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Association between household socio-economic status and stunting among under-five children in Zimbabwe

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University of Witwatersrand

School of Public Health

Association between Household Socio-Economic Status and Stunting Among Under-Five Children in Zimbabwe

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Student Number: 723578

A Research Report submitted to the Faculty of Health Sciences,

University of the Witwatersrand, in fulfillment of the requirements for the degree of

Degree of Master of Public Health

Johannesburg, June 2017

UNIVERSITY OF THE WITWATERSRAND SCHOOL OF PUBLIC HEALTH

TITLE: Association between Household Socio-Economic Status and Stunting Among Under-Five Children in Zimbabwe

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Research report submitted to the Faculty of Health Sciences, The University of the Witwatersrand Johannesburg, 2017 in partial fulfillment of the requirements for degree Master of Public Health, in the field of Maternal and Child Health.

DECLARATION

I, Nozipho O. Musakwa Maravanyika, declare that this research report is my own original work. It is submitted in partial fulfillment of the requirements for the degree Master of Public Health in Maternal and Child Health, at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to this or any other university.

X

Nozipho Musakwa Maravanyika

DEDICATION

This work is dedicated to the Almighty God for His wisdom and grace, my super supportive mother and father, my inquisitive precious daughter (what is “cleaning nose in church”/clinical research), my friends and the Rhema North Bible Church for their continued prayer support and encouragement during my studies.

ABSTRACT

Background

The disparities in health outcomes between the poor and the rich are increasingly widened, with conditions like stunting still dominating the public health agenda. Policy-makers and researchers need to investigate and inform policies that are aimed at reducing inequities and implement interventions based on available evidence.

Objectives

The study aimed to investigate the relationship between household socio-economic status and stunting in children younger than five years in Zimbabwe using the 2010 Demographic and Health Survey (DHS). The specific objectives were (i) to describe the different levels of stunting in children under-five years of age; (ii) to determine the association between socio-economic status and stunting in the under-five year age group; and (iii) to determine other factors associated with stunting in children under-five years of age in Zimbabwe.

Methods

Data from the 2010 Zimbabwe DHS was used for a cross sectional analysis. A modified Poisson regression was used to compute the crude and adjusted prevalence ratios (PR) and the 95% confidence interval (CI) of the association between socio-economic status and stunting. For multivariate models, variables that were identified a priori, those that had a p-value <0.20 in bivariate analyses and inclusion of variables that resulted in a change of 10% or more in the estimate of outcome, were included in the multiple regression models as potential confounders.

Results

A total of 1,080 children (**25.3%;** 95% CI: 23.8-26.8 %) of the 4,761 included in the sample were stunted. In univariate analysis, children in the richest households were shown to have a 43% significantly reduced prevalence of stunting as compared to the poorest households [crude PR=0.57, 95% CI (**0.45 – 0.72)**]. In multivariate analysis, the richer households had less stunted children than the poorest households (adj PR 0.63; 95% CI: 0.47 - 0.84), richer (adj PR 0.79 95% CI: 0.63 - 0.97 ;), middle (adj PR 1.01; 95% CI: 0.87 – 1.17 ;), and poorer (adj PR 0.85; 95% CI: 0.74 – 0.97). Other factors associated with stunting were the child's anaemia status, age, sex, weight, living with mother or other, the mother's height and the mother's body mass index (BMI).

Conclusion

This study showed that household socio-economic status is associated with stunting in children under the age of five years in Zimbabwe. Stunting is still an immense challenge for most economically unindustrialized nations, Zimbabwe included, and threatens the possibility of many of these countries meeting the Sustainable Development Goals. Therefore there is need for multi-sectoral interventions that include poverty alleviation, social welfare, educational and health policies that will enhance the socio-economic status of the household in order to improve children's nutritional status in Zimbabwe.

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ACRONYMS

AIDS	Acquired Immune Deficiency Syndrom
ANC	Antenatal Care
BMI	Body Mass Index
DHS	Demographic and Health Survey
HIV	Human Immuno-Deficiency Virus
ILO	International Labour Organisation
IMR	Infant Mortality Rate
MDG	Millennium Development Goal
MOHCW	Ministry of Health and Child Welfare
SES	Socio-Economic Status
UNICEF	United Nations Children's Fund
US$	United States Dollar
WHO	World Health Organization
ZDHS	Zimbabwe Demographic and Health Survey
ZNNS	Zimbabwe National Nutrition Survey
ZWD	Zimbabwean Dollar

CHAPTER ONE: INTRODUCTION

This chapter presents an overview of malnutrition worldwide, in Africa and in Zimbabwe and some of the factors that affect stunting. A brief literature review follows, covering some aspects of malnutrition relevant to this study. The chapter concludes with a theoretical framework, a problem statement, justification for the study and the objectives.

1.1 Background

A child's growth is potentially affected by many societal, economic, environmental and biological factors (1). Most children depend essentially on their families to provide for their basic human needs. The presence of adults in a household improves the chances of child survival, because adults provide resources and care for children (2). However in sub-Saharan Africa, poor socio-economic status and a lack of access to basic health care services results in young children dying prematurely(3–5). In 2015, there were about 5.9 million deaths of children under the age of five globally. Most of these deaths occurred in sub-Saharan Africa, where children were at least 14 times more likely to die before the age of 5 than those in developed countries (3,6). Most of the global child deaths are due to preventable and treatable causes, including diarrhoea, pneumonia and malaria. Malnutrition is the underlying cause in approximately 45% of under-five deaths according to the World Health Organization (6).

1.1.2 Malnutrition and its causes

Malnutrition is a condition that compromises the bodily functions of a person, to the extent that processes such as growth, gestation, and immunity do not work well (7). It includes a state of over and under-nutrition, however in the context of developing countries and this study; malnutrition will only refer to under-nutrition. The global burden of malnutrition in children is high with more than 300 million children under the age of five years estimated to be chronically under-nourished (8,9). Malnutrition contributes to more than a third of all child deaths worldwide (10).

Malnutrition can be acute or chronic (11–13). Acute malnutrition is an indicator of current change in nutritional status, reflecting recent weight changes or disruption in nutrient intake (7,9,14,15). This could be caused by either a disease state or insufficient dietary intake (16). Chronic malnutrition also known as stunting refers to a long standing lack of nutritional sufficiency leading to failure to achieve adequate length or height (8,17,18). A child under five years of age is labelled stunted if they are short for their age compared to an international standard - the World Health Organization z-score (19,20). If a child falls below two standard deviations of the z-score, then it is an indicator of linear growth retardation (7). Stunting demonstrates chronic malnutrition because it occurs over a longer period of time (21). Some of the short term and coexisting consequences of stunting include increased susceptibility to sickness and ultimately death (20,22,23). Another short term result of stunting is decreased intellectual, motor and language development in early childhood (24). From a social perspective it is associated with poverty resulting from increase in health expenditure for caring of the sick/sickly child and the opportunity costs for the care of the sick child (10).

The long term consequences of stunted growth and development include decreased adult stature, compromised reproductive health, increased risk of obesity and associated co-morbidities (22).

Other long term consequences include decreased school performance and learning capacity (12,25). This all ultimately results in unachieved potential and decreased work capacity and productivity in adulthood (13,18).

Chronic malnutrition, which manifests as stunted growth, can rarely be reversed after the age of two years (26,27). Any impact on stunting levels would require strategies targeted at women during pregnancy and at children from birth to twenty-four months of age (28–30).

1.2 Literature review

The nutritional status of an individual can be assessed using the ABCD approach, which are the anthropometric, biochemical, clinical and dietary methods (31–33). Anthropometric measurement offers a distinctive advantage as it is more sensitive, less expensive, with less bias and easier to assess when compared to the other methods. An individual's nutritional status if measured anthropometrically is compared to a reference population's median and inferences made about that status (20,30).

In stunting, which is chronic under-nutrition reflected as retarded linear growth, the reference population(the population from which inference about growth and development is obtained) is applicable to children from all over the world after extensive studies (34). A number of scholars agree that stunting is a paramount indicator of malnutrition as it also has the greatest prevalence globally, an effective predictor of human capital as well as an important indicator of child health inequalities (8,26,35,36). Stunting has additionally been recognised as one of the most difficult

nutrition indicators to treat especially after the window of opportunity (within the first 1,000 days of life) (37).

1.2.1 Stunting worldwide

Globally, stunting is more prevalent in developing than developed countries (12,38). Approximately 165 million children under the age of five are stunted, with 36 countries accounting for 90% of the world's stunted children, with 21 of these countries in Africa (3,4,12,33,39). Stunting in children younger than five years within developed countries stands at about 5.1 million children whereas in developing countries the figure stands at about 159.7 million children (4). There has been a global decline in childhood stunting rates since the 1990s, including in Asia, whilst the African region has seen an increased number of stunted children over the last decade (3).

Research has shown that nutrition is usually inclined by five factors: political instability; poverty/inequality; ineffective development policy; climate and environmental change; and inadequate and poorly administered food security, health prevention, and nutrition programs (40). At the household level, reasons for stunting could be related to socio-demographic factors such as the mother's level of education, mother's employment status, gender norms within the society, mother's partner's years of education, mother's partner lives/d at home and mother's partner's age; maternal stature, poor nutrition during pre-conception, tobacco use in pregnancy and lactation and childhood infection (9,13,41).

When food security falls in a household, the most vulnerable population is usually the women and children (12,42,43); therefore an assessment of socio-economic status to ascertain the vulnerabilities is crucial. Stunting can provide a proxy for the socio-economic vulnerability of families and might inform policy on social protection and where safety nets might be effective.

1.2.2 Stunting in Zimbabwe

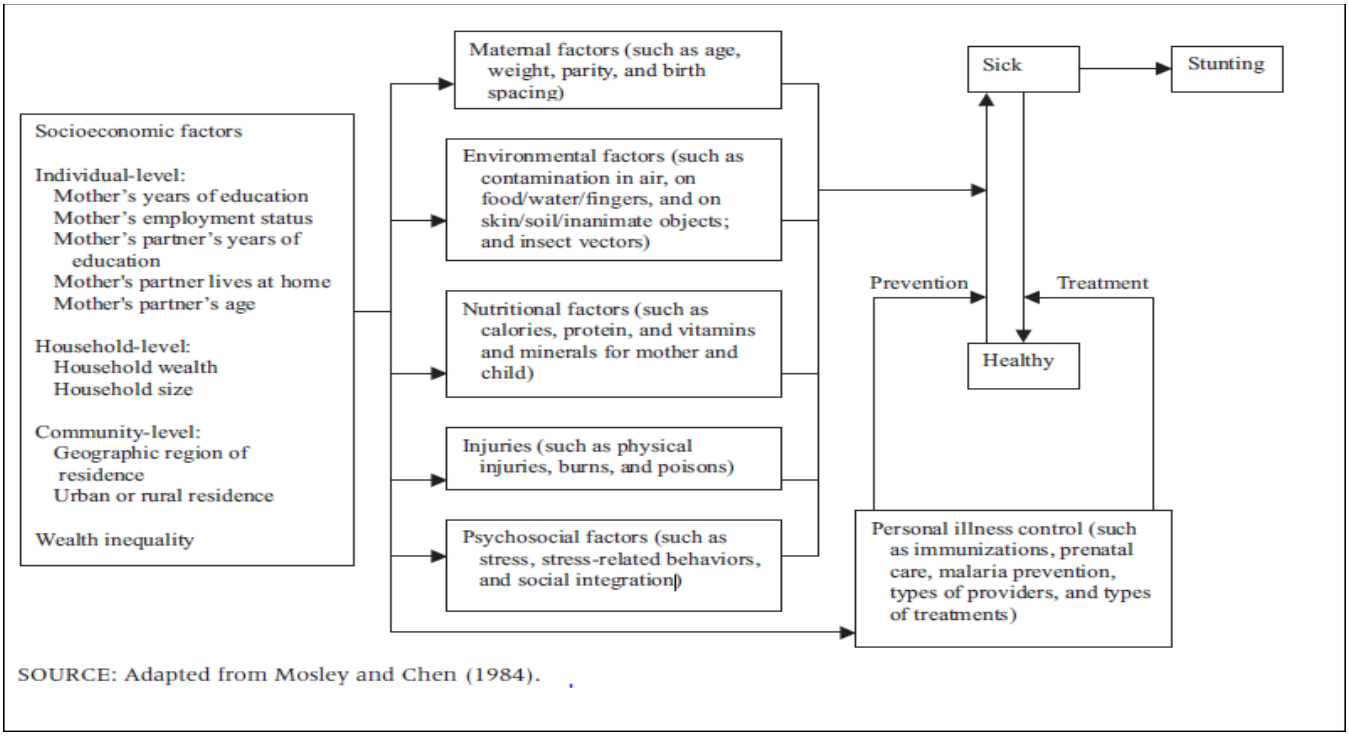
The stunting rates in the world were at 25.7% worldwide, 35.6% in Africa, 39.6% for sub-Saharan Africa and in Southern Africa were at 30.8% in 2011(4). In Zimbabwe the prevalence of stunting among children aged 0-59 months has increased over a period of time, from 21% in the 1994 to 33% in 2010 (44). Socio-economic status could be a major influence in stunting rates in light of fluctuating living conditions and the economy. An unstable economy results in the majority of the population living with socio-economic deprivation which has been shown to have an impact on livelihood and consequently food security.

1.2.3 Conceptual framework for understanding stunting

Reinbold's stunting conceptual framework

There are numerous factors affecting stunting and according to Reinbold's socio-economic framework adapted from Mosley and Chen conceptual framework on childhood stunting, these can be broken down into two: proximate and distal determinants of stunting (1,22,45). Distal factors, are indicated by socio-economic variables such as region of residence, mother's education, and access to land; whereas more proximate or intermediate factors, including hygiene and nutritional factors incidence of disease, and age and sex of the child. The Mosley and Chen framework is shown in Figure 1.

Currently there are no theories that directly correlate socio-economic status and stunting. However, the framework by Reinbold can be utilized to express how socio-economic status affects child health and nutrition. Davis and Blake originated the framework in 1954 in which they assessed fertility and indirect (distal) and proximate or more direct variables (46). Mosley and Chen in 1984 added other independent variables delineated and linked them to child mortality, into those that occur at individual, household and community levels (45).



Source: (1)

Fig 1.1 Mosley and Chen conceptual framework on childhood stunting

The authors merge nutritional status of the child to the levels of mortality to create health indices for the dependent variables. After this, other factors which are consequential, for example maternal factors, the environment, personal illness control and nutritional deficiency of the child

are paired to the level of mortality in a specific birth cohort in order to create a general health index (45). In addition, the richness and robustness of the framework is intrinsic in that it looks at both the social and biomedical aspects – with the authors' impressing the strong interaction of the social determinants of health and the wellness of children (1,28).Mosley and Chen have stated clearly that such interactions are crucial in understanding child mortality and morbidity outcomes and that the framework was produced to be used in the context of countries with poorer socio-economic status (45).

The vital part of the model is identifying the direct determinants and intermediate variables that influence the risk of morbidity and mortality in children, within their local and cultural setting (1,45). In this study, not all the aspects of the framework were used, but those which typically relate to nutrition and socio-economic status as identified by Reinbold and those that were also collected in the Demographic Health Survey were utilized.

1.2.4 Socio-economic factors affecting stunting

These are influences that underpin stunting through the policies, laws and legislature, politico-legal, socio-cultural, education that impact the household/community a child lives in (47). These factors impact on the quantity and quality of actual resources and the way they are available at household or individual level. For example at household level, the individual productivities of the caregivers have an impact on a child's level of growth faltering or survival (8,9,48). A DHS study done in Kenya, revealed that improving the socio-economic status of the mother, greatly decreased the incidence of stunting. In turn higher socioeconomic status impacts a set of

"proximate determinants" of health, including food security, feeding practices, stress levels of caregivers that in turn directly affect the nutritional consequences of children(49).

A mother's level of education, for example is known to have an impact on the child's survival (48,50–52) and education is highly and negatively correlated with childhood mortality even when other factors associated with education are controlled for (28,52–54). The mother's education is deemed to have a greater role than the father's education probably due to a greater maternal involvement in child care (55). Some researchers state that more highly educated people seek health care more actively and are more likely to engage in healthier care practices for instance by providing more nutritious food and hand washing (28). Caldwell et al. concluded that an educated mother is more comfortable with engaging the health care system and questioning treatment (56). This could impact stunting programs in that once a mother can understand the significance behind certain care practices she is more likely to engage in them. A study in urban Mozambique revealed that a mother's status in the household and years of education had an impact on stunting levels (57), while another study in Ghana showed that household wealth and whether there was a head of household were the strongest determinants of stunting (38,58). Ruel et al also show that good care practices could moderate the negative effects of poverty and low maternal schooling (38). From the current literature it seems education does play a "protective role" against stunting.

Economic status plays a significant role in malnutrition, with household assets being available for sale if need be(11,50,54). Children living in Zimbabwean rural areas have been identified as being at a higher risk of stunting, with about 93% of households lacking access to financial or

agricultural resources to provide a minimum acceptable diet (59). In Brazil it was noted that investing in physical infrastructure would translate to changes in the intergeneration cycle of poverty (8). This would be achieved through increasing access to economic opportunities; and the improvement of sanitation and water systems therefore decreasing the spread of infectious diseases and ultimately reducing stunting (8,60).

Haslpenny (2012) and Arimond (2004) have also found that mortality and morbidity rates are higher in rural and economically disadvantaged areas than in urban and economically well-off areas (60–63). The study by Lawson (2016) found that children belonging to parents who are married and live together have relatively better survival chances in comparison with children who are brought up with only one parent or caretaker (64). Children who experienced paternal death or paternal separation were prone to an increase in lower food security and or relative poverty resulting in greater stunting in Tanzania (64).

In another study conducted in Bangladesh the prevalence of stunting declined as the household wealth status increased, from 54% in the poorest households (lowest wealth index quintile) to 25% in the wealthiest households (highest wealth index quintile) (65).

Looking at the literature available one could conclude that in the absence of adequate care, household food security (a proxy of socio-economic status), health and environmental services, and unmet basic causes in a country might push an ill child into stunting (37,38,51,66,67).

Ultimately, a number of studies using different analytic as well as study designs showed that increasing child age, decreasing socio-economic status as well as lower birth weight are risk factors for stunting (26,66,68). Socio-economic factors that have an impact on nutrient intake and uptake have a higher consequence on stunting status in children than other factors like geography or ethnicity (17,34).

Nutrition

The proximal causes of stunting according to the Reinbold model are a product of the socio-economic factors that exist in the child's immediate environment that can cause malnutrition (1). These causes include family and household factors; inadequate complementary feeding practices (calories, protein, multivitamins available for mother and child); psychosocial stresses; the premise of breastfeeding and the presence/absence of concomitant infection; the presence of injuries like physical burns etc.; the sanitation and water supply for the community and household; and inadequate health seeking behaviour (1,24).

Some immediate causes of malnutrition include inadequate dietary intake as well as disease states which lead to morbidity (stunting) and death (69). Inadequate complementary feeding either through the use of poor quality foods, inadequate feeding practices and lack of food and water safety could likely result in stunted children. Poor quality foods have poor micronutrient quality; a low dietary diversity – with low intake of animal source foods or foods with anti-nutrients and giving children complementary foods with low energy (24). A caregiver with poor feeding practices such as infrequent feeding; infrequent feeding during and after illness; making foods

with wrong consistencies; feeding insufficient quantities and practicing non-responsive feeding would put a child at risk of stunting (24,70).

Poor breastfeeding through delayed initiation, non-exclusive breastfeeding, early cessation of breastfeeding and the presence of infection are some of the main causes of stunting (71,72). The outcome of malnutrition within a child then affects how much they eat, absorb and utilize for bodily functions (18,47). Further compounding the two factors above is the malnutrition and infection cycle. This malnutrition and infection cycle consists of increased nutritional requirements in an ill child, while at the same time the child's intake is decreased resulting in worsening of malnutrition and worsening of the illness(41). The cycle can be broken by good care and health seeking practices (70,73).

Dietary diversity

Dietary diversity is defined by the World Health Organization as the number of food groups consumed over a given period (63) The definition is based on the assumption that if a child ate from at least four food groups on the previous day, then they most likely ate adequate micronutrients to prevent malnutrition. The food groups are seven in total namely (i) grains, tubers, roots; (ii) legumes and nuts; (iii) dairy products; (iv) flesh foods (meat, poultry, fish, insects and organ meats; (v) eggs; (vi) vitamin A rich fruits and dark leafy vegetables; and (vii) other fruits and vegetables.

Environmental factors

Approximately 53% of the Zimbabwean population live in rural areas, and are more likely to have water sources further from their houses or lack piped water as well as lacking adequate sanitation facilities (27,34). Clean running water and adequate plumbing reduce the likelihood of gastrointestinal diseases that are particularly dangerous for children living in poor conditions, and this is hypothesized to have an impact on stunting levels through the malnutrition and infection cycle (8,10).

One can infer that poverty or the lack of resources at household or community level (through environmental influences) has an impact on the nutrition status of children. It is likely that in an environment where there is lack of water and inadequate sanitation, stunting levels are likely to be high.

Other socio-demographic factors

Maternal factors seem to have a great impact on stunting rates, with factors like poor nutrition during conception, adolescent pregnancy, maternal mental health and short birth spacing contributing to the risk of stunting (10). Other factors that have an impact on stunting include the parity within a household and recent evidence also indicates that children born to women who are stunted are at greater risk of dying than children of mothers with normal height (23,57,74).

Taking all the available evidence into consideration, one can conclude that numerous factors including status of women in a society, the infrastructure levels of the community and education all impact on the socio-economic status and ultimately the stunting of children.

The information on how socio-economic status impacts stunting is limited in sub-Saharan Africa, and not completely available for Zimbabwe after 2008, when the US dollar was introduced as the main currency. Thus the study of socio-economic status and its association with stunting in a sub-Saharan and Zimbabwean context would be informative.

1.3 Study rationale

A study conducted in 2010 using all the previous Zimbabwe Demographic Health Surveys by Mbuya et al (27), did not find a significant association between stunting and household socioeconomic status. The surveys used in that study were before the dollarization in 2008 (use of the United States Dollar –US$-as the main currency) (75).Thus a study to assess the association between household socio-economic status and stunting after 2008 would be beneficial, as there are many socio-economic changes that have occurred across the country. A conversion in the Zimbabwean economy from the Zimbabwean dollar (ZW$) to a multi-currency economy occurred in 2008 (75). This was necessitated after the value had dropped from ZW$ 1 for US$1.47 in 1980 to ZW$10 billion for US$0.33 in 2008, which had resulted in widespread poverty and hunger (42,75). In 2008, political instability in Zimbabwe was at its worst with widespread violence and food insecurity resulting in shops not having any food. All these factors could have had effects on child malnutrition.

Investigating how the household socio-economic status affected stunting post the dollarization era is important in order to inform health and nutrition policies and programmes in Zimbabwe.

1.4 Aims and Objectives

1.4.1 Aim or study question

To determine the association between household socio-economic status and stunting among children under-five years in Zimbabwe

The hypothesis was that households with poor socio-economic status have higher stunting levels.

1.4.2 Objectives

i. To describe the different levels of stunting in children under-five years of age;

ii. To determine the association between socio-economic status and stunting in the under-five year age group; and.

iii. To determine other factors associated with stunting in children under-five years of age in Zimbabwe.

CHAPTER TWO: METHODOLOGY

2.1 Introduction

This chapter describes the study setting, survey design, study population, materials, statistical methods, the variable construction, the steps in data analysis and ethical issues considered in this study. Additionally anything that was characterised in the primary study that could affect this secondary study is also delineated in this chapter.

2.2 Study setting, design and population

2.2.1 Study setting

Zimbabwe

The study location, Zimbabwe, is a landlocked country and shares borders with South Africa, Zambia, Mozambique, Malawi and Botswana (Figure 2). The country is divided into 8 provinces and 52 districts. In 2012, Zimbabwe had a population of approximately 13 million (21,76). About 61% of the Zimbabwean population is classified as poor, with 45% living below the poverty line(77)

Figure 2.1 Map of Zimbabwe



Source:(42,78)

2.2.2 Study design

The study was a secondary data analysis of the Zimbabwean Demographic and Health Survey (ZDHS) dataset of 2010-11 which was a nationally representative cross-sectional survey (21).

Data Source

Zimbabwe Demographic and Health and Survey (ZDHS) The data for this study was obtained from the 2010-2011 Zimbabwe Demographic and Health Survey (ZDHS) which is the fifth survey to be conducted by the Central Statistical Office (CSO) in Zimbabwe as part of the Zimbabwe National Household Survey Capability Programme (79) .The survey is also part of the worldwide Demographic and Health Surveys programme, which has been implemented in Africa, Asia, Latin America, and Europe (21)

2.2.3 Study population

For this study (a secondary analysis), the study population consists of all children in the sampled households who were present and alive and whose information was obtained from the primary study.

Primary study

The primary study population was a representative sample of 10 828 households which included all women and men aged 15-49 years (21). The sample population that was interviewed had to be either permanent residents of the households or those who had visited and stayed in the household the night before the survey. The 2002 population census was used as the sampling frame, whilst the households were the sampling units. The ZDHS sample was derived using a stratified, two stage cluster design where enumeration areas (EAs) were the sampling units in the first stage. These enumeration areas were developed by subdividing wards (which are the lowest administrative units). There were a total of 406 EAs, 169 in urban and 237 in rural areas. The second stage of the sampling involved a complete listing of households in all the selected EAs. Mapping was done for private households excluding institutional living arrangements listed for all the clusters (21).

The main objectives of the ZDHS were to determine the latest information on "fertility levels; sexual activity, fertility preferences; knowledge and use of family planning methods; breastfeeding practices; nutritional status of mothers and young children; early childhood mortality and maternal mortality; maternal and child health; malaria prevention and treatment; HIV awareness and behaviour; domestic violence"(21).

Questionnaire design

The 2010 -2011 ZDHS used three questionnaires namely the Household questionnaire, Women's questionnaire and the Men's questionnaire to collect specific information from eligible respondents (Appendix 2). The Household Questionnaire collected basic information on the characteristics of each person listed in each household such as age, sex, education and relationship to the head of the household.

The Household Questionnaire also collected information on the characteristics of the household's dwelling unit such as the source of water, type of toilet facilities and materials used for the floor of the house.

The Women's Questionnaire was used to collect information from women in the reproductive age group between 15 and 49. Women were asked questions about their background characteristics (education, residential history, and media exposure), birth history and antenatal, delivery and post-natal care, vaccinations and childhood illnesses among other things.

The staff for the survey were trained for a period of two weeks to administer questionnaires, take anthropometric measurements and collect blood samples were required.

2.4 Variables and measurements

In this analysis, variables that were not applicable to the survey, as well as variables that were not relevant to the analysis were removed from the Zimbabwe Demographic Health Survey 2011 dataset.

Outcome

The main outcome for this study was stunting status as defined by the anthropometric measure, height-for-age. As per WHO guidance, a standard deviation (SD) of -2 from the median identifies those who are malnourished, and a SD of -3 from the median identifies those who are severely malnourished (38,80)). Height-for-age reflects the long-term consequences of malnutrition and is shown as deficits in linear growth. For this study the outcome is designated as a binary yes/no. This was obtained by classifying every child with a SD of greater than -2 as not stunted (No) and anyone with a SD less than or equal to as stunted.

Covariates / Independent variables

For the purpose of this study the independent variables were grouped into either socioeconomic factors or proximate factors;

i) *Socio-economic factors:* the main exposure used in the study were the wealth quintiles (for each household), however these other factors were considered:

Individual level:

Highest level of education of mother: No schooling, primary, secondary, or tertiary

Work Status: this was collapsed into binary options yes/no

Household level:

1. Household size: this was computed as two variables children under 5 years of age and total number of children in the house.
2. Household wealth/Socio-economic status: Household asset indicators common to urban and rural areas were used to create the wealth scores for households in both areas. Categorical variables ascertaining the different wealth scores were coded into different indicators. Those that were continuous were then examined using a principal component analysis to produce a common factor score for each household reported as wealth quintiles, which were categorized in the ZDHS as poorest, poor, middle, richer and richest. Attached see appendix C)

Community level: Geographic region of residence, urban or rural residence - these factors were collected in the DHS and reported as urban/rural

(ii) Proximate factors:

Maternal factors: child's birth order (parity order), age, BMI, height

Birth order the order in which a child was born in a family

Mother's age: This was categorized according to the following (15/19 =1 "15-19") (20/29=2 20-29) (30/39=3 30-39) (40/49=4 40-49)

Mother's BMI*:* This variable was re categorized and classified as (14.82/18.49 =1 "underweight") (18.5/24.99=2 "normal") (25/29.99=3 "overweight") (30/48.80=4 "obese")(32).

Mother's height was classified as (114.9/160=1 "short") (160.1/169.9=2 "medium") (170/197.4=3 "tall")(32)

Nutritional Factors:

Dietary diversity: this was computed by adding up the various food groups and if the child consumed all three food groups, they were considered as receiving a diversified diet, if they consumed at least one of the food groups they were considered partially diversified. If the child did not consume from any of the three food groups starches, vegetables or protein they were considered not eating a diversified diet. Dietary diversity refers to the number of foods from different food groups consumed in a given period of time (63).

Ever Breast fed – this was computed as ever breastfed, never breastfed, don't know

Anaemia status of child- this was classified as severe, moderate, mild and not anaemic

Anaemia status of mother-this was classified as severe, moderate, mild and not anaemic

Personal Illness Control:

Past illness – this was computed as whether the child had any of the common childhood illness (diarrhea, cough or fever within the last two weeks).

Immunizations: this was computed as the number of immunization as a table if the child had completed (diphtheria/pentavalent, measles, polio and BCG or gotten a booster shot according to the Zimbabwean Ministry of Health and Child Welfare vaccination calendar (81). A score was assigned according to whether the child was partially immunized, fully immunized or received no immunization.

**The birth weight and height of the child was taken out of the model as they are both directly on the pathway to stunting and would confound the data* (82).

2.6 Hypothesis

Null Hypothesis: There is no difference in child stunting between levels of socio-economic status in Zimbabwe

Alternative Hypothesis: There is a difference in child stunting between levels of socio-economic status in Zimbabwe

2.7 Data Management:

For this secondary study, the primary dataset was opened and reviewed. Additional recoding and cleaning was done using Stata software (version 13.0, STATA Corp.Dallas TX,).

The Children's Record (KR file) was used as it contained all the variables that were needed for the study. The KR file contained data collected from the households on the children, their mothers and the household demographics. First the data was imported into the Stata software programme and then cleaned before analysis. The cleaning involved dropping variables that were not deemed necessary (through literature search) for the analysis and recoding of data into categorical variables. Data cleaning ensured that all incomplete and inconsistent entries were accounted for and excluded from the analysis.

2.8 Statistical analysis

Data was analysed per study objective. The primary study used stratified two stage cluster sampling and therefore survey data analysis methods were used to adjust for stratification and clustering so that accurate point estimates and standard errors were obtained (83). An assumption

of independence of outcome measures is expected amongst standard data analyses and when this is violated new methods of data analysis are required (83). To correct for this in the secondary study, Stata's survey set command was declared in the data analysis to account for the clustering.

In all analyses, variables with a p-value of <0.05 were considered as statistically significant. The mean and standard deviation was used to describe continuous variables and where data were not normally distributed, the median and interquartile range was used. Frequencies and proportions were used to describe categorical variables.

To describe the different levels of stunting in children under-five years in Zimbabwe from the ZDHS 2010, frequencies and proportions (percentages) were computed, as well as cross tabulations. A number of children were missing anthropometric data and these were excluded from the univariate and multivariate analysis. *check limitations*

Bivariate and multivariable modified Poisson regression was used to compute the crude and adjusted prevalence ratios (PR) and the 95% confidence interval (CI) of the association socio-economic status and stunting. For multivariable models, variables that were identified a priori, that had a p-value <0.20 in bivariate analyses and their inclusion resulted in a change of 10% or more in the estimate of outcome were included in the multiple regression models as potential confounders.

2.9 Ethical considerations

Permission for use of the data was obtained from Measure DHS (76) The study was approved by the Human Research Ethics Committee (Medical) of the University of Witwatersrand (certificate no. M150238).

CHAPTER THREE: RESULTS

This chapter delineates the results from the 2010/2011 DHS secondary study. Firstly there is a description of mothers and their children 0-59 months whose heights and age measurements were available. Secondly it summarises the analysis and the results thereof.

3.1 Child, mother's and household characteristics

Child characteristics

Table 3.1 shows characteristics of children who were enrolled in the study. There were approximately 5,596 children in the study, with roughly equal numbers of males and females. Half the children were in the age range 26-59 months. Most of the children fell within the 5-15kg weight range. Almost two thirds of all the children had been breastfed at some point in their lives. According to the analysis a quarter of the children were stunted. About two thirds of the children in the study were the first or second child in the family, with half of the children coming from a household were they were the only child under 5. Just over half of the children had received the full schedule of immunization according to the Zimbabwean national immunization schedule. There wasn't adequate information on the dietary diversity of the children as just over half had missing information, while one third ate predominantly starchy foods. The majority of the children's households were located in rural areas.

Mother's characteristics

The majority of mothers with children under the age of five were between the ages of 20-39 years. Two thirds of the mothers had a normal BMI, with approximately half of the mothers being short (<160cm). At least one out of three mothers had received secondary education.

However one in three mothers were not currently employed. The majority (four fifths) of mothers were married. See Table 3.2.

Household characteristics

Table 3.3 shows a summary of selected household characteristics. Two thirds of households were headed by a man, with the majority of households self-identifying as Christian. Most of the households were in rural areas and most children lived with their mothers.

Table 3.1 Characteristics of children under 5 in the Zimbabwe Demographic Health Survey 2011

Variable	Number	%	N (%) Stunted	N (%)Not Stunted	P-value
Sex					
Male	2397	50.4	572 (13.4)	2245 (36.3)	0.024
Female	2364	49.7	509 (11.9)	2270 (38.4)	
Age					
<6 months	638	13.4	34 (0.8)	509 (11.9)	
6 -12 months	756	15.9	91(2.1)	594 (13.9)	< 0.001
13-25 months	985	20.7	333 (7.8)	546 (12.8)	
26-59 months	2383	50.0	623 (146)	1548 (36.2)	
Weight					
< than 5kg	203	3.6	19 (0.3)	135 (3.3)	
5 – 10kg	1750	31.3	442 (7.9)	1245 (23.4)	
10.1 – 15kg	1955	34.9	601 (10.7)	1323 (24.2)	<0.001
15.1 – 20kg	508	9.1	19 (0.3)	485 (8.8)	
Height					
< than 50cm	56	1.0	5 (-)	8.87 (0.2)	
50 – 80 cm	2125	38.0	597 (10.7)	1467 (26.4)	<0.001
80.1 – 100cm	1832	32.7	479 (8.6)	1336 (23.9)	
100.1 – 110 cm	362	6.5	0 (0)	359 (6.4)	
Birth Order					
Singleton	1798	32.1	322 (5.8)	1477 (17.6)	
Second	1504	26.9	288 (5.1)	1217 (15.9)	0.006
Third/Fourth	1599	28.6	310 (5.5)	1290 (16.7)	
Higher than five	650	11.0	155 (2.8)	496 (6.4)	
Past Illness					
No	3196	99.3	1067 (19.1)	3170 (56.6)	0.013
Yes	1081	0.8	13 (0.2)	26 (0.2)	
Immunization					
No Immunization	730	13.1	110 (2.0)	375 (6.7)	
Partial Immunization	1512	27.0	225 (4.0)	1062 (19.0)	<0.001
Full Immunization	2965	53.0	746 (13.3)	1759 (31.4)	
Anaemia					
Severe	34	0.6	16 (0.29)	16 (0.3)	

Moderate	994	17.8	299 (5.34)	679 (12.1)	
Mild	892	15.9	241 (4.31)	639 (11.4)	<0.001
Not Anaemic	1382	2.5	362 (6.47)	1001 (17.9)	
Breastfeeding					
Never breastfed	193	3.5	23 (0.4)	39 (0.7)	<0.001
Ever breastfed	3494	62.4	784 (14.0)	1762 (31.5)	
Still breastfeeding	1874	34.0	1631(29.1)	273(4.9)	
Dietary Diversity					
No Diversity	986	17.6	119 (2.1)	634 (15.5)	
Full Diversity	4	-*	2 (-)	2 (-)	
Starchy Foods	2209	39.5	458 (8.2)	1398 (31.3)	<0.001

***-numbers too small**
****chi-squared**

Table 3.2 Characteristics of mothers of under 5 children in the Zimbabwe Demographic Health Survey 2011

Variable	Number	%	N(%) Stunted	N (%)Not Stunted	P-value
Mother's Age					
15 -19	401	7.2	81 (1.4)	238 (4.2)	
20 – 29	3311	59.2	615 (11.0)	1891 (33.8)	0.197
30 -39	1623	29.0	317 (5.7)	933 (16.7)	
40 -49	260	4.7	68 (1.2)	134 (2.4)	
Mother's BMI					
Underweight (<18.49 kg/m²)	319	5.7	95 (1.7)	177 (3.6)	
Normal (18.5 – 24.9 kg/m²)	3488	62.3	719 (12.9)	2036 (36.4)	
Overweight (25 – 29.99 kg/m²)	1158	20.7	196 (3.5)	700 (12.5)	<0.001
Obese (30 kg/m² +)	429	7.7	65 (16)	265 (4.7)	
Mother's height					
Short (<160cm)	2778	49.7	675 (12.1)	1506 (26.9)	
Medium (160 – 169.9cm)	2381	42.6	366 (6.5)	1522 (27.2)	< 0.001
Tall(170 cm +)	239	4.3	34 (0.6)	154 (2.8)	
Mother's education					
No education	95	16.9	25 (0.4)	50 (0.9)	
Primary	1814	32.4	391 (7.0)	1015 (18.1)	0.001
Secondary	3521	62.9	647 (11.6)	2042 (36.5)	
Higher	166	3.0	17 (0.3)	1.6	
Mother's work status					
Currently not working	3299	59.0	652 (11.6)	1902 (34.0)	
Currently working	2261	40.4	422 (7.5)	1277 (22.8)	0.399
Marital Status					
Never in union	200	3.6	47 (0.8)	97 (1.7)	
Married	4824	86.2	907 (16.2)	2845 (50.9)	
Not together	572	10.2	127 (2.3)	254 (4.5)	<0.001
Mother's Anaemia status					
Severe	17	0.3	4 (-)	10 (0.19)	
Moderate	307	5.5	52 (0.9)	172 (3.1)	
Mild	1059	18.9	219 (3.9)	603 (10.8)	<0.001
Not anaemic	3607	64.5	729 (13.0)	2139 (39.2)	

Table 3.3 Household characteristics of children under 5 in the Zimbabwe Demographic Health Survey

Variable	Number	%	N (%) Stunted	N (%)Not Stunted	P-value
Wealth Quintiles					
Poorest	1277	22.8	301 (5.4)	723 (12.9)	
Poorer	1178	21.1	236 (4.2)	698 (12.5)	
Middle	1070	19.1	249 (4.5)	603 (10.8)	<0.001
Richer	1190	21.3	194 (3.5)	672 (12.0)	
Richest	880	15.7	101 (1.8)	499 (8.9)	
Head of Household					
Male	3235	57.8	613 (11.0)	1902 (34.0)	0.036
Female	2360	42.2	467 (8.4)	1294 (23.1)	
Number of Children <5 years in household					
1	3099	55.4	531 (9.5)	1633 (29.2)	
2	1917	34.3	420 (7.5)	1206 (21.6)	
3	454	8.1	96 (1.7)	285 (5.1)	<0.001
4-7	126	2.2	34 (0.6)	71 (1.3)	
Place of Residence					
Urban	1666	29.8	249 (4.5)	891 (15.9)	<0.001
Rural	3930	70.2	831 (14.9)	2305 (41.2)	
Religion					
Traditional	48	0.9	9 (0.2)	32 (0.6)	
Christian	5093	91.0	974 (17.4)	2195 (52.1)	0.601
other	454	8.1	97 (1.7)	249 (4.5)	
Child lives with					
Mother	4845	86.6	1075 (19.2)	3192 (57.1)	
Other	363	6.5	6 (0.1)	4 (-)	<0.001

*(-) number too small

3.2 Stunting

Of the 5,596 children in the study, 25.3% (C.I. 23.8-26.8 %) were stunted. The age group with the highest frequency of stunted children was the 25 -59 months age group (Figure 3).

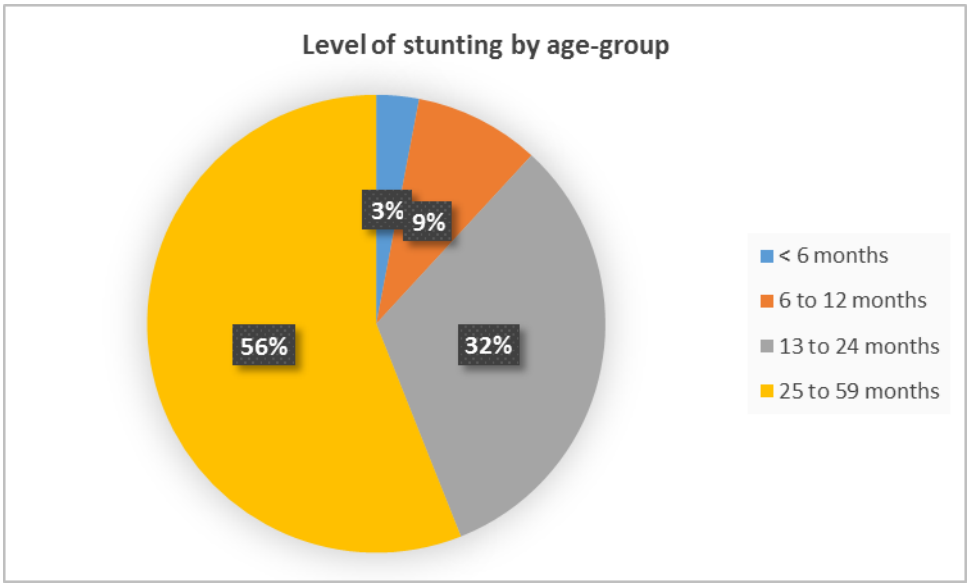


Fig 3.1 Graphical representation of stunting among the different age groups

3.3 Association of socioeconomic status with stunting

In univariate analysis, children from the richest homes had a much lower prevalence of stunting as compared to children from the poorest household (unadj PR 0.50; 95% CI: 0.45 – 0.72). When comparing those in the richer households with the poorest the prevalence was also low (unadj PR 0.72**:** 95% CI**:** 0.64 – 0.91). Those children coming from poorer households had a lower prevalence of stunting when compared to those from the poorest households (unadj PR 0.86; 95% CI: 0.74 – 1.01). This is shown in Table 3.4.

With regards to other factors in the univariate analysis, females had a lower likelihood of being stunted (unadj PR 0.88; 95% C.I. 0.74 – 1.01). Older children were more likely to be stunted

compared to younger children, that is children, aged 6-12 months had a two-fold increased prevalence of stunting compared to those less than six months; those aged 13-25 months had a six fold increased prevalence of stunting compared to those less than six months and those 26-59 months of age had an approximately five fold increase in prevalence.

A larger current weight was associated with increased prevalence of stunting, those with a weight of 5-10kg had a 2.7 fold increased prevalence of stunting compared to those less than 5kg. Those between 10.1-15kg had a 3.25 fold increase in prevalence of stunting; whereas for those between 15.1 – 20 kg and above the weight became protective against the prevalence of stunting compared to those less than 5kg (aPR 0.39; 95% C.I. 0.19-083).

Breastfeeding was associated with stunting; with those who were still breastfeeding having a lower prevalence of stunting. Those who had breastfed at any one time but were not breastfed currently had an increase in stunting compared to those still breastfeeding. The children who had breastfed at some point had a sixteen percent lower prevalence of stunting as compared to those who had never been breastfed. Those who were still breastfeeding at the time of the study were 52% (adj PR 0.000; 95% C.I. 0.34 – 0.69) less likely to be stunted than those who had never been breastfed.

Partial immunization provided some protection in the prevalence of stunting as compared to those who were not immunized. However those who received full immunization had a higher prevalence of stunting than those who received no immunization (aPR 1.32; 95% C.I. 1.09 –

1.58). Children with severe anaemia had a higher prevalence of stunting. Those with moderate anaemia had 40% less prevalence of stunting; the children with mild anaemia had 45% less prevalence of stunting; and those children who were not anaemic had a 47% lower prevalence of stunting.

The mother's BMI had a bearing on the prevalence of stunting. Mothers who were classified as normal, overweight or obese according to the BMI scales had children with a lower prevalence of stunting as compared to those mothers who were classified as underweight.

The mother's height also showed an association, with the taller mothers having less stunted children. Mothers with a height between 161- 169cm had a protective effect against stunting in their children with a 27% less prevalence of stunting. Taller mothers of 170cm and above had children with a 40% less prevalence of stunting.

The place where the household was situated had an impact on prevalence. Households situated in rural areas had a 1.2 increase in prevalence of stunted children as compared to households in urban areas.

Children who were living with people other than their mothers had a two-fold increase in prevalence of stunting as compared to children who were living with their mothers.

Child birth order, past illness, dietary diversity, mother's age, mother's education, mother's work status, marital status, mother's anaemia status, head of household, number of children under the age of five in household, religion of household showed no significant associations in the univariate analysis. The results are shown in Table 3.4.

Table 3:4 Univariate analysis of factors associated with stunting, Zimbabwe Demographic Health Survey 2011

Variable	Prevalence Ratio	95% Confidence Interval	p-Value
Sex			
Male	1.00		
Female	0.88	0.79 -0.98	0.024
Age			
<6 months	1.00		
6 – 12 months	2.09	1.34 -3.26	0.001
13 -25 months	5.98	3.95 – 9.08	<0.001
26 – 59 months	4.53	3.05 -6.73	<0.001
Weight			
< than 5kg	1.00	1.51 – 4.71	0.001
5 -10kg	2.67	1.86 – 5.65	<0.001
10.1 – 15kg	3.25	0.19 -0.83	0.015
15.1 – 20kg	0.39	0.23 – 0.79	<0.001
Height (cm)			
< than 50	1.00	0	0
50 – 80	0.85	0.39 – 1.85	0.681
80.1 -100	0.78	0.36 – 1.69	0.524
Birth Order			
Singleton	1.00	0	0
Second	0.99	0.85 -1.15	0.901
Third/Fourth	1.00	0.87 – 1.17	0.899
Higher than five	1.22	1.01 – 1.48	0.036

Past Illness			
No	1.00		
Yes	1.33	0.84 – 2.10	0.229
Breastfeeding			
Never breastfed	1.00		
Ever breastfed	1.86	1.21 – 2.87	0.005
Still breastfeeding	1.19	0.77 – 1.84	0.430
Immunization			
No immunization	1.00		
Partial Immunization	0.77	0.62 -0.96	0.023
Full Immunization	1.32	1.09 -1.58	0.004
Anaemia			
Severe	1.00		
Moderate	0.60	0.44 – 0.85	0.003
Mild	0.55	0.39 – 0.77	0.001
Not Anaemic	0.53	0.38 – 0.74	<0.001
Dietary Diversity			
No diversity	1.00		
Full diversity	2.50	0.57 – 10.92	0.22
Starchy Foods	1.57	1.26 – 1.95	<0.001
Mother's Age (years)			
15 -19	1.00		
20 -29	0.97	0.79 – 1.19	0.758
30 -39	1.00	0.79 – 1.27	0.993
40 – 49	1.32	0.99 – 1.78	0.067
Mother's BMI (kg/m^2)			
Underweight (<18.49	1.00		
Normal (18.5 -24.9)	0.75	0.60 – 0.92	0.007
Overweight (25 – 29.99)	0.63	0.49 – 0.79	<0.001
Obese (30+)	0.56	0.41 – 0.77	<0.001
Mother's Height (cm)			
Short (160)	1.00		
Medium (160 -169.9)	0.63	0.55 – 0.72	<0.001

Tall (170)	0.59	0.41 – 0.82	0.002
Mother's Education			
No education	1.00		
Primary	0.84	0.59 – 1.19	0.322
Secondary	0.72	0.50 – 1.04	0.087
Higher	0.49	0.27 – 0.87	0.016
Mother's Work Status			
Currently not working	1.00		
Currently working	0.97	0.86 – 1.03	0.663
Marital Status			
Never in union	1.00		
Married	0.74	0.57 – 0.95	0.019
Not together	1.02	0.77 – 1.35	0.873
Mother's Anaemia			
Severe	1.00		
Moderate	0.86	0.35 – 2.13	0.743
Mild	0.99	0.41 – 2.36	0.978
Not anaemic	0.92	0.39 – 2.20	0.858
Wealth Quintiles			
Poorest	1.00		
Poorer	0.86	0.74 – 1.01	0.059
Middle	0.99	0.84 – 1.17	0.950
Richer	0.76	0.64 -0.90	0.003
Richest	0.57	0.45 – 0.72	<0.001
Head of Household			
Male	1.00		
Female	1.08	0.97 – 1.23	0.165
Number of children <5 years old in household			
1	1.00		
2	1.05	0.93 – 1.20	0.435
3	1.03	0.82 – 1.29	0.809
4-7	1.32	1.00 -1.74	0.051
Place of Residence			

Urban	1.00		
Rural	1.21	1.05 – 1.40	0.008
Religion			
Traditional	1.00		
Christian	1.10	0.63 – 1.93	0.735
Other	1.23	0.67 – 2.27	0.491
Child lives with			
Mother	1.00		
Other	2.41	1.45 – 4.02	0.001

* Child's height removed as it is highly correlated with stunting
- figure too small to be statistically significant

Multivariable analysis

In multivariable analysis, after adjusting for child anaemia status, child age, breastfeeding, immunization status, child sex, place of residence, mother's BMI, mother's height and who the child lives with; the association between socio-economic status and stunting still maintained statistical significance. This shows that an inverse relationship exists between wealth quintiles and stunting in Zimbabwean children. The multivariate analysis showed that children from the richest homes had a much lower prevalence of stunting as compared to children from the poorest household (aPR 0.63; 95% CI: 0.47 – 0.84). When comparing those in the richer households with the poorest the prevalence was also low (aPR 0.79**: 95% C.I** 0.63 – 0.97). However those children coming from a middle wealth quintile had about the same prevalence of stunting as those from the poorest household (aPR 1.01; 95% CI: 0.87 – 1.17). The children coming from poorer households had a lower prevalence of stunting when compared to those from the poorest households (aPR 0.85; 95% CI: 0.74 – 0.95).

These results are shown in Table 5.

Table 3.5 Final multivariate model of factors associated with stunting, Zimbabwe Demographic Health Survey 2011

Variable	Prevalence Ratio	Confidence Interval	P-value
Wealth Quintiles			
Poorest	1.00		
Poor	0.85	0.74 – 0.97	0.019
Middle	1.01	0.87 -1.17	0.876
Richer	0.79	0.63 – 0.97	0.030
Richest	0.63	0.47 – 0.84	0.002
Child Anaemia Status (g/l)			
Severe (Hb < 70)	1.00		
Moderate (Hb = 70 – 99)	0.72	0.52 – 1.00	0.05
Mild (Hb = 100 – 109)	0.67	0.48 – 0.95	0.025
Not Anaemic (Hb >=110)	0.68	0.48 – 0.96	0.027
Child Age-group			
<6 months	1.00		
6 – 12 months	2.12	1.11 – 4.07	0.024
13 – 24 months	5.02	2.53 – 9.98	<0.001
25 – 59 months	6.34	3.14 -12.78	<0.001
Immunization Status			
No immunization	1.00		
Partial Immunization	1.07	0.88 – 1.31	0.479
Full Immunization	1.11	0.92 – 1.33	0.28
Child Sex			
Male	1.00		
Female	0.83	0.74 – 0.92	0.001
Child Weight			
0 -5 kg	1.00		
5 -10 kg	0.56	0.30 – 1.05	0.072
10.1 – 15 kg	0.25	0.13 – 0.48	<0.001
15.1 – 20 kg	0.03	0.01 – 0.07	<0.001

Child birth Order			
First	1.00		
Second	1.02	0.88 -1.17	0.230
Third/Fourth	1.06	0.92 – 1.22	0.820
Fifth/Eighth	1.19	1.00 – 1.41	2.010
Higher	1.1	0.60 – 2.00	0.300
Breastfeeding			
Never breastfed	1.00		
Ever breastfed	0.84	0.60 – 1.18	0.030
Still breastfeeding	0.48	0.34 – 0.685	0.000
Place of Residence			
Urban	1.00		
Rural	0.97	0.78 – 1.20	0.770
Child Lives With			
Mother	1.00		
Other	2.00	1.28 – 3.21	0.002
Mother's height (m)			
Short (< 1.60)	1.00		
Medium (1.61 – 1.69)	0.66	0.58 – 0.75	<0.001
Tall (>=1.70)	0.65	0.48 – 0.87	0.005
Mother's BMI (kg/m²)			
Underweight (<17.9)	1.00		
Normal (18.0 – 24.9)	0.83	0.70 – 0.99	0.043
Overweight (25 – 29.9)	0.77	0.62 – 0.95	0.015

*used generalized linear modelling with Poisson regression

CHAPTER FOUR: DISCUSSION

This chapter presents a discussion and interpretation of the results of the study as well as the conclusions and recommendations.

The study's aim was to determine the association between household socio-economic status and stunting among children under-five years in Zimbabwe. This study showed that the prevalence of stunting in children younger than five years in Zimbabwe was at 25. 27% in 2010-11. This is less than what was reported in the ZDHS. This might be due to a number of reasons, including that in our calculation we did not include children whose heights and weights were flagged in the primary dataset. We achieved the objective of describing the levels of stunting in children under-five years of age in Zimbabwe. We also determined the association between socio-economic status and stunting in the under-fives year age group in Zimbabwe as well as other factors associated with stunting in children under-five years of age in Zimbabwe. A prevalence of 25% stunting is high because stunting is considered a public health problem when 20% or more of the population is stunted (31,32,80). In the Sub- Saharan Africa stunting levels are quite high, and within the southern African region in which Zimbabwe is located, 25% percent is comparable to neighbouring countries. In Zimbabwe the stunting levels have not reduced enough to be significant, in 1999 the stunting level was at 34%, and in 2004, the level went up to 35%, which means that there hasn't been any significant intervention enough to cause a drop in stunting levels.

The prevalence of stunting was inversely related to wealth quintiles with the poorest households having higher prevalence of stunting as compared to households with a higher socio-economic status. This association might exist because socio-economic status allows families to have access

to other material and amenities that improve their children's health status (54,80). In a study in Bangladesh, the prevalence of stunting dropped as the household wealth status increased, from 54% in the poorest households to 25% in the wealthiest households(65). The prevalence of stunting and its inverse relation to stunting was expected as poverty (lower wealth quintiles) is a known risk factor for malnutrition, and the need for policies to address social inequalities among all income groups (23,57,84). Case in her report showed that income seemed to exert a causal effect on health status including through nutritional status, better sanitation, improved living standards, reduction of psychological stress and decreased vulnerability to infections (85). Other authors supported this view by attributing the advance in good nutrition in the 19th century to higher incomes rather than medical advances or public health campaigns (86–88). However there is need to further explore these findings.

The wealth index that was used to compute wealth quintiles in the DHS has been tested and seen to work in a large number of countries as it uses a composite of household goods and access to health services and the type of flooring as well as sanitation facilities. This ensures that income is not classified only according to wages and salaries, as it also account for rural-urban differences. I think it was appropriate for the Zimbabwean context.

The most stunted children were found in the 24 – 59 months age group, which had 50% of all stunted children. The least number of stunted children were in the less than six months age group. This is likely to be because those less than six months required less nutrients and were receiving breastmilk (17,34). As children got older they had a higher chance of stunting. This is supported by studies that show increasing child age, as well as decreasing socio-economic status and lower birth weight are risk factors for stunting (27,66,87).

Other factors that impacted on the prevalence of stunting were the child's anaemia status, with children who had no anaemia, mild anaemia and moderately anaemic found to have a lower prevalence of stunting as compared to those who were severely anaemic. In infants and young children, severe chronic anaemia has been associated with delayed growth and long term effects on neurodevelopment and behaviour (89,90). Chronic anaemia has a negative effect on linear growth during all stages of growth (infancy, childhood and adolescence (89). Thus it is expected that children suffering from anaemia have a higher prevalence of stunting.

Male children had a higher prevalence of stunting as compared to female children. In several studies conducted in sub-Saharan Africa, boys seem to have a higher prevalence of stunting before the age of five. Wamani (17) observed that this difference in sex seemed more distinct in the poorest households as compared to richer households. This may be caused by biological and evolutionary mechanisms, with males being more susceptible to environmental stress in early life.

The higher a child's weight, the lower the prevalence of stunting as compared to those in a lower weight category. Children in the 15.1 - 20kg category had the lowest prevalence of stunting in this study.

Maternal factors that showed significant associations with higher prevalence of stunting were if children not living with their mother and having a shorter mother. Children are known to experience more adverse events if they are not living with their biological mothers (10,86,91).

Children with shorter mothers (height less than 1.61m) had a higher prevalence of stunting as compared to mothers of medium or tall height. In other studies children with a mother below 150 cm were 3.6 times more likely of being stunted (20,32,87,92). This is evidenced by the intergenerational cycle of stunting, with a stunted mother being more likely to give birth to a stunted child due to inadequate fetal nutrition(32,87).

Children with mothers who had a low to normal BMI had a higher prevalence of stunting when compared to children whose mothers were overweight or obese). Mothers who are overweight or obese are more likely to give birth to higher birth weight babies who are less likely to be stunted (8).

4.1 Study strengths and limitations

The major strength of this study was that the validity and credibility were high as the primary selection of the study participants was a multistage random sampling with the use of a data analysis method which was used to adjust for stratification and clustering so that accurate point estimates and standard errors were obtained. The generalizability (external validity) of the study results is quite high as the sample was for the whole nation of Zimbabwe.

The limitations of dietary assessment as done in the DHS include the fact that a 24-hour recall which does not give a mean intake, but simply a snapshot of intake in the previous 24 hours therefore is not representative of typical diet. As diets vary from day to day the ability of a single 24hr recall to provide accurate estimate of long-term energy intake is limited

The findings of this study should be interpreted with caution in light of a few limitations. This data was collected at one point in time (cross-sectional), which allowed us to observe associations but left us unable to determine the direction of causality. Data collectors were trained extensively to ensure that they were able to conduct interviews in a proper manner and were continually monitored and supervised to minimise errors. Questionnaires were translated into the local language and pretested to ensure proper understanding of questions.

As the researcher in this study did not contribute in the primary study's data collection, she has little understanding of all processes and challenges that were experienced. The primary study may have been limited by other forms of measurement error. The DHS items included in the questionnaire were developed specifically for all DHS programs in the world, therefore some questions might not be appropriate for the Zimbabwean context.

Stunting is a chronic condition and thus the current living situation which was collected for the survey would not give an accurate picture of past living circumstances. This could also increase the risk of recall bias and information bias and we see that a lot of nutrition information was missing. The use of self-reported data could have increased the risk of bias, social desirability has been found to be negatively correlated with most nutritional variables.

All electronic data files for the ZDHS were returned to the ZIMSTAT central office in Harare, where they were stored on a password-protected computer. The data processing operation

consisted of secondary editing, which involved editing computer-identified inconsistencies and coding of open-ended questions(78).

4.2 Conclusions: Policy implications and recommendations

Stunting is considered a public health problem when 20% or more of the population is stunted (31,32,80). Thus with 25 – 32% of young children stunted in Zimbabwe, interventions that tackle the stunting problem must be urgently implemented. Stunting is projected to reduce a country's gross domestic product by as much as three percent and thus addressing this problem could improve the economic outlook in the long term. Some interventions that should be implemented include the elimination of anaemia, which could increase productivity in adulthood by between five and seventeen percent. (12,52,93)

Interventions targeted at improving the livelihood of poor families, such as social grants, should be considered. This is because in contrast to children born to well-off families, children from poorer households are more exposed to risks for disease through inadequate water and sanitation, indoor air pollution, crowding, poor housing conditions, and high exposure to disease vectors (22,64,94,95). These children are more likely to have lower resistance to infectious diseases because they are undernourished (an underlying cause of about 50% of deaths in children younger than 5 years), to have diets deficient in one or more essential micronutrients (e.g., vitamin A, iron, zinc), to have a low birth weight as a result of poor maternal nutrition, infections during pregnancy, and short birth intervals, and to have recurrent disease episodes(64,96).

Macroeconomic and microeconomic policies should aim to improve average income without having contrary effects on its distribution(11,50,97,98). This would enhance child nutrition as households would have better access to healthcare, education and other proximate determinants of stunting. The same is true of policies aimed at improving the living standards of the poor. Social protection programs can act as antipoverty programs as shown by the South African child grant schemes (10,86). By the end of 2010, the child grant had become an important source of income for impoverished households resulting in an increase in the health status not only of the grant recipient but of other members of the households (10). Other interventions and policy that target girl children and young women as early as possible should be incorporated into all schools/communities. Studies show that promoting female education and literacy can improve nutrition status as well as encourage health seeking behaviors(30,93). Increasing knowledge of nutrition on preparation and handling of food could potentially increase the micronutrient status of both adolescent girls and their families(88,93)

However, no single intervention can stand alone to deliver the required level of improving nutrient status without considering factors that impact the child. Thus a spectrum of interventions need to be investigated which involve a synergy of multi-sectorial partnerships with considerable accountability to bring about lasting solutions to decrease the levels of stunting in Zimbabwe and Southern Africa as a whole. Furthermore, research into what would be a sustainable and equitable way of providing social grants in Zimbabwe would be very useful.

APPENDIX A

R14/49 Ms Nozipho Musakwa-Maravanyika

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M150238

NAME: (Principal Investigator)	Ms Nozipho Musakwa-Maravanyika
DEPARTMENT:	School of Public Health University of the Witwatersrand
PROJECT TITLE:	Association between Household Socio-Economic Status, and Stunting among Under-Five Children in Zimbabwe
DATE CONSIDERED:	27/02/2015
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr Aziza Mwisongo
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	02/03/2015

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**.

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX B: Snippet of Questionnaire

The full ZDHS survey instruments can be found at http://dhsprogram.com/what-we-do/survey/survey-display-475.cfm

201	CHECK COLUMN 11 IN HOUSEHOLD SCHEDULE. RECORD THE LINE NUMBER AND NAME FOR ALL ELIGIBLE CHILDREN 0-5 YEARS IN QUESTION 202. IF MORE THAN SIX CHILDREN, USE ADDITIONAL QUESTIONNAIRE(S).
202	LINE NUMBER FROM COLUMN 11 NAME FROM COLUMN 2
203	IF MOTHER INTERVIEWED, COPY MONTH AND YEAR OF BIRTH FROM BIRTH HISTORY AND ASK DAY; IF MOTHER NOT INTERVIEWED, ASK: What is (NAME)'s birth date?
204	CHECK 203: CHILD BORN IN JANUARY 2005 **(9)** OR LATER?
205	WEIGHT IN KILOGRAMS **(10)**
206	HEIGHT IN CENTIMETERS
207	MEASURED LYING DOWN OR STANDING UP?
208	CHECK 203: IS CHILD AGE 0-5 MONTHS, I.E.,

	WAS CHILD BORN IN MONTH OF INTERVIEW OR FIVE PREVIOUS MONTHS?
209	LINE NUMBER OF PARENT/ OTHER ADULT RESPONSIBLE FOR THE CHILD (FROM COLUMN 1 OF HOUSEHOLD SCHEDULE). RECORD '00' IF NOT LISTED.
210	ASK CONSENT FOR ANEMIA TEST FROM PARENT/OTHER ADULT IDENTIFIED IN 209 AS RESPONSIBLE FOR CHILD.
212	RECORD HEMOGLOBIN LEVEL HERE AND IN THE ANEMIA PAMPHLET **(11)**.
213	GO BACK TO 203 IN NEXT COLUMN OF THIS QUESTIONNAIRE OR IN THE FIRST COLUMN OF THE NEXT PAGE; IF NO MORE CHILDREN, GO TO 214.

APPENDIX C

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