting was the health status of the child. There is a reciprocal relationship between the health status of the child and stunting, poor health status due to infections leads to stunting and stunting leads to impaired immunity which makes the children vulnerable to infections. Infections such as diarrhea, acute respiratory infections and malaria have been found to be associated with stunting in children under the age of 5 (Akram et al., 2018; Batiro et al., 2017; Gari et al., 2018; Sinha et al., 2018) as there is a vicious cycle of infection, impaired nutrition (due to illness) and lowered immunity. The children expend energy which should be used for growth in fighting recurrent infections.

Childcare Practices. Childcare practices are very important in early childhood development. According to Martorell (2017), the first 1,000 days influence whether the child will survive, thrive, and grow, and have long term impact on adult health and human capital. Exclusive breastfeeding during the first 6 months of life and provision of nutritious complementary foods as the baby grows in a safe environment contribute to the well-being of the child. Initiation of breastfeeding within 1 hour of delivery and breastfeeding exclusively for 6 months promotes optimal child growth and development as the colostrum is rich in nutrients that are protective. It has been found that delay in initiating breastfeeding within 1 hour of birth increases the risk of stunting in children, while those who are breastfed within 1 hour of birth and exclusively for 6 months are at low risk of stunting (Alemayehu et al., 2015). In Zimbabwe, while most children (98%) are breastfed at some point in their lifetime, less than 50% are exclusively breastfed and the median duration for exclusive breastfeeding is only 2.3 months instead of the recommended 6 months (ZIMSTAT & ICF International, 2016). It was estimated that exclusive breastfeeding prevented about 1.2 million child deaths globally, and children who continued breast feeding until 24 months while getting nutritious complementary food were at low risk of ill health and death (UNICEF, 2015). In their study in Nigeria, Akombi et al. (2017) concluded that prolonged breastfeeding contributed to stunting, however, Cetthakrikul et al. (2018) argued that it was the interaction of breastfeeding duration and the wealth status of the household that was a determinant of stunting. Prolonged breastfeeding became the only option in a poor household which could not afford adequate and appropriate complementary food for their children.

Children are eased into eating family meals through complementary feeding. WHO (2019) recommended that complementary feeding should be timely, adequate, safe, and appropriate if it was going to be beneficial to the child. Some studies have shown that children under the age of 5 are not adequately breastfed nor receiving adequate and appropriate complementary feeding (Ersino et al., 2016; Tadele et al., 2016). The quality of the complementary foods given to children have an impact on their health status, the diet must be diversified within the seven food items recommended by WHO (Frempong & Annim, 2017). Frempong and Annim (2017) reported that 25% of the children who ate at least four of recommended food items were stunted. The immunization program in Zimbabwe is quite robust, providing vaccines that prevent diarrhea, pneumonia, and measles, some of the conditions that are associated with malnutrition. Pratim (2019) found full immunization to be protective against stunting, and Shukla et al. (2018) reported that incomplete immunization was a risk factor to stunting.

Application of the UNICEF Conceptual Framework for Malnutrition

UNICEF conceptual framework for malnutrition provides for an understanding of factors that are associated with undernutrition. UNICEF (1990) developed the conceptual framework to facilitate the assessment and understanding of the causes of malnutrition. While malnutrition occurs at individual level, the causes are multifaceted with an interplay between factors at household, community, national and international levels. UNICEF (1990) identified that the immediate causes of undernutrition, including stunting were inadequate food intake and disease, with disease affecting food intake and utilization of nutrients and inadequate food intake making the body more susceptible to disease. The inadequate dietary intake and disease are due to a combination of factors such as inadequate household food, inadequate clean water, and sanitation as well as low utilization of health services. The framework indicates that the underlying causes are interrelated and mostly results from lack or insufficient fulfilment of children and women's basic needs. These underlying causes are grouped into three major groups: lack of basic health services and a healthy environment; inadequate household food security and poor maternal and childcare. The basic causes themselves can be traced to inequities that exist in society which are influenced by the socio-political and ideological context as well as the economic structures, cultural and religious systems. In this study, the basic causes which include education, employment, and income; underlying causes such as inadequate care and feeding practices, and household environment and health care and for the immediate causes, dietary intake which include breastfeeding and complementary feeding, and diseases such as diarrhea, acute respiratory infections and malaria will be examined.

Engle et al. (1996) reviewed the UNICEF conceptual framework and found it useful in evaluating the capacity and ability of the care practices, the resources for care, health services and the environment. The authors unpacked the care component in the UNICEF conceptual framework to define the resources needed by the caregiver to enable caring for the child as well as how the child's characteristics affected the care received. Eagle et al. (1996) noted that ability of the caregiver to render the needed care depended on the availability of resources for care at household level and the support provided at community, regional, national, and international level. The resources for care included educational status, the health and nutritional status, and mental health status of the mother or caregiver, whether they had autonomy over household resources, workload, and other constraints, and the social support received by the mother or caregiver.

Ruel (2008) modified the UNICEF (1990) conceptual framework of malnutrition to illustrate where targeted nutrition interventions would be effective. Short and long routes for improving child nutrition were identified. The short routes target the immediate causes of malnutrition, achieving impact early and the long routes focus on the underlying and basic causes of malnutrition and their impact is delayed as the interventions are not direct (Ruel, 2008).

In Afghanistan, the UNICEF conceptual framework was adapted and applied to guide the assessment on how the food and nutrition situation was viewed at different administrative levels in the health, agriculture, and other sectors and whether there was a common understanding on the definition of the problem, the underlying causes, and solutions (Levitt et al., 2009). The results showed the need for collaboration between the agriculture and health sectors at all levels as well as inclusion of community views in policy development. Basing on the UNICEF conceptual framework, Menon et al. (2011)

developed an assessment framework with three domains of epidemiologic, operational, and sociopolitical to enable development of appropriate nutrition strategies that are grounded in the three domains. This framework recognized the interlinkages between the domains and how the sociopolitical domain influenced how nutrition problems and the solutions were framed and perceived at every level.

Menon (2012) used the UNICEF conceptual framework to identify the drivers of undernutrition in South Asia. The author identified low coverage of exclusive breastfeeding, age-appropriate complementary feeding, micro-nutrient supplementation, and hygiene practices as the most important immediate causes, whereas gender, household poverty and access to services where the critical underlying causes. Silveira et al. (2015) used the UNICEF conceptual framework to examine the associations between socioeconomic, biological factors, and postnatal infant weight gain. The framework was used to select the exposure variables. Children's area of residence and regions represented the basic causes as these variables showed socioeconomic differences, while some household (e.g., assets and food security) and human capital outcome (e.g., maternal education, age, number of ANC visits etc.) represented the underlying causes and child factors such as illness, hospitalization due to diarrhea and pneumonia, and duration of exclusive breastfeeding represented the immediate causes. The results of this study indicated that poverty and lower human capital were associated with poor weight gain. The UNICEF conceptual framework has been used to identify causes of undernutrition, adapted to highlight components of the framework, expanded to add interventions, and guiding policy dialogue (Menon, 2012). Black et al. (2013) adapted the

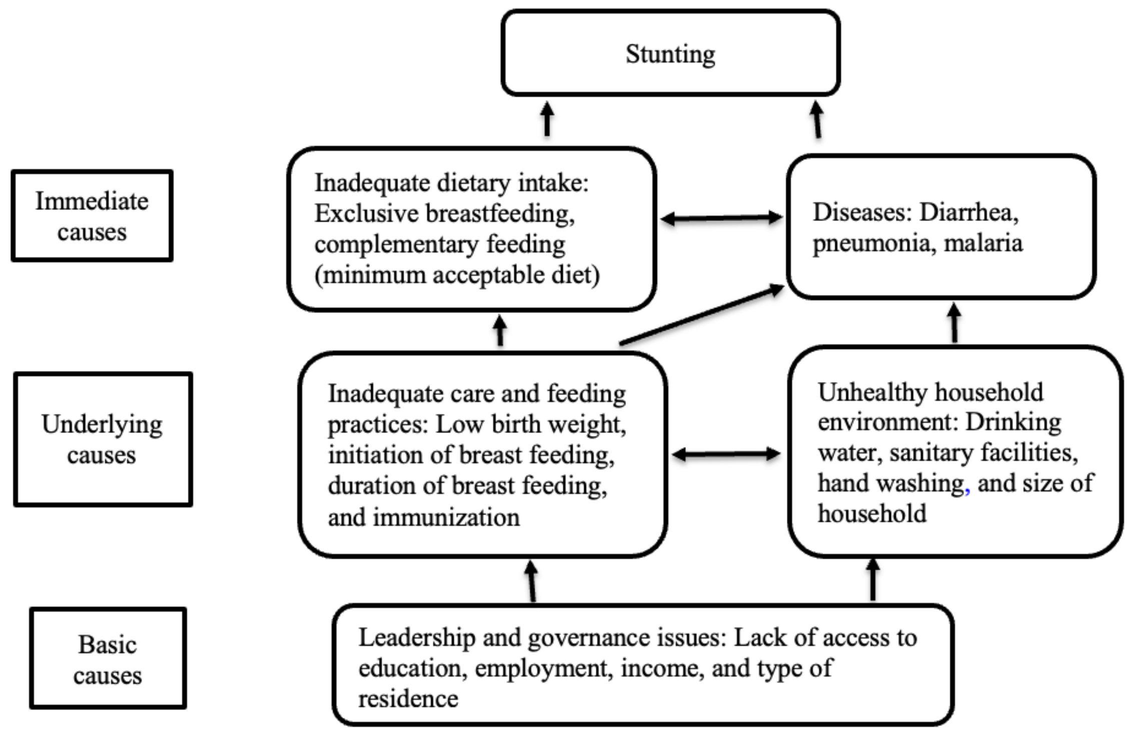
UNICEF conceptual framework to show the dietary, behavioral and health determinants of optimum nutrition, growth, and development and how these are affected by the underlying and basic causes of malnutrition. This framework showed the pathway to optimum fetal and child growth rather than the determinants of undernutrition.

Later in 2013, UNICEF adapted its own conceptual framework to put more emphasis on policies and programs on maternal nutrition and health, and appropriate infant and young child feeding, and care practices (UNICEF, 2013). This was brought about by the evidence that faltering growth which leads to stunting begins during pregnancy and continues up to 2 years of age. The new conceptual framework also indicated that there were intergenerational consequences of undernutrition including stunting and showed the reciprocal nature of the relationship of results of undernutrition and the underlying and basic causes, thereby perpetuating the vicious cycle of undernutrition, poverty, and inequities.

In this study, the conceptual framework (Figure 4), adapted from the UNICEF conceptual framework for malnutrition (2013) was used to identify the immediate and underlying and basic causes of stunting in children aged under 5 years of age in Zimbabwe and any significant factors that might be driving the rate of stunting in Zimbabwe.

Figure 4

Conceptual Framework



Adapted from the UNICEF conceptual framework on malnutrition (2013).

Summary and Transition

The literature review synthesized the available information on the problem of stunting worldwide and exposed the limited research on the risk factors associated with stunting in Zimbabwe at country level and whether there are any significant factors among them that drive the problem of stunting. As shown in chapter 1, there has been very slow decrease in stunting over a period of almost 30 years. Most work on stunting in sub-Saharan Africa has been done in other countries such as Ethiopia, Uganda, Nigeria, Kenya, among others. Substantial research on stunting has also been conducted in Asian countries such as Bangladesh and India. The studies have identified factors at basic, underlying, and immediate levels to be associated with stunting. Factors such as the age (Saloojee & Coovadia, 2015), education level (Makoka, & Masibo, 2015), income and employment status of the mother (Burroway, 2017), the sex (Gough et al., 2016), and health status of the child (Mbuya & Humphrey, 2016) have been identified as some of the factors associated with stunting in children under the age of 5.

The literature available shows several studies conducted in Zimbabwe were either limited in geographical scope such as a district or town and as such could not be generalized or focused on specific issues such as effects of water, sanitation and hygiene on stunting or the country as part of global research study. That being the case, the sample size of these studies was relatively small, and this also limited their generalizability. Nevertheless, literature review has noted that predictors of stunting included sociodemographic features such as maternal age, educational level, employment status and income; environmental factors such as access to water and sanitation, hand washing and size of household; child characteristics such as age, gender, and health status as well as childcare practices as being associated with childhood stunting.

There is general agreement globally on the need to stop or reduce childhood stunting and recommendations have been made to address the burden of stunting. Some of the recommendations are nutrition specific interventions such as infant and young child feeding including exclusive breastfeeding, and complementary feeding, adolescent, and maternal nutrition interventions (Higgins-Steele et al., 2016). In addition, nutrition sensitive interventions such as food and nutrition surveillance, improving water and sanitation, and community nutrition education and promotion programs are equally important.

There is need to understand stunting in Zimbabwe, especially identifying the most significant among these factors that influence the stunting rate to remain persistently high. The literature review confirmed the relevance of the study as well as the need to close this gap in literature. The predictors of stunting in children under the age of 5 years in Zimbabwe were assessed guided by the UNICEF conceptual framework on malnutrition and the most significant among these predictors was identified. Secondary data from the 2015 Zimbabwe Demographic and Health Survey was used. The following Chapter 3 details the methodological approach that was used in answering the research questions for this study.

Chapter 3: Research Methods

Introduction

The purpose of this study was to identify and describe the risk factors that drive stunting in children under 5 years of age in Zimbabwe and identify the most significant between these risk factors, leading to the persistent high levels of stunting in the country. Stunting has serious health, developmental, and economic consequences that are both short and long term. Short-term health consequences include increased morbidity and mortality; developmental consequences include low cognitive, motor, and language development; and economic consequences include increased opportunity costs for care of the sick child and increased health expenditures. Long-term health outcomes include short adult stature, increased risk of obesity and associated chronic diseases, and reproductive health problems such as infertility. The developmental outcomes are low school performance and low learning capacity, leading to unachieved potential. All these lead to economic consequences, such as low work capacity and productivity, as adults who are stunted tend to have low-paying jobs (WHO, 2014), and the economic growth of the country is subdued (The World Bank, 2018).

In Zimbabwe, 31% of total deaths are attributed to noncommunicable diseases, such as diabetes, which are associated with stunting (MOHCC, 2016). While the burden of stunting is known, there has not been a comprehensive study to identify the predictors of stunting in Zimbabwe and to determine which are the most significant predictors that drive the level of stunting to remain high. Determining the risk factors for stunting and identifying the most significant factors that lead to the magnitude of the problem will provide ample evidence to public health practitioners, which could guide in development of appropriate interventions and as advocacy to policy makers to allocate adequate resources for the interventions to be implemented. Documenting the predictors of stunting, particularly the most significant predictors, will give evidence that can be used to inform policy and practice by public health practitioners. In this chapter, I provide description and justification of the research design, the study population, sampling and sampling procedure, and the methodology used in testing the hypotheses to answer the research questions. The data analysis plan and ethical issues related to the study are also described.

Research Designs and Rationale

This was a quantitative study using a cross-sectional research design. I used secondary data from the ZDHS of 2015 to identify the association between stunting among young children and determinants, which included socioeconomic factors, environmental factors, child characteristics, and childcare practices.

Cross-Sectional Study Design

The cross-sectional research method is used to examine the relationship between a disease or health-related characteristic (such as stunting) and other variables of interest that exist in the population at one point in time (Aschengrau & Seage III, 2014). Cross-sectional studies are good for studying large samples and allow for generalization from the study sample to broader groups beyond the sample. Such studies can also be replicated to other samples under similar conditions (McCusker & Gunaydin, 2015). According to Omair (2015), cross-sectional studies are easy to conduct, have a low cost, and are the most used by researchers. The cross-sectional study design was chosen as the data were already available, making it effective in terms of time and money. I used this design to determine the presence of an outcome (such as stunting) and the risk factors (such as socioeconomic and environmental factors, child characteristics, and childcare practices) at the same time. Using the cross-sectional study design did not, however, show causality but only relationships among the variables (Omair, 2015).

The cross-sectional study design was considered appropriate for this study because the intention was not to establish causality but to identify associations among the variables. The design allowed simultaneous comparison of several variables and calculations of odds ratios to further understand the association between the variables (Setia, 2016). Comparing many different variables simultaneously with a framework was advantageous as it allowed me to establish the net effect of a variable on the outcome variable after controlling for the other confounders. Both descriptive and inferential statistical methods were employed to analyze the malnutrition indicator and its determinants using data from children under 5 years of age covered during the 2015 ZDHS.

Data Source

The data were obtained from the ZDHS, which is part of the DHS program. The DHS program, in conjunction with relevant agencies in various developing countries, collects accurate, reliable, and nationally representative data for a wide range of monitoring and impact evaluation indicators on population, health, and nutrition (DHS, n.d.). DHS adopts standard procedures, methodologies, and manuals to guide the survey processes and to ensure the data collected are true reflections of the situations they intend to describe and are comparable across time and location. The standard DHS considered in this study is conducted at 5-year intervals in all the countries involved. Apart from the standard survey, DHS also conducts other types of surveys, such as the Malaria Indicator Survey, which provides information on malaria prevalence and prevention practices, as well as information about the characteristics of health facilities and services available in a country, among others.

In Zimbabwe, the 2015 ZDHS was the sixth in the series of the standard surveys conducted in the country. The previous surveys were conducted 1988, 1994, 1999, 2005–2006, and 2010–2011. The 2015 survey was implemented by ZIMSTAT with several other national and international agencies while ICF International provided the necessary technical assistance for the success of the survey through DHS. The main goal of the 2015 survey was to provide current estimates of basic demographic and health indicators. The survey collected information on a several demographic and health indicators, such as marriage, fertility levels, mortality, sexual and reproductive health, breastfeeding practices, nutritional status, maternal and child health, knowledge and behavior toward HIV/AIDS and other sexually transmitted diseases, smoking, cancer, and male circumcision. Information were also collected from all respondents on the socioeconomic and environmental characteristics and women empowerment using three sets of questionnaires: the household, women's, and men's questionnaires. In addition, the ZDHS 2015 also included anthropometry measurements for children ages 0–59 months, women ages 15–49 years, and men ages 15–54 years; anemia for all children ages 6–59 months, women ages 15–49 years, and men ages 15–54, who voluntarily agreed to testing; and HIV for women ages 0–49 years and men ages 0–54 years.

The DHS program provides unrestricted survey data files for legitimate academic research after completing a formal online registration which serves as a request; data are made available via public access. The data are stored and can be downloaded, when access is given, in various formats such as SPSS, SAS, and Stata along with the Recode Manual and the questionnaires used for data collection. For this study, permission was obtained to use the 2015 ZDHS, and the data set was downloaded in the SPSS data format for women ages 15–49 years, household, and children together with the questionnaires and the recode manual. The data were deidentified, and the data sets contained the variables of interest in this study.

Study Variables

The study dependent variable is stunting, which was measured as dichotomous and coded Yes = 1 and No = 2. The independent variables were grouped into four categories of: (a) sociodemographic factors (age, marital status, educational attainment, employment status, income, and area of residence); (b) environmental factors (availability of water, sanitary facilities, hand washing, and size of household); (c) child characteristics (age, sex, size at birth, and health status); and (d) childcare practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization).

Methodology

Population

According to Aschengrau and Seage (2014), study populations in cross-sectional studies are selected without regard to exposure or disease status. Thus, all children (6,352) under 5 years of age who had their height measured and their mothers, irrespective of their socioeconomic, educational, or nationality background, living in any part of Zimbabwe during the period July to December 2015 when the ZDHS was conducted constitute the study population, as they were all eligible to partake in the survey.

Sampling and Sampling Procedures

The 2015 ZDHS was a nationally representative survey that relied on the 2012 Zimbabwe population census for the sampling frame. Administratively, Zimbabwe is divided into 10 provinces—namely, Manicaland, Mashonaland Central, Mashonaland East, Mashonaland West, Matabeleland North, Matabeleland South, Midlands, Masvingo, Harare, and Bulawayo. Each province is divided into districts, and each district is divided into wards. The wards are further divided into smaller convenient areas, which were designated census enumeration areas (EAs) during the 2012 population census. The ZDHS uses a stratified, two-stage cluster design to select the sample, with EAs forming the first stage of the sampling. In all, 400 EAs comprising 166 in urban areas and 234 in rural areas were selected. The second stage listed and mapped all the households in the EAs, from which a total of 11,196 noninstitutional households were selected. All women ages 15–49 years and men ages 15–54 years in these households who were either permanent residents or who spent the night before the survey in the household were eligible for the interview. Also, information on all children below the age of 5 years living in the households was collected. There were four questionnaires administered during the ZDHS 2015; the household questionnaire collected information on all people (members and visitors) in the household as well as identifying women ages 15–49 years for the women's questionnaire and men ages 15–54 years for the men's questionnaire and the biomarker questionnaire for anthropometry, anemia, and HIV testing. Children 0–14 years for HIV testing, 0–59 months for anthropometry, and 6–59 months for anemia testing were identified through the household questionnaire. This study enrolled all children who had their anthropometric measurements taken and women who had children under the age of 5 years. Table 1 is the data extraction template I used to create a database specific to my study. Table 1 presents the data regarding the variables of interest that were required to answer the research questions and where they were found and coded in the ZDHS data sets.

Table 1

Data Extraction Template

Variable name	ZDHS code
Sociodemographic factors	
Mother's age	V013
Marital status	V501
Education	V106
Employment status	V717
Income	V190
Area of residence	V025
Environmental factors	
Source of drinking water	V113
Sanitary facilities	V116
Hand washing	V462
Household size	V136
Child characteristics	
Child's age	B19
Sex	B4
Size at birth	M18
Diarrhea episodes	H11
Acute respiratory episodes	H31
Fever	H22
Height/age parameter	V439 – V441
Childcare practices	
Initiation of breastfeeding	V426
Exclusive breastfeeding	V409 – V413, M55
Continued breastfeeding	M4
Complementary feeding	V414
Immunization	H2 – H9

Procedures for Recruitment, Participation, and Data Collection

To ensure the credibility of the survey, technical teams were drawn from ZIMSTAT, MOHCC, the Medical Research Council of Zimbabwe, and the Zimbabwe National Family Planning Council, among others, and trainings of the different categories of the field workers were conducted at various dates prior to the survey period. Instructions on interviewing techniques and field procedures, a detailed review of the questionnaire content, and mock interviews between participants were included in the training. An ICF biomarker specialist trained the technical team on taking anthropometric measurements, collecting finger-prick blood samples for hemoglobin measurement and HIV testing, and proper storage of the dried blood spot specimens for HIV testing. The team supervisors' training included measures for data quality control. Data collection for the survey took place within a period of 6 months, July 6 to December 20, 2015.

Pretesting of DHS Questionnaire

The four questionnaires used for the 2015 ZDHS were programmed into computer tablets in three languages—Shona, Ndebele, and English—to facilitate computer-assisted personal interviewing for data collection. Pretesting of questionnaires and taking anthropometric measurements and collection of finger prick blood for hemoglobin measurement and HIV testing was done by trained field staff, and the questionnaires were modified based on the lessons learned from the pretesting. The pretesting was conducted in 150 households outside the ZDHS 2015 sample enumeration areas.

Data Collection and Response Rate

Data were collected from July 6, 2015, to December 20, 2015, by 15 teams, comprised of a supervisor, four interviewers, and three biomarker interviewers, using the tablet computers. All data from interviewers were transferred to the supervisor's tablet computer at the end of each day. Of the 11,196 households selected for the sample, 10,657 were occupied and 10,534 were successfully interviewed, giving a response rate of 99%. In the interviewed households, 10,351 women ages 15–49 years were eligible to be interviewed but only 9,937 were interviewed, thus yielding a response rate of 96%.

Operationalization of Variables

As previously indicated, the ZDHS 2015 data sets contain the independent and dependent variables of interest for this study.

Dependent Variable

The dependent variable for this study was whether a child under the age of 5 years was stunted or not. Stunting is a measure of the nutritional status of children that is calculated from the height and age data collected from the children. Stunting is expressed using growth standards published by WHO in 2006. The growth standards were generated through data collected in the WHO Multicentre Growth Reference Study (WHO Multicentre Growth Reference Study Group, 2006). Stunting, like wasting and undernutrition, is expressed as in standard deviation unit from the median of the Multicentre Growth Reference Study expressed in Z-score. Children whose height-for-age z-score is below minus two standard deviations (–2 SD) of the median of the reference population are short for their age and, thus, stunted or chronically malnourished. Children who are below minus three standard deviations (–3 SD) are said to be severely stunted. This information was extracted from the records of the anthropometric measurements for children 0–59 months in the data set. This variable was therefore a binary response variable indicating whether a child was stunted or not and denoted 1 if yes and 0 if otherwise.

Independent Variables and Covariates

The study had four categories of independent variables and their covariates; (a) sociodemographic factors of the mother comprising age, marital status, educational attainment, employment status, income and area of residence as covariates; (b) environmental and household characteristics factors comprising source of household drinking water, availability of sanitary facilities in household, hand washing, and size of household as covariates; (c) child characteristics includes age, sex, size at birth, and health status as covariates; and (d) childcare practices with covariates comprising of initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization. In the following sections, detailed descriptions of the listed variables were provided including how each one was categorized for inclusion in the study.

Sociodemographic Factors

Age

In the 2015 ZDHS, the women respondents answered questions about their month, year of birth and age at last birthday. The age in this study was taken from the completed years at the time of interview. The age variable was categorized into 5-year age groups for descriptive purposes (Andrade, 2017) and comparison among the age groups (Incera & McLennan, 2018). The groups were thus: 15-19, 20-24, 25-29, 30-34, 35-39, 40-44 and 45-49 years. Knowing the age of the participant was important as there is evidence that both young and older age is associated with adverse child outcomes (Fall et al, 2015).

Marital Status

Marital status was taken from the respondents’ answers to the question regarding their current marital status. The possible responses were never married, married (married and living together) and formerly married (divorced, widowed, separated, and no longer living together); and these were used in this study to categorize marital status. It was essential to ascertain the marital status of the participants as there is evidence that suggest that marriage enhances child wellbeing than any other living arrangements. Single mothers divide their time between investing time in their child's wellbeing and time spent earning a living (Ribar, 2015).

Education

Education was determined by considering the respondents' answers regarding the highest level of education attained. Several studies have linked education of the mother to child wellbeing as levels of education has been found to influence access and use of health services (Imai et al., 2014). Children whose mothers are better educated seem to have better nutritional outcomes (Nepal, 2018). In this study, the education levels were categorized as no education, primary, secondary, and higher.

Employment

Employment was based on the participant's response regarding their current employment status (whether employed or not). There is evidence that mother's employment can either be beneficial or detrimental to child's health outcomes (Garti et al., 2018). This depends on whether the income obtained contributes to household food expenses or whether the time spent away from the baby is detrimental to the child's nutrition status (Habibi et al., 2018). The results would be interesting to understand how employment affected child nutrition in Zimbabwe.

Income

Income was measured based on the calculated wealth index, which was categorized into five categories of poorest, poor, middle, richer, and richest. It was important to measure income as there is evidence that income influences child nutrition and access to health services. In Zimbabwe, the transportation fare to health facilities and user fees deter access to health services. It has been noted that income concentrated in the hands of mothers' results in higher spending on children's health and nutrition compared to income concentrated in the hands of fathers (van der Meulen Rodgers & Kassens, 2018).

Area of Residence

Residence was categorized into urban and rural in this study. Rural areas in Zimbabwe have disproportionate access to health service. This is either due to the non-existence of the services (hard to reach areas) or due to the transport cost and poor road network. ZIMSTAT & ICF International (2015) reported that children residing in rural areas are more at risk of stunting than children residing in urban areas.

Environmental Factors

Availability of Water

Availability of water was determined by the participants responses regarding the main source of their water supply. This was categorized as improved water source and unimproved water source. Improved water source included protected dug well, tube well/borehole, public tap/standpipe and piped into dwelling. Unimproved water source was an unprotected well/spring, or water bodies such as rivers. Water from unprotected sources predispose children to diarrheal diseases as the water could be contaminated. According to the Centers for Disease Control and Prevention (2019), diarrheal diseases are among the top ten causes of mortality in Zimbabwe.

Sanitary Facilities

Sanitary facilities were determined based on the participants responses on the type of toilet facilities they used. This variable was categorized into no facility, unimproved facility, and improved facility. Participants who responded no facility were thus practicing open defecation which is associated with many health risks. Improved facilities are non-shared facilities that prevents contact with human waste and thus reduces the risk of diarrheal diseases.

Hand Washing

Hand washing was determined through analysis of data on the participants responses to questions on hand washing. Poor hygiene can lead to microbial ingestions which can result in environmental enteropathy which is a risk factor that affects early childhood development. The environmental enteropathy may result in poor nutrient absorption leading to stunting in children (Ngure et al., 2014). This variable was categorized as soap and water, other cleansing agent and water, water only, soap or other cleansing agent but no water and no water, soap or other cleansing agent, and no facility.

Size of Household

This was determined by participants responses regarding the number of household members. The variable was categorized into three groups, ≤ 3 (small), 4–6 (medium), and ≥ 7 (large). There is evidence that children in large families are at risk of stunting

(Geberselassie et al., 2018). This study ascertained whether this variable was associated with stunting in children in the Zimbabwean context.

Child Characteristics

Age

Age of the child was determined through the participants responses regarding the age of their children reported in months. Age was categorized into six age groups for descriptive and comparison purposes (Andrade, 2017; Incera & McLennan, 2018). The width of the age groups was 12 months except for the first year of life which had a width of 6 months. Thus, the categories were under 6 months (>6), 6–11 months, 12–23 months, 24–35 months, 36–47 months, and 48–59 months. Studies have shown that the 24 – 35 months age group is at higher risk of stunting than the lower age groups (Mzumara et al., 2018).

Sex

Sex of the child was determined by analyzing the participants responses regarding the sex of the child. The variable is naturally categorized into two groups: boy and girl. There is conflicting evidence on which sex is more at risk of stunting than the other. Most studies indicate that boys are more at risk of stunting than girls (Bork & Diallo, 2016; Ntenda & Chiung, 2016) while others indicate that girls are more at risk of stunting than boys (Pillai & Ortiz-Rodriguez, 2015; Geberselassie et al., 2018).

Size at Birth

This was determined from the participants responses regarding the size of the child at birth. The variable was categorized into five size groups for comparison. The categories were very large, larger than average, average, smaller than average and very small. Akram et al. (2018) reported higher risk of stunting in small children.

Health Status of Child

This was analyzed from the responses of the participants regarding any illness two weeks prior the survey. Three variables were considered namely diarrhea, acute respiratory infection, and fever. Each of the variable was dichotomized into whether the child suffered from the illness in the two weeks before the survey or not. It has been reported that diarrhea and acute respiratory infections are associated with stunting (Akram et al., 2018).

Child Care Practices

Initiation of Breastfeeding

Initiation of breastfeeding was determined by analyzing the participants responses regarding the timing of putting the child to the breast for the first time after birth. In this study, the variable was grouped into three categories based on the timing of initiation of breastfeeding. The categories were immediately, within one hour and more than one hour. There is evidence to show that children who were not initiated early to breastfeeding have high risk of getting stunted (Permadi et al., 2017).

Exclusive Breastfeeding

Exclusive breastfeeding was determined by analyzing the participants responses regarding whether they are currently breastfeeding or whether they gave other foods before six months. This variable was categorized into two groups, whether the child was exclusively breastfed or not. Permadi et al. (2017) indicates that children who were not exclusively breastfed for were 9.5 times more at risk of stunting than children who were exclusively breastfed.

Duration of Breastfeeding

Duration of breastfeeding was going to be determined based on the period for which the child was put to breast. The variable had been categorized into 4 categories thus: currently breastfeeding, breastfed for 1 year or less, breastfed between 1 and 2 years, and breastfed for more than 2 years. Children who are breastfed longer and given adequate complementary food are less likely to be stunted (Atsbeha et al., 2015). However, there was no data to analyze this variable.

Complementary Feeding

This was determined by participants responses regarding complementary feeding, diversity of the feeds and the frequency of feeding. This variable was categorized as to whether the complementary food given met the minimum acceptable diet. Hence this variable was categorized into two groups of whether the children were fed a minimum acceptable diet or not (Yes/No). Dietary diversity has been reported to have positive association with HAZ (Perkins et al., 2018).

Immunization

Immunization was determined by the participants responses regarding the vaccination status of their children. The ZDHS sampled children aged 12-23 months for this variable. Children within this age should have received all the basic vaccinations by the age 12 months. This variable was categorized into three groups. Children who received all the basic vaccinations were categorized as fully immunized, those who received one or more but not all were categorized as partially immunized and children who received no vaccination at all were categorized as not immunized. Lack of vaccination has been found to be significantly associated with stunting.

Table 2

Study and Outcome Variables

Type of variable	Variable name	Level of measurement
Dependent	Stunting	Dichotomous
Independent	Sociodemographic factors	
	Age	Nominal
	Marital status	Nominal
	Education	Nominal
	Employment	Dichotomous
	Income	Nominal
	Area of residence	Dichotomous
	Environmental factors	
	Availability of water	Nominal
	Sanitary facilities	Nominal
	Hand washing	Nominal
	Size of household	Nominal
	Child characteristics	
	Age	Nominal
	Sex	Dichotomous
	Size at birth	Nominal
	Health status	Nominal
	Childcare practices	
	Initiation of breastfeeding	Nominal
	Exclusive breastfeeding	Dichotomous
	Duration of breastfeeding	Nominal
	Complementary feeding	Nominal
	Immunization	Nominal

Data Analysis Plan

Data analysis was conducted using Statistical Package for Social Sciences (SPSS) version 25 provided by Walden University. The statistical package is used to perform complex statistical data analysis. The SPSS software package allows for management and statistical analysis of social science data. Data in this study were analyzed appropriately to answer the research questions. Descriptive analysis was conducted to generate frequencies on all variables. Binary logistic regression analysis was conducted to assess the associations between stunting and the independent variables. Then multivariate logistic regression analysis was conducted to test the effect of two or more variables on the dependent variable and thus it was used to identify the most significant variables that drive the stunting levels to remain high in Zimbabwe.

The research questions, hypotheses to be considered and the method of addressing them were as follows:

RQ1: Is there an association between sociodemographic factors (mother's age, marital status, level of education, employment status, income, and area of residence) and stunting in children under age 5?

> $H_0$1: There is no association between sociodemographic factors (mother's age, marital status, level of education, employment status, income, and area of residence) and stunting in children under age 5.
>
> H_a1: There is an association between sociodemographic factors (mother's age, marital status, level of education, employment status, income, and area of residence) and stunting in children under age 5.

To address RQ1, the frequency distribution of the sociodemographic variables was determined. A binary logistic regression was conducted to calculate the crude and adjusted odds ratios and obtain the relationship or association between the dependent and independent variables. The level of significance for which a variable was judged to be statistically significant was set at 0.05 (p-value) and 95% confidence interval.

RQ2: Is there an association between environmental factors (source of drinking water, sanitary facilities, hand washing, and household size) and stunting in children under age 5?

> $H_0$2: There is no association between environmental factors (source of drinking water, sanitary facilities, hand washing, and household size) and stunting in children under age 5.
>
> H_a2: There is an association between environmental factors (source of drinking water, sanitary facilities, hand washing, and household size) and stunting in children under age 5.

To address RQ2, the frequency distribution of the environmental variables was determined. A binary logistic regression was conducted to calculate the crude and adjusted odds ratios and obtain the relationship or association between the dependent and independent variables. The level of significance for which a variable would be said to be statistically significant set at 0.05 (p-value) and 95% confidence interval.

RQ3: Is there an association between child characteristics (age, sex, size at birth, and health status [diarrhea, acute respiratory infection, and fever]) and stunting in children under age 5?

> $H_0$3: There is no association between child characteristics (age, sex, size at birth, preceding birth interval, and health status [diarrhea, acute respiratory infection, and fever]) and stunting in children under age 5.

H_a3: There is an association between child characteristics (age, sex, size at birth, preceding birth interval, and health status [diarrhea, acute respiratory infection, and fever]) and stunting in children under age 5.

To address RQ3, the frequency distribution of the child characteristics variables was determined. A binary logistic regression was conducted to calculate the crude and adjusted odds ratios and obtain the relationship or association between the dependent and independent variables. The level of significance for which a variable was judged to be statistically significant was set at 0.05 (p-value) and 95% confidence interval.

RQ4: Is there an association between childcare practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization) and stunting in children under age 5?

H_04: There is no association between childcare practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization) and stunting in children under age 5.

H_a4: There is an association between childcare practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization) and stunting in children under age 5.

To address RQ4, the frequency distribution of the childcare practices variables was determined. A binary logistic regression was conducted to calculate the crude and adjusted odds ratios and obtain the relationship or association between the dependent and independent variables. The level of significance for which a variable was judged to be statistically significant was set at 0.05 (p-value) and 95% confidence interval.

RQ5: Are there any significant factors that drive the levels of stunting in children under age 5, controlling for sociodemographic factors, environmental factors, child characteristics, and childcare practices?

$H_0$5: There are no significant factors that drive the levels of stunting in children under age 5, controlling for sociodemographic factors, environmental factors, child characteristics, and childcare practices.

H_a5: There are significant factors that drive the levels of stunting in children under age 5, controlling for sociodemographic factors, environmental factors, child characteristics, and childcare practices.

To address RQ5, a stepwise multiple logistical regression was used to determine the most significant factors that drive the levels of stunting in children under 5. Identification of the most significant factors that drive the levels of stunting is needed to fill the knowledge gap and direct appropriate interventions. Resources have been poured into interventions to reduce malnutrition but there has been a marginal reduction over the years.

Threats to Validity

Validity and reliability of data is important as they are essential to ensure the credibility of the study findings (Aschengrau & Seage, 2014). External validity is the extent to which the findings of the study can be generalized to the whole population. The ZDHS 2015 sample was obtained in a manner that provided external validity. The sample was designed to yield representative information for the whole country, urban and rural areas and for each of the 10 provinces (ZIMSTAT & ICF International, 2015). Potential threats to internal validity include participants giving inaccurate information and recall bias when reporting past events. However, there were quality controls that were put forth when the data for the ZDHS was collected. Quality control measures were employed in sampling the participants, the data collection strategy, data entry, and coding. The data were collected in a manner that minimized bias and the response rate was high for all the four questionnaires. According to Creswel (2005), reliability is the ability of a research instrument to produce stable and consistent results. The DHS program is designed to collect data that are comparable across years and countries. To ensure reliability, the DHS program developed standard questionnaires, with similar survey procedures which are followed in each country. In addition, a set of manuals was also developed to use with the model questionnaires (Rustein & Rojas, (Eds), 2006). During the ZDHS process, a pilot test was conducted to ensure stability and consistency, in areas that were not part of the enumeration areas. The quality control measures assured data that was valid and reliable. The methods used to conduct the ZDHS are consistent with scientific research assumptions and the data is generalizable. In addition, the DHS program strives to maintain the highest standards of data collection, processing, and analysis (Pullum, 2019).

Ethical Considerations

Only secondary data from the ZDHS 2015 were used to answer the research questions in this study. According to the DHS program (DHS, n.d.), there are standard procedures and methodologies to guide the survey process and strict standards for protecting the privacy of the participants. The procedures and questionnaires were reviewed by the ICF Institutional Review Board (IRB) and the Medical Research Council of Zimbabwe to ensure that the survey complies with the ethical procedures for conducting research with human participants. The ZDHS 2015 data were therefore collected in compliance of the expected ethical procedures. All the participants signed the informed consent and they were assured of privacy and confidentiality. The data are stored in an ethical manner such that they are only accessible to individuals who apply and are cleared to retrieve the data. To access the data, a formal application was submitted to The DHS program through a link on their web page stating the purpose for which the data would be used. Approval to use the data was thereafter given. The SPSS data file for household and women ages 15–49 years along with the relevant questionnaires and recode manuals were downloaded. Clearance from the Walden University IRB (approval number 09-09-20-06-0616474) and the Medical Research Council of Zimbabwe was obtained before undertaking the analysis for my study.

Summary and Transition

This quantitative cross-sectional study was designed to identify the predictors of stunting in children under the age of 5 years in Zimbabwe and identify any significant predictors that drives the stunting levels to remain high. Data for the study were obtained from the ZDHS 2015 which was conducted by ZIMSTAT and the ICF International. The methodology for the study has been described in this chapter. This includes the research design and rationale, the sampling procedure, and the process of collecting ZDHS data which was used during my analysis. The description of the analysis plan which includes the statistical tests for research question was also described. The chapter ends with a detailed validity and reliability issues as well as ethical considerations. The hypotheses described in this chapter were tested and results of all statistical analyses are presented in Chapter 4 along with a discussion of these findings in Chapter 5.

Chapter 4: Results

Introduction

The purpose of this study was to identify and describe the risk factors that drive stunting in children under 5 years of age in Zimbabwe and identify the most significant of these risk factors by analyzing secondary data, the ZDHS 2015 data set. The ZDHS collects information on population, health, nutrition, and HIV from a nationally representative sample. In this chapter, I report on the results of the study. Descriptive statistics are reported for all the studied variables. These are presented as frequencies and percentages for the categorical variables as shown in the tables and figures. Logistic regression analysis was conducted between the dependent variable and each of the independent variables to obtain the crude odds ratio (*OR*), and multiple logistic regression was conducted to obtain the adjusted odds ratio (*AOR*); these and the confidence intervals (CI) are reported. Finally, stepwise multiple logistical regression was conducted to identify the most significant factors that drive the levels of stunting children under the age of 5.

The study had five research questions with hypotheses that were tested and are presented in subsequent sections and tables. RQ5 was modified to identify the most significant predictors rather than the interaction of variables as previously intended due to the complexity of interpretation of results. Research questions and hypotheses are as follows:

RQ1: Is there an association between sociodemographic factors (mother's age, marital status, level of education, employment status, income, and area of residence) and stunting in children under age 5?

$H_0$1: There is no association between sociodemographic factors (mother's age, marital status, level of education, employment status, income, and area of residence) and stunting in children under age 5.

H_a1: There is an association between sociodemographic factors (mother's age, marital status, level of education, employment status, income, and area of residence) and stunting in children under age 5.

RQ2: Is there an association between environmental factors (source of drinking water, sanitary facilities, hand washing, and household size) and stunting in children under age 5?

$H_0$2: There is no association between environmental factors (source of drinking water, sanitary facilities, hand washing, and household size) and stunting in children under age 5.

H_a2: There is an association between environmental factors (source of drinking water, sanitary facilities, hand washing, and household size) and stunting in children under age 5.

RQ3: Is there an association between child characteristics (age, sex, size at birth, and health status [diarrhea, acute respiratory infection, and fever]) and stunting in children under age 5?

$H_0$3: There is no association between child characteristics (age, sex, size at birth, preceding birth interval, and health status [diarrhea, acute respiratory infection, and fever]) and stunting in children under age 5.

H_a3: There is an association between child characteristics (age, sex, size at birth, preceding birth interval, and health status [diarrhea, acute respiratory infection, and fever]) and stunting in children under age 5.

RQ4: Is there an association between childcare practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization) and stunting in children under age 5?

$H_0$4: There is no association between childcare practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization) and stunting in children under age 5.

H_a4: There is association between childcare practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization) and stunting in children under age 5.

RQ5: Are there any significant factors that drive the levels of stunting in children under age 5, controlling for sociodemographic factors, environmental factors, child characteristics, and childcare practices?

$H_0$5: There are no significant factors that drive the levels of stunting in children under age 5, controlling for sociodemographic factors, environmental factors, child characteristics, and childcare practices.

H_a5: There are significant factors that drive the levels of stunting in children under age 5, controlling for sociodemographic factors, environmental factors, child characteristics, and childcare practices.

Data Analysis

I used the cross-sectional study design to test the hypotheses, using secondary data from the ZDHS. The results presented are based on the frequency distributions and the logistical analyses I conducted. All children (6,352) under 5 years of age who had their height measured and their mothers had been sampled, but the actual data obtained were 6,252 pairs; cases with invalid HAZ were filtered out. Descriptive analysis and binary logistical regression was conducted for each variable, and multiple logistical regression was conducted for each research question after controlling for potential confounding, to determine predictors associated with stunting in children under 5 in Zimbabwe. Stepwise multiple logistical regression was conducted to build the most predicting model, and variables with a p value of <0.05 were retained as the most significant factors that drive stunting levels in children under the age of 5 in Zimbabwe.

Results

With regards to stunting, in this study, I found that 26.2% of the children under 5 were stunted (n = 1,351) and 73.8% (n = 3,823) were not stunted.

Research Question 1

RQ1: Is there an association between sociodemographic factors (mother's age, marital status, level of education, employment status, income, and area of residence) and stunting in children under age 5?

$H_0$1: There is no association between sociodemographic factors (mother's age, marital status, level of education, employment status, income, and area of residence) and stunting in children under age 5.

H_a1: There is an association between sociodemographic factors (mother's age, marital status, level of education, employment status, income, and area of residence) and stunting in children under age 5.

Table 3 illustrates the frequency and percentage of the sociodemographic characteristics of the mothers. The total sample size was N = 6,252, but it was less in some variables due to missing values. Most of the women fell in the 25–29 years age group (*n* = 1729, 27.6%). The second highest was 20–24 years (*n* = 1479, 23.7%), closely followed by 30–34 (*n* = 1448, 23. 2%). The least was in the oldest age group of 45–49 years (*n* = 53, 0.9%). Most of the women were married (*n* = 5,382, 86.1%) followed by formerly married (*n* = 621, 9.9%), and those who never married (*n* = 249, 4%). The women who had attained secondary school education (*n* = 3,850, 61.6%) were the highest, followed by primary education (*n* = 2,007, 32.1%), and women with no education (*n* = 75, 1.2%) were the least. With regards to employment, many of the women were employed (*n* = 3,235, 51.9%), and some unemployed (*n* = 2,954, 47.4%) with a small number having unknown status (*n* = 45, 0.7%). The highest number of women belonged to the poorest wealth bracket (*n* = 1,459, 23.3%), closely followed by women in the richer category (*n* = 1,446, 23.1%), poorer (*n* = 1233, 19.7%), middle (*n* = 1,089, 17.4%), and the richest (*n* = 1,026, 16.4%). The dominant residential area was rural (*n* = 4,333, 69.3%) and 30.7% (*n* = 1,919) lived in the urban area. Manicaland province had the highest number of participants (*n* = 956, 15.3%), followed by Harare (*n* = 903, 14.5%), Midlands (*n* = 840, 13.4%, Mashonaland West (*n* =828, 13.3%), Masvingo (*n* = 742, 11.9%), Mashonaland Central (*n* = 620, 9.9%), Mashonaland East (*n* = 595, 9.5%), Matabeleland North (*n* = 284, 4.5%), Bulawayo (*n* = 238, 4%) and Matabeleland South (*n* = 230, 3.7%).

Table 3

Frequency Distribution of Sociodemographic Characteristics, N = 6,252

Independent variables	Total	%
Age (years)		
15–19	392	6.3
20–24	1479	23.7
25–29	1729	27.6
30–34	1448	23.2
35–39	785	12.6
40–44	367	5.9
45–49	53	0.9
Education		
No education	75	1.2
Primary	2007	32.1
Secondary	3850	61.6
Higher	320	5.1
Marital status		
Never married	249	4
Married	5382	86.1
Formerly married	621	9.9
Employment		
Not employed	2954	47.4
Employed	3235	51.9
Not known	45	0.7
Income		
Poorest	1459	23.3
Poorer	1233	19.7
Middle	1089	17.4
Richest	1026	16.4
Residence		
Urban	1919	30.7
Rural	4333	69.3
Regions		
Manicaland	956	15.3
Mashonaland Central	620	9.9
Mashonaland East	595	9.5
Mashonaland West	828	13.3
Matabeleland North	284	4.5
Matabeleland South	230	3.7
Midlands	840	13.4
Masvingo	742	11.9
Harare	903	14.5
Bulawayo	238	4

Note: * may vary due to missing values in some variables

Table 4 shows the results of the OR and AOR of the sociodemographic characteristics. Binary logistic regression results indicated that age (30–34 years), education, income, type of residence, and region were significant. The multivariate logistic regression analysis indicated that the most significant sociodemographic predictors of stunting were education and income. The results showed that mother's age was not associated with stunting; however, children with mothers in the other age groups, except in the 40–44 age group (AOR = 1.171; 95% CI: .824–1.665), had lower chances of stunting compared to children with mothers in the 15–19 years age group. Children with mothers who had no education had greatest odds of stunting, followed by children who had mothers with primary and secondary education compared to children with mothers who had higher education (AOR = 5.720; 95% CI: 2.900–11.283; AOR = 3.360; 95% CI: .2.094–5.390; AOR = 2.725; 95% CI: 1.726–4.300, respectively). The children of mothers who were married had 28% (AOR = .722; 95% CI: .547–1.088) lower odds of stunting and children of mothers who were formerly married had 19% (AOR = .814; 95% CI: 547–1.212) lower odds of stunting than in children of mothers who never married.

There were 12% more chances of stunting (AOR = 1.126; 95% CI: .986–1.285) in children with employed mothers compared to children whose mothers were not employed. With regards to income, children from the poorest families had higher odds (AOR = 2.506; 95% CI: 1.762–3.565) of being stunted than children from the richest families. Children in rural areas had lower odds (AOR = .763; 95% CI: .568–1.024) to be stunted than children living in urban areas. While the region was not significant, children living in Matabeleland South were more likely (AOR = 1.095; 95% CI: .766–1.565) to be stunted than children living in other regions.

Table 4

Unadjusted Odds Ratios and Adjusted Odds Ratios of the Sociodemographic Characteristics, N = 6,252

Independent variables	Unadjusted odds ratio	P	95% CI	Adjusted odds ratio	P	95% CI
Age (years)						
15–19	Reference					
20–24	.909	.487	.693–1.191	.953	.734	.722–1.257
25–29	.864	.280	.663–1.126	.922	.562	.699–1.215
30–34	.751	.038	.572–.985	.837	.218	.630–1.111
35–39	.858	.305	.640–1.150	.958	.783	.705–1.301
15–19	1.089	.621	.776–1.529	1.171	.379	.824–1.665
45–49	.631	.221	.302–1.318	.618	.202	.292–1.306
Education						
Higher	Reference					
No education	9.101	.000	4.750–17.437	5.270	.000	2.900–11.283
Primary	4.748	.000	3.055–7.379	3.360	.000	2.094–5.390
Secondary	3.408	.000	2.203–5.271	2.725	.000	1.726–4.300
Marital status						
Never married	Reference					
Married	.798	.162	.581–1.095	.722	.139	.547–1.088
Formerly married	.878	.500	.603–1.200	.814	.311	.547–1.212
Employment						
Not employed	Reference					
Employed	.988	.853	.873–1.119	1.126	.080	.986–1.285
Income						
Richest	Reference					
Poorest	2.601	.000	.2.082–3.247	2.506	.000	1.762–3.565
Poorer	2.079	.000	1.648–2.623	2.028	.000	1.424–2.888
Middle	1.873	.000	1.472–2.384	1.824	.001	1.278–2.605
Richer	1.871	.000	1.487–2.354	1.673	.000	1.308–2.140
Residence						
Urban	Reference					
Rural	1.414	.000	1.227–1.628	.763	.072	.568–1.024
Region						
Manicaland	Reference	.003			.217	
Mash. Central	.938	.606	.735–1.197	.883	.325	.690–1.131
Mash. East	.743	.023	.575–.960	.787	.072	.606–1.022
Mash. West	.906	.393	.722–1.137	.905	.402	.717–1.142
Mat. North	.699	.036	.501–.977	.631	.009	.447–.889
Mat. South	1.081	.658	.766–1.524	1.095	.619	.766–1.565
Midlands	.913	.424	.830–1.142	.933	.553	.743–1.173
Masvingo	.861	.206	.683–1.086	.892	.348	.703–1.132
Harare	.694	.002	.551–.875	.909	.508	.684–1.207
Bulawayo	.504	.001	.340–.747	.708	.124	.456–1.099

Research Question 2

RQ2: Is there an association between environmental factors (source of drinking water, sanitary facilities, hand washing, and household size) and stunting in children under age 5?

> $H_0$2: There is no association between environmental factors (source of drinking water, sanitary facilities, hand washing, and household size) and stunting in children under age 5.
>
> H_a2: There is an association between environmental factors (source of drinking water, sanitary facilities, hand washing, and household size) and stunting in children under age 5.

Table 5 shows the frequency distribution of the environmental factors. Most of the participants (*n* = 4,463, 74.5%) used improved water sources, with a smaller number (*n* = 1,531, 24.5%) using unimproved water sources. With regards to sanitary facilities, most participants had no sanitary facilities (*n* = 2,370, 37.9%), followed by those with improved facilities (n = 2,341, 37.4%) and unimproved facilities (*n* = 1,284, 20.5%). For hand washing, the majority (*n*= 3,793, 60.7%) had no hand washing facilities; followed by those who used water only (*n* = 943, 15.1%); soap and water (*n* = 858, 13.7%); no soap, no cleansing agent, soap, or water (*n*= 508, 8.1); other cleansing agent but no water (*n* = 123, 2%); and those who used other cleansing agent alone (*n* = 28, 0.5%). In terms of the size of household, the majority had a medium-sized family of four to six people (*n* = 3,293, 52.7%), followed by large family (*n* = 1,706, 27.3%), and small family (*n* = 1,254, 20.1%).

Table 5

Frequency Distribution of Environmental Factors, N = 6,252

Independent variables	Total	%
Source of drinking water		
Improved water source	4,463	74.5
Unimproved water source	1,531	24.5
Sanitary facilities		
No facility	2,370	37.9
Unimproved facility	1,284	20.5
Improved facility	2,341	37.4
Hand washing		
Soap and water	858	13.7
Other cleansing agent and water	28	0.5
Water only	943	15.1
Soap or other cleansing agent but no water	123	2
No water, soap, or other cleansing agent	508	8.1
No facility	3,793	60.7
Size of household		
≤3 (small)	1,254	20.1
4–6 (medium)	3,293	52.7
≥7 (large)	1,706	27.3

With regards to environmental factors, the results in Table 6 indicated that the most significant predictor of stunting was sanitation facilities. Where there was unimproved water source, children were 1.06 times more likely (AOR = 1.060; 95% CI: .912–1.232) to be stunted than children with improved water supply. Similarly, children who had no sanitary facilities in their homes had higher chances (AOR = 1.670; 95% CI: 1.428–1.954) of being stunted, followed by children who had unimproved facilities (AOR = 1.335; 95% CI: 1.116–1.598). For hand washing, children who lived in households that did not use soap and water or other cleansing agent and water had higher odds of stunting compared to children who used soap and water for handwashing. Children who had access to water only had higher chances (AOR = 1.057; 95% CI: .838–1.333) of being stunted when compared with others, followed by children who had no hand washing facility (AOR = 1.015; 95% CI: .761–1.327). Children born in a large family had the highest chances (AOR = 1.145; 95% CI: .929–1.410) of being stunted, followed by children born in a medium family (AOR = 1.032; 95% CI: .858–1.242).

Table 6

Crude Odds Ratios and Adjusted Odds Ratios of Environmental Factors

Independent variables	OR	P	95% CI	AOR	P	95% CI
Source of drinking water						
Improved water source	Reference	.000				
Unimproved water source	1.276	.001	1.109–1.468	1.060	.448	.912–1.232
Sanitary facilities						
Improved facility	Reference	.000				
Unimproved facility	1.365	.006	1.146–1. 626	1.335	.002	1.116–1.598
No access	1.712	.000	1.480–1.981	1.670	.000	1.428–1.954
Hand washing						
Soap and water	Reference	.651			.899	
Other cleansing agent and water	.730	.541	.265–2.006	.564	.269	.204–1.558
Water only	1.145	.243	.912–1.438	1.057	.641	.838–1.333
Soap or other cleansing agent but no water	1.205	.414	.771–1.884	1.001	.996	.634–1.591
No water, soap or other cleansing agent	1.110	.455	.845–1.457	1.005	.974	.761–1.327
No facility	1.159	.119	.963–1.396	1.015	.882	.835–1.233
Size of household						
≤3 (small)	Reference	.195			.317	
4 – 6 (medium)	1.051	.590	.878–1.257	1.032	.735	.858–1.242
≥7 (large)	1.172	.113	.963–1.925	1.145	.204	.929–1.410

Research Question 3

RQ3: Is there an association between child characteristics (age, sex, size at birth, and health status [diarrhea, acute respiratory infection, and fever]) and stunting in children under age 5?

$H_0$3: There is no association between child characteristics (age, sex, size at birth, preceding birth interval, and health status [diarrhea, acute respiratory infection, and fever]) and stunting in children under age 5.

H_a3: There is an association between child characteristics (age, sex, size at birth, preceding birth interval, and health status [diarrhea, acute respiratory infection, and fever]) and stunting in children under age 5.

Table 7 shows the frequency distribution of child characteristics. The results show that most of children (*n*= 1,276, 20.4%; *n*= 1,275, 20.4%) were in the older age groups, 36-47 months, and 48-59 months, respectively. This was followed by the 12-23 months age group (*n*= 1,257, 20.1%), 24-35 months (*n*= 1,238, 19.8%), <6 months (*n*= 620, 9.9%) and 6-11 months (*n*= 587, 9.4%). Most of the children were girls (*n* = 3,177, 50.8%) and boys were 49.2% (*n* = 3,075). The size at birth was predominantly average (*n* = 3,028, 48.4%), followed by larger than average (*n* = 1,753, 28%), smaller than average (*n* = 675, 10.8%), very large (*n* = 516, 8.2%), very small (*n* = 256, 4.1%) and with unknown size (*n* = 25, 0.4%). The majority of the children did not have diarrhea within 2 weeks preceding the survey (*n* = 4,902, 83.1%) with 16.9% having had diarrhea (*n* = 1,000), 38.8% (*n* = 2,289) had acute respiratory infection and 61.2% (*n* = 3,614, 61.2%) had no incident of acute respiratory infection, 86% (*n* = 5,079) had no fever while 14% (*n* = 145) had fever at least 2 weeks prior to the survey.

Table 7

Frequency Distribution of Child Characteristics

Independent variables	Total	%
Age (months)		
<6	620	9.9
6–11	587	9.4
12–23	1,257	20.1
24–35	1,238	19.8
36–47	1,276	20.4
48–59	1,275	20.4
Sex		
Boy	3,075	49.2
Girl	3,177	50.8
Size at birth		
Very large	516	8.2
Larger than average	1,753	28
Average	3,028	48.4
Smaller than average	675	10.8
Very small	256	4.1
Don't know	25	0.4
Health status		
Diarrhea: Yes	1,000	16.9
Diarrhea: No	4,902	83.1
Acute respiratory infection: Yes	2,289	38.8
Acute respiratory infection: No	3,614	61.2
Fever: Yes	100	14
Fever: No	5,079	86

The results in Table 8 indicated that the age, sex, size at birth, diarrhea, and acute respiratory infection were significant predictors of stunting. In terms of age, children in the 24–35 months age group had the highest odds of stunting (AOR = 3.049; 95% CI: 2.378–4.026), followed by children in the 12–23 months age group (AOR = 2.402; 95% CI: 1.845–3.126); 36–47 months (AOR = 1.889; 95 CI: 1.445–2.471) and 48–59 months (AOR = 1.067; 95% CI: .804–1.417). Girls had 26% less odds (AOR = .736; 95% CI: .736-.860) of stunting compared to boys. Similarly, children born very small and smaller than average had higher chances (AOR = 3.378; 95% CI: 2.322–4.914 and AOR = 2.181; 95% CI: 1.624–2.928 respectively) of being stunted than children born larger. Additionally, children who diarrhea and acute respiratory infection had higher odds (AOR = 1.361; 95% CI: 1.153–1.606; AOR = 1.289; 95% CI: 1.126-1.475 respectively) of stunting than children who had no diarrhea or acute respiratory infection.

Table 8

Crude Odds Ratios and Adjusted Odds Ratios of Child Characteristics, N = 6,252

Independent variables	OR	P	95% CI	AOR	P	95% CI
Age (months)						
<6	Reference	.000				
6–11	.844	.310	.607–1.172	.762	.112	.545–1.066
12–23	2.457	.000	1.901–3.177	2.402	.000	1.845–3.126
24–35	3.051	.000	2.357–3.949	3.049	.000	2.378–4.026
36–47	1.828	.000	1.404–2.381	1.889	.000	1.445–2.471
48–59	1.009	.948	.764–1.334	1.067	.652	.804–1.417
Sex						
Boy	Reference					
Girl	.760	.000	.671–.860	.736	.000	.647–.837
Size at birth						
Very large	Reference	.000			000	
Larger than average	1.002	.986	.772–1.301	1.024	.864	.783–1.338
Average	1.152	.262	.900–1.474	1.228	.112	.953–1.582
Smaller than average	2.003	.000	1.505–2.665	2.181	.000	1.624–2.928
Very small	2.942	.000	2.051–4.220	3.378	.000	2.322–4.914
Health status						
Diarrhea: No	Reference	.000			.001	
Diarrhea: Yes	1.533	.000	1.315–1.787	1.361	.000	1.153–1.606
Acute respiratory infection: No	Reference	.000			.001	
Acute respiratory infection: Yes	1.331	.000	1.174–1.508	1.289	.000	1.126–1.475
Fever: No	Reference	.840			.151	
Fever: Yes	1.018	.772	.854	.870	.340	.720–1.052

Research Question 4

RQ4: Is there an association between childcare practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization) and stunting in children under age 5?

$H_0$4: There is no association between childcare practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization) and stunting in children under age 5.

H_a4: There is association between childcare practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization) and stunting in children under age 5.

Table 9 shows the frequency distribution of childcare practices. The number of children for childcare practices was different depending on the age group for the childcare practice. The children who were immediately initiated on breastfeeding after being born were 1,079 (58.9%) and those who were initiated on breastfeeding within the first hour were 296 (16.2%) and 455 (24.9%) children were initiated on breastfeeding more than an hour of being born. Only 43.3% (282) of children under the age of 6 months were exclusively breastfed and 368 (56.7%) were not exclusively breastfed. As for the duration of breastfeeding, the database failed to provide the details (age in months of when breastfeeding was stopped) for the analysis of the information, thus this part of the question remains unanswered. Most of the children (1,616, 86.1%) did not have a minimum acceptable diet as only 261 (13.9%) children had a minimum acceptable diet. With regards to immunization, 924 (72.3%) children under 23 months were fully vaccinated, 172 (13.4%) children were partially vaccinated and 182 (14.3%) children were not vaccinated.

Table 9

Frequency Distribution of Childcare Practices

Independent variables	Total	%
Initiation of breastfeeding		
Immediately	1,079	58.9
Within 1 hour	296	16.2
More than 1 hour	455	24.9
Exclusive breastfeeding		
Yes	282	43.3
No	368	56.7
Minimum acceptable diet		
Yes	261	13.9
No	1,616	86.1
Immunization		
Fully immunized	924	72.3
Partially immunized	172	13.4
Not immunized	182	14.3

As for childcare practices, Table 10 shows that complementary feeding (minimum acceptable diet) and immunization were significant. The odds of stunting were 1.192 times (95% CI: .199–1.560) greater in children who were initiated on breastfeeding more than an hour after being born and 1.178 times (95% CI: .864–1.606) greater in children who were initiated on breastfeeding within one hour of being born than children who were immediately put to the breast after being born. Children who were not exclusively breastfed had 44% more chances of being stunted than children who were exclusively breastfed (AOR= 1.440; 95% CI: .345–6.004). In addition, children who were not given a minimum acceptable diet had 1.709 times chances of being stunted than children who received a minimum acceptable diet (95% CI: 1.189–2.456). In terms of immunization, children who received no immunization had 1.446 times higher odds (95% CI: 1.040–2.010) of getting stunted than children who were vaccinated.

Table 10

Crude Odds Ratios and Adjusted Odds Ratios of Childcare Practices

Independent variables	OR	P	95% CI	AOR	P	95% CI
Initiation of breastfeeding						
Immediately	Reference	.149			.337	
Within 1 hour	1.068	.463	.896–1.271	1.178	.301	.864–1.606
More than 1 hour	1.154	.052	.998–1.335	1.192	.199	.199–1.560
Exclusive breastfeeding						
Yes	Reference					
No	1.019	.935	.650–1.598	1.440	.617	.345–6.004
Minimum acceptable diet						
Yes	Reference					
No	2.344	.000	1.764–3.114	1.709	.004	1.189–2.456
Immunization						
Fully immunized	Reference	.002			.000	
Partially immunized	1.119	.555	.771–1.624	.688	.028	.544–.870
Not immunized	2.177	.000	1.422–3.333	1.446	.002	1.040–2.010

Research Question 5

RQ5: Are there any significant factors that drive the levels of stunting in children under age 5, controlling for sociodemographic factors, environmental factors, child characteristics, and childcare practices?

$H_0$5: There are no significant factors that drive the levels of stunting in children under age 5, controlling for sociodemographic factors, environmental factors, child characteristics, and childcare practices.

H_a5: There are significant factors that drive the levels of stunting in children under age 5, controlling for sociodemographic factors, environmental factors, child characteristics, and childcare practices.

The stepwise multivariate analysis was used to build the most predicting model for stunting between the variables to identify the most significant factors. The final model stepwise analysis used 10 steps and removed all the other variables except education, income, size of household, age of child, sex, size birth, health status (incidence of diarrhea and acute respiratory infection), minimum acceptable diet and immunization. Table 11 indicates that children with mothers who had no education had 6.020 times higher odds (95% CI: 2.926–12.385) at being stunted than children of mothers with higher education. Children with mothers who had primary education had 3.351 times (95% CI: 2.016–5.570), and children of mothers with secondary education had 2.789 times higher odds (95% CI: 1.708–4.554) of stunting than children of mothers with higher education. In terms of income, all covariates were statistically significant. However, children with mothers who were poorest (AOR = 2.063; 95% CI: 1.584–2.687) were more likely to be stunted than children with mothers who were richest. As far as the size of the household was concerned, children from large sized families (AOR = 1.347; 95% CI: 1.087–1.670), followed by children in medium sized families (AOR = 1.183; 95% CI: .925–1.435) had higher odds had higher odds of stunting than children from small sized families. The odds of stunting were 3.75 times (95% CI: 2.682–5.226) in children aged 24–35 months, 2.325 times in children aged 12–23 months (95% CI: 1.655–3.267) and 1.512 times in children aged 36–47 months (95% CI: 1.013–2.257) more than children less than six months of age. Girls were less likely (AOR = .716; 95% CI: .625-.820) to be stunted than boys. In terms of size at birth, very small children were 3.218 times (95% CI: 2.175–4.760) and small children were 2.232 times (95% CI: 1.644–

3.030) more likely to be stunted than very large children. As for the children's health status, children who had diarrhea (AOR = 1.309; 95% CI: 1.099–1.558) and children who had acute respiratory infection (AOR = 1.272; 95% CI: 1.111–1.458) had higher odds to stunting. The odds of stunting were 1.97 times (95% CI: 1.450–1.458) higher in children who did not meet the minimum acceptable diet. Children who were not immunized had the highest odds (AOR = 1.643; 95% CI: 1.226–2.202) of stunting than children who were fully immunized.

Table 11

Adjusted Odds Ratios for the Most Predicting Variables of Stunting

Independent variables	AOR	95% CI	P value
Education			
Higher	Reference		
No education	6.020	2.926–12.385	.000
Primary	3.351	.2.016–5.570	.000
Secondary	2.789	1.708–4.554	.000
Income			
Richest	Reference		.000
Poorest	2.063	1.584–2.687	.000
Poorer	1.769	1.367–2.288	.000
Middle	1.650	1.255–2.169	.000
Richer	1.645	1.257–2.152	.000
Size of household			
Small	Reference		.023
Medium	1.183	.925–1.435	.089
Large	1.347	1.087–1.670	.007
Age (months)			
<6	Reference		.000
6 – 11	.768	.537–1.098	.141
12 – 23	2.325	1.655–3.267	.000
24 – 35	3.745	2.683–5.226	.000
36 – 47	1.512	1.013–2.257	.043
48 – 59	.858	.569–1.293	.464
Sex			
Boy	Reference		
Girl	.716	.625–.820	.000
Size at birth			
Very large	Reference		.000
Larger than average	1.023	.777–1.348	.870
Average	1.644	.914–1.541	.198
Smaller than average	2.232	1.644–3.030	.000
Very small	3.218	2.175–4.760	.000
Health status			
Diarrhea: No	Reference		
Diarrhea: Yes	1.309	1.099–1.558	.002
Acute respiratory infection: No	Reference		
Acute respiratory infection: Yes	1.272	1.111–1.458	.001
Minimum acceptable diet: Yes	Reference		
Minimum acceptable diet: No	1.970	1.450–2.676	.000
Immunization			
Fully immunized	Reference		
Partially immunized	1.170	.916–2.202	.209
Not immunized	1.643	1.226–2.202	.001

Summary

The study design was a cross-sectional, quantitative research design using secondary data from the ZDHS 2015, which I obtained from the DHS program. In this study I sought to determine associations between sociodemographic factors, environmental factors, child characteristics and childcare practices with stunting in children under 5 years of age in Zimbabwe. I also intended to determine the most significant variables that drove the stunting rate. I conducted binary and multivariate logistic regression to answer the research questions. I have presented my findings in this chapter, reporting the frequencies, crude, and adjusted odds ratios for all the variables in relation to having stunting and odds ratios for the most significant predictors.

The prevalence of stunting in this study was found to be 26.2%. I found statistically significant associations between some independent variables and stunting. For RQ1, significant associations were found between education, income, and stunting. In terms of education, children whose mothers had no education were most likely to be stunted than children from mothers who had some form of education. In terms environmental factors, the odds of having stunting were significant in the sanitary facilities category, with children living with no access to sanitary facilities having the highest odds of stunting (OR = 1.712, 95% CI: 1.428–1.954). The child characteristics that were significantly associated with stunting were age, sex, size at birth, incidence of diarrhea, and acute respiratory infection. For size at birth, children born smaller than average and very small had the highest odds of stunting, with children born smaller than average being 2.003 times (95% CI: 1.624 – 2.928) and children born very small 2.942

times (95% CI: 2.322–4.914) higher than children born very large. With regards to childcare practices, significant associations were found for minimum acceptable diet and immunization with stunting. Children who were not given a minimum acceptable diet had 1.709 times higher odds (95% CI: 1.189–2.456) than children who were given minimum acceptable diet. Children with no immunization had 1.446 times higher odds of stunting (95% CI: 1.040–2.010). The stepwise multivariate analysis identified mothers education, income, age of child, sex, size at birth, incidence of diarrhea and acute respiration, minimum acceptable diet, and immunization as the most significant predictors of stunting in children under 5 years of age.

Chapter 5 provides discussion and interpretations of the findings, and the limitations of the study. I provided the social change implications of the findings, recommendations, and conclusion.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

Stunting is a major global public health concern as it is one of the most significant limitations to human development. Stunting is a largely irreversible outcome of inadequate nutrition and illness especially in the first 1,000 days of a child's life (WHO, 2014). Stunting is also strongly associated with chronic diseases, such as diabetes and cardiac disease, in adulthood and lower income due to poor academic performance (Musheiguza et al., 2021). Zimbabwe has been implementing nutrition interventions to reduce all forms of malnutrition, but stunting remains high. The purpose of this study was to identify and describe the risk factors that drive stunting in children under 5 years of age in Zimbabwe and pinpoint the most significant predictors that drive stunting in children under age 5. Knowing the risk factors is important in identifying the strategies to reduce stunting. Thus, the UNICEF conceptual framework for undernutrition was used in the assessment of the predictors of stunting in children under 5 years of age in Zimbabwe.

I conducted a cross-sectional quantitative study, using secondary data from the 2015 ZDHS. The sample size for this study was 6,252 children under 5 years of age who had their anthropometric measurements taken. I determined the prevalence of stunting and used binary and multivariate logistic regression to assess the association between the dependent and independent variables. In my analysis, the independent variables were grouped into four categories, each with covariates: (a) sociodemographic factors (mother's age, education, marital status, employment, income, area of residence, and region); (b) environmental factors (source of drinking water, sanitary facilities, hand washing, and household size); (c) child characteristics (age, sex, size at birth, and health status [diarrhea, acute respiratory infection, and fever]); (d) childcare practices (initiation of breastfeeding, exclusive breastfeeding, duration of breastfeeding, complementary feeding, and immunization). I conducted stepwise logistical regression to determine the strong predictors that drive the levels of stunting in Zimbabwe. I provided an interpretation of the findings in the following sections, and I also discussed these findings, highlighting the implications for social change and recommendations for future research and possible interventions.

Interpretation of Findings

The interpretation of the results for the five research questions are presented here.

RQ1: Maternal Sociodemographic Factors and Stunting

In the assessment of the association between sociodemographic factors, age (30–34 years), education, income, area of residence, and region were found to have a statistically significant independent association with stunting. In terms of age, children born from older mothers aged 40–44 years (AOR = 1.171; 95% CI: .824–1.665), were at higher risk of stunting than children from mothers in other age groups. This in inconsistent with the finding of Akombi et al. (2017) that children whose mothers are less than 20 years of age are at higher risk of stunting. My study showed that among the various sociodemographic factors related to stunting, education and income were the most significant predictors of stunting in children under 5 years of age in Zimbabwe.

This finding is consistent with existing literature; Gebru et al. (2019) reported that children from poor households and low maternal education had significantly high odds of stunting. Low maternal education translates to poor decision-making processes with respect to nutrition and child health (Nahar & Pillai, 2019), lower access and use of maternal health care, and less comprehension of the information on childcare given at health facilities (Nuamah et al., 2019). Nwosu and Ataguba (2020) support the finding that children from poor families are at high risk of stunting, as resources are inadequate in the home to buy nutritious food. This study reported that children living in the rural areas were at lower risk of stunting, which is contrary to existing evidence that children in rural areas bear a higher burden of stunting than children in urban areas (Senbanjo et al., 2019; Zhu et al., 2020). Children in urban areas have access to a diversified diet, better health systems and health care, and safe water and better sanitation (Zhu et al., 2020). People in urban areas mostly purchase food, and people living in rural areas mostly grow their food. The economic meltdown in Zimbabwe from 2008 onward could have affected food availability for children living in the urban areas, as many parents lost their jobs and income was severely reduced in many families. Further research could be conducted to confirm this finding.

RQ2: Environmental Factors

In examining the environmental factors, the bivariate analysis indicated that water and sanitation were statistically associated with stunting. Children using unimproved water sources had higher odds of stunting than children using improved water sources (OR = 1.276; 95% CI: .912–1.232). When I controlled for other variables, I observed that the most significant factor associated with stunting was sanitation (no access AOR = 1.712; 95% CI: 1.428–1.954), which was statistically significant at 95% CI. This confirms the finding by Aguayo et al. (2016) that children from households without access to improved water sources and sanitation are likely to be stunted. With regards to hand washing, children who washed hands using soap and water and using other cleansing agent and water were found to have lower odds of stunting. The other covariates had higher odds of stunting; for example, children in households that used water only had the highest odds of stunting (AOR = 1.057; 95% CI: .838–1.333). Literature suggests that hand washing with soap is more effective where there is clean water; children washing hands before eating with unclean water were likely to be stunted as they would be ingesting pathogens from unclean water (Kwami et al., 2019). While the size of the household was not significant, I found that children from large households were 1.145 times more at risk of stunting (95% CI: .929–1.410) than children from small households. This is consistent with existing literature that indicates that large households expose children to the risk of stunting (Gupta & Santhya, 2020). Rana and Goli (2018) found that children in a large family are at risk of stunting as they most probably had low birth weight.

RQ3: Child Characteristics

Using binary and multiple logistic regression, I found that age of the child, sex, size at birth, and health status (diarrhea and acute respiratory infection) were statistically significant. The age group at very high risk was 24–35 months (AOR = 3.049; 95% CI: 2.378–4.026) followed by 12–23 months (AOR = 2.402; 95% CI: 1.845–3.126). In contrast, Sarma et.al. (2017) found that children aged 12–23 months had the highest odds of stunting (AOR = 3.98; 95% CI: 3.32–4.76), followed by children aged 24–35 months (AOR = 3.46; 95% CI: 2.88–4.14).

The results of this study align with other studies that have indicated that ages above 12 months are at high risk of stunting (Gebru et al., 2019; Zhu et al, 2021). In this study, I found that girls had lessor odds of being stunted than boys did (AOR = .736; 95 CI: 647–.837). This finding supports earlier findings that boys are at greater risk of being stunted (Gebru et al., 2019; Sinha et al., 2018; Woodruff et al., 2018). Being born small was found statistically significant; children born very small (AOR = 3.378; 95% CI; 2.322–4.914) and smaller than average (AOR = 2.181; 95% CI: 1.624–2.928) had greater odds for stunting in this study. Previous researchers established that size at birth matters and is associated with stunting (Khan et al., 2019; Singh et al., 2017). I found that children who had episodes of diarrhea and acute respiratory infection had higher odds of being stunted (AOR = 1.361; 95% CI: 1.153–1.606 and AOR = 1.289; 95% CI: 1.126–1.475, respectively). Fever was not found to be statistically significant, though children with fever had higher odds of stunting than children without (AOR = .870; 95% CI: .720–1.052). Existing literature confirms these findings that children with diarrhea and acute respiratory infection are at high risk of stunting (Arini et al., 2020; Brander et al., 2019; Ntshebe et al., 2019). In a study in Ethiopia, Gari et al. (2018) found that malaria (fever) increased the risk of stunting in children under 5 years of age.

RQ4: Childcare Practices

Delayed initiation of breastfeeding after being born exposes a child to greater risks of stunting based on the results of this study. I found that children who had delayed initiation of breastfeeding of more than 1 hour (AOR = 1.192; 95% CI: .199–1.560), followed by children who were initiated within 1 hour (AOR = 1.178: 95% CI: .864–1.606) were at the greatest odds to stunting. Batiro et al. (2017) found that children who were initiated to breastfeeding after 1 hour of childbirth were about five times (AOR = 5.16; 95% CI: 2.24–1.590) more likely to be stunted compared to children who were initiated to breastfeeding early.

There is substantial evidence on the benefits of exclusive breastfeeding (Jama et al., 2020; Mundagowa et al., 2019). In this study, children who were not exclusively breastfed were 1.440 times (95% CI: .345–6.004) more likely to be stunted than children who were exclusively breastfed. Early introduction of other foods escalates the risk of diarrhea and other infections, putting a child at risk of malnutrition (including stunting) and death (Mundagowa et al., 2019). The minimum acceptable diet is a composite indicator composed of minimum dietary diversity and minimum meal frequency. I found out that children who are not given a minimum acceptable diet are more likely (AOR = 1.709; 95% CI: 1.189–2.456) to be stunted than children who receive a minimum acceptable diet. Previous studies have confirmed that stunting is reduced when children fulfill the minimum acceptable dietary requirements (Misty et al., 2019; Walters et al., 2019).

In terms of immunization, I found that children who are not immunized are more likely to be stunted (AOR = 1.446; 95% CI: 1.40–2.010) than children who are fully immunized. This finding is consistent with earlier findings by Batiro et al. (2017), who noted that children’s immunization status shows significant association with stunting.

Children who are not immunized are more likely to be stunted than children who are immunized (Batiro et al., 2017).

RQ5: Most Significant Predictors

To identify the most significant predictors, a stepwise multivariate analysis was conducted, and the final model identified education, income, age of child, sex, size at birth, health status, minimum acceptable diet, and immunization as the most predicting variables for stunting. This confirms the finding by Corsi et al. (2016) that the most important predictors for stunting include no maternal education, poor dietary diversity, and being in the poorest quintile. Children of mothers with no education had 6.020 times higher odds (95% CI: 2.926–12.385) of being stunted than children of mothers with higher education. Higher maternal education has been found to be inversely associated with stunting and other forms of child undernutrition (Vollmer et al., 2017). When Vollmer et al. (2017) compared the role of paternal and maternal education in child malnutrition, they found stronger associations for maternal education than paternal education. Higher education influences the mother's values, affects household income, allocating more resources for child health and nutrition. Hassan et al. (2016) found that spending more years in schooling gave mothers more autonomy and more decision-making powers regarding a child's health and nutrition services, leading to better child outcomes. Argaw et al. (2019) confirmed that higher education increases mothers' knowledge of healthy behaviors.

Children from the poorest mothers were more likely to be stunted than children from the richest mothers (AOR = 2.063; 95% CI: 1.584–2.687). Similarly, Rahman et al.

(2021) found that children from the poorest families had the highest rates of malnutrition, including stunting. Being poor leads to limited income in the family and inadequate food security and health care services. There seems to be a cycle between education and poverty. Lack of education may lead to lower or lack of income in the family, and this in turn may lead to no education for the children, which in turn affects their ability to earn money in the future. Mothers' ownership of assets was found to have a positive impact on child health and nutritional status as it strengthens their bargaining power in the home (van der Meulen Rodgers & Kassens, 2018).

The size of the household matters, as children from large families are vulnerable to stunting. I found that children from large families had 35% higher odds of stunting than children from small families (AOR = 1.347; 95% CI: 1.087–1.670). Previous studies have indicated the size of the family has a strong relationship with child nutritional status, with children from large families at increased risk of stunting (Ahsan et al., 2017; Mulugeta et al., 2017). Rana et al. (2019) confirmed that, apart from stunting, children from large families are also at risk of increased mortality.

Ahsan et al. (2017) asserted that a child's age is significantly associated with stunting. In this study, children ages 24–35 months had the highest odds of stunting (AOR = 3.745; 95% CI: 2.682–5.226) compared to other age groups. This matches other studies showing such an increased risk for the 24–35 months age group (Ntenda & Chuang, 2018). At this age, the children may no longer be breastfeeding and there may be a deficit in complementary feeding and an increase in the presence of childhood diseases. However, this finding is contrary to other studies that report that the older age groups of

36–47 months and 48–59 months have higher odds of stunting than younger age groups (Mzumana et al., 2018).

In this study, I found that sex of the child was one of the most significant predictors of stunting. Girls are less likely to be stunted than boys, and this finding aligns with previous studies (Fantay Gebru et al., 2019; Mzumara et al., 2018). However, in a recent study in India, Alderman et al. (2021) found girls to have higher odds of stunting than boys. Previous reseearchers have established that size at birth matters and being born small is associated with stunting (Khan et al., 2019; Singh et al., 2017). Singh et al. (2017) suggested a need for nutritional counseling for pregnant women for better child outcomes.

This study confirmed available evidence that episodes of diarrhea and acute respiratory infection predispose children under 5 to stunting (Khan & Islam, 2017; Obeng-Amoako et al., 2021). Obeng-Amoako et al. (2021) suggested a synergistic relationship between infection and stunting, each being a risk factor for the other. Children who met the minimum acceptable diet have lower odds of stunting. This supports Walters et al.'s (2019) findings in a study in Malawi. Household food insecurity associated with a less diverse diet may be a factor in not meeting minimum acceptable diet (Walters et al., 2019). The economic challenges in Zimbabwe may have contributed to household food insecurity and may be leading to failure to meet minimum acceptable diet.

In this study, children who were not vaccinated had the highest odds of stunting. Kim et al. (2017) found that no vaccination or partial vaccination was significantly associated with severe stunting. In addition, Poirrer (2020) endorsed that full vaccination is protective for children under 5 of age.

Interpretation of Findings

The conceptual framework, adapted from the UNICEF conceptual framework for malnutrition (2013) was used to identify the immediate and underlying and basic causes of stunting in children aged under 5 years of age in Zimbabwe and any interplay between the causes that might be driving the rate of stunting in Zimbabwe.

Applying the conceptual framework for malnutrition to this study, evidence was found that basic causes (education and income) were significantly associated with stunting of children under 5 years of age in Zimbabwe. Education is important as it influences how mothers understand the need for accessing and utilizing health services. Mothers are given most of the information on childcare such as breastfeeding, weaning, and complimentary feeding, immunization, and environmental health, among others. The level of maternal education impacts on health literacy and how she uses the information she gets on childcare. Level of education also impacts on the type of jobs one can get and thus without good education, mothers are blocked from well-paying jobs limiting disposable income to buy nutritious food for the child or provide a healthy environment, such improved water source, and sanitary facilities. There was a clear path from the basic predictors identified in this study to the underlying and immediate causes that were found to be significant. The final model to identify the strongest predictors indicated education and income at basic level, size of household, size at birth and immunization as underlying causes and at immediate level, dietary intake (minimum acceptable diet) and health status (diarrhea and acute respiratory infections) were found significant. The effective use of the UNICEF conceptual framework for malnutrition in designing interventions at a multi-sectoral level could potentially reduce the burden of stunting in Zimbabwe.

Limitations of the Study

This study used secondary data originally obtained as part of the 2015 ZDHS. Using secondary data can create limitations as the original data were not collected to answer the research questions of this study. During collection of the data, there could have been recall bias for questions that relied on memory of past events, and bias could also have been introduced by the researchers when they collected the data or when they entered it into the database. Data quality checks were put in place during the whole survey process. When I assessed the data for internal and external validity, I was satisfied with the quality control measures that were put in place from sampling of participants, the data collection, the response rate, data entry and coding. The age of the data was a limitation as some of the information could be outdated. I was unable to get the database of the 2018 national nutrition survey. There was no data on duration of breastfeeding in the database for analysis hence this part of the questions remains unanswered. In addition, RQ5 was modified to identify the most significant predictors rather than interactions as initially intended. This was due to the complexity of interpretation of the results.

Recommendations

This study presents findings that contribute to the literature on stunting in Zimbabwe. The final model of the stepwise multivariate analysis provided the most predicting model for stunting and this should be the basis for interventions to reduce stunting in Zimbabwe. Education and income (wealth) were significant and as these are at the basic level, this is evidence that public health practitioners should use to influence policy to ensure that all girls are enrolled and retained in school as education plays a very important part in household wealth, food security and childcare practices. Policies such as conditional cash transfer for girl enrolment in school could be put in place to encourage parents to send their children to school.

In terms of improving household wealth (income), public health practitioners could recommend partnerships with private and non-governmental organization to improve the capacity of women to generate income and improve food security and access to health services. This would contribute to improvement in the size of children at birth, immunization of children and provision of a minimum acceptable diet to children. Further research is needed to find out which interventions could be integrated based on the findings of this study. Once there is evidence, scale up of such an integrated intervention would be recommended to policy makers. Follow up interviews to clarify some of the findings of this study could not be made, and the data set did not contain information such as time spent to prepare food and feed the child, duration of breastfeeding, therefore, I recommend that a mixed methods study using quantitative and qualitative data could provide more robust information on the predictors of stunting and guide the design of the interventions to reduce stunting.

This study identified that urban children are more at risk of stunting than rural children contrary to existing evidence. This an area for further exploration, to substantiate these findings or not and if substantiated, to identify the reasons. In addition, this study did not look at paternal attributes which could be associated with stunting, hence this could an area of research. This study had intended to identify any interaction between the variables which drive the levels of stunting but due to the complexity of interpretation of the data, this was not done, therefore this is an area for future research to provide evidence on the interactions of variables that drive stunting levels.

Implications

This study carries important information for public health professionals in developing strategies and interventions to reduce stunting. The consequences of stunting are irreversible and affects the individual child, the family, community, and country. The findings of this study offer opportunity for the development of targeted interventions to reduce stunting. Public health practitioners should realize that there is scope to involve other sectors and act jointly to reduce stunting. Involving the community in the identification of and development of strategies and interventions would increase community ownership of the problem of stunting and implementation of the interventions.

Using the UNICEF conceptual framework for malnutrition, strategies and interventions should be developed for each level. For example, for the basic causes, advocacy could be made to policy makers to implement policies that encourage enrollment and retention of the girl child at school, return to school programs for women; and put in place policies that create a conducive environment for families to engage in income generating activities. Kwami et al. (2019) argued that income growth, food production and women's education were important considerations for long term solutions to stunting. Private - public partnerships could be fostered for community programs that provide poverty reduction support. Woldehanna et al. (2017) asserted that household wealth and parental education play an important role in children's nutritional status.

At the underlying level, private – public partnerships, and community engagement to increase access to clean water, improved sanitation and reduce open defecation to zero. To ensure availability of diversified foods, seed houses and Ministry of Agriculture, under the advisement of Ministry of Health, could embark on a program to provide inputs such as seeds and fertilizers and teach the community how to grow, preserve and store diversified foods to increase household food security. Ministry of Health should ensure access to quality health services that provide health education to mothers on infant and young child feeding, immunization and prevention of diseases and infections.

At immediate level, there should be consolidation of information on health and nutrition and use it to prevent stunting in their children. In addition, there is evidence that it is possible to recover from early stunting and this study provides information which age groups are at higher risk of stunting, therefore interventions implemented at an earlier age could reduce the risk of stunting in the older age groups. Public health practitioners could engage the communities and families to discuss improvement of children's nutrition status through improvement of adolescent and maternal nutritional status, and in partnership with other stakeholders such as women's clubs, educate mothers on how to provide and cook good nutritious food using local foods and good hygiene during food preparations.

Conclusion

In conclusion, this study has provided evidence on the predictors of stunting and appears to be one of the first studies to document interaction between the predictors of stunting in children under 5 years of age in Zimbabwe. The study was a cross-sectional quantitative research, using secondary data from the 2015 ZDHS. The purpose of this study was to identify and describe the risk factors that drive stunting in children under 5 years of age in Zimbabwe and identify the most significant predictors of stunting utilizing the UNICEF conceptual framework for malnutrition. I assessed the associations between sociodemographic, environmental factors, child characteristics and childcare practices with stunting in children under 5years of age in Zimbabwe. I also identified factors that were strong predictors of stunting. The findings of this study showed there was statistically significant associations between some of the factors while others showed reduced likelihood of stunting. Zimbabwe implements a variety of interventions to reduce malnutrition, the National Nutrition Strategy (2014–2018) outlines the strategies and interventions. However, some of the strategies are not being implemented for several reasons. This study may offer an opportunity to review the strategies and target the most significant predictors identified in this study.

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Appendix A: Data Extraction Template

Variable Name	**ZDHS CODE**
Sociodemographic Factors	
Age	V013
Marital status	V501
Education	V106
Employment status	V716, V717, V721, V751, V732
Income	V190
Area of residence	V025
Environmental Factors	
Source of drinking water	V113
Sanitary facilities	V116
Hand washing	V462
Household size	V136
Child characteristics	
Age	B8, B19
Sex	B4
Size at birth	M18
Diarrhea episodes	H11
Acute respiratory episodes	H31
Fever	H22
Height/Age parameter	V439 – V441
Child care practices	
Initiation of breastfeeding	V426
Exclusive breastfeeding	V409 – V413, M55
Continued breastfeeding	M4
Complimentary feeding	V414
Immunization	H2 – H9

Appendix B: Letter of Approval for Use of Conceptual Framework

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United Nations House, Plot 617/618 Central District Area, Garki, Abuja
Telephone: (+234 (0) 9 -4616100/+234 (0) 9-4618578| www.unicef.org

12 December 2019

Ranganai Matema
Health Specialist
UNICEF
Sokoto, Nigeria

Dear Ranganai Matema,

RE: Request for Approval of External Academic Publication

Following receipt of your request to use UNICEF conceptual framework for malnutrition to guide your research on "Predictors of stunting in children under the age of five years in Zimbabwe" as part of your PhD program in Public Health at Walden University, I am pleased to inform you that in accordance with paragraph 10 of UNICEF's Policy on Outside Activity (CF/EXD/2012-009), your request was recommended by the Representative on 15 November, 2019 and approved by the Director, DHR on 5 December, 2019. You may proceed to use the framework for the purpose of your dissertation and ensure proper citation.

I sincerely wish you success in your PhD program.

Yours sincerely,

Jorge A. Ballestero
Chief of Human Resources
UNICEF Nigeria Country Office