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RELATIONSHIP BETWEEN SOCIO-ECONOMIC STATUS AND INFANT GROWTH IN DZIMAULI VILLAGE, LIMPOPO PROVINCE, SOUTH AFRICA

By

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A mini-dissertation submitted in partial fulfilment of the requirements for the degree of Master of Public Health (MPH) at the University of Venda, Thohoyandou 0950, Limpopo Province, South Africa.

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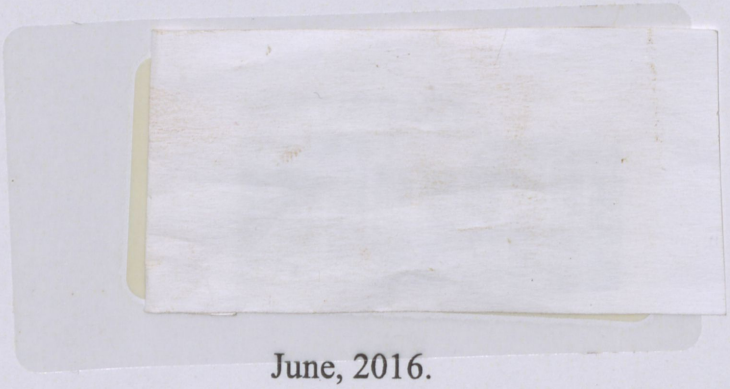

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DECLARATION

I, Gbadamosi M.A., hereby declare that the dissertation titled "**Relationship between Socio-economic Status and infant Growth in Dzimauli Village, Limpopo Province, South Africa**" is my original work. All references to works done by other people and institutions are duly cited and referenced. I further certify that the dissertation has not been submitted anywhere else.

Gbadamosi M.A.

Signature: ..... Date: 09-06-2016

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DEDICATION

This work is dedicated to the Almighty God who gave me the privilege, strength and wisdom to pursue this degree, to my wife, who supported and encouraged me throughout the period of the study, and to my children for their encouragement and understanding.

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ABSTRACT

Background

Social class differences have been recognised to affect child growth and development.

Purpose of the study

This study is focused on investigating the relationship between socioeconomic status and physical growth of infants at Dzimauli Village.

Methodology

Secondary analysis was done on demographic information of household head, mother and primary caregiver, household socioeconomic data, maternal feeding practices and child anthropometric measurements for 186 infants. Data were analysed using Statistical Package for Social Sciences (SPSS) version 20. Logistic regression was used to determine independent predictors for stunting and wasting. The Chi-Square test was used to identify related variables and statistical significance was set at $p<0.05$.

Results

At birth 6.5% of infants had a low birth weight, 11.3%, were stunted, 8.1% underweight and 7.5% were wasted. Stunting became noticeable in the early months with 18.9% being stunted (< - 2 Standard Deviation (SD)) by the third month and this percentage remained high for the 12 month period. Increased weight gain was observed during the first three months but then declined until the mean weight-for-age (WAZ) at 12 month was below zero SD. About six percent of infants were overweight (> 2SD) by the 12th month. Postnatally, a gradual pattern of stunting was observed in the infants. The factors influencing whether a child was stunted included ownership of agricultural land (Odds Ratio (OR)=4.577; p = 0.0009), marital status of household head (OR=0.236; p=0.029) and sex of child (OR=0.267; p=0.024) while household income was the only determinant of wasting (OR=0.279; p=0.015). Wealth index was significantly associated with underweight (p=0.012) and household income was significantly associated with wasting (p=0.037). The infants in the study were breastfed for longer period with 78% still breast feeding by the ninth month. However, exclusive breastfeeding was uncommon because of early introduction of supplementary food, with 39.5% of infants receiving some grains by the end of the first month. Only 0.6% of the infants were exclusively breastfed for more than 3 months.

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Conclusions

At birth stunting and underweight were less common. There was a significant relationship between wealth index and stunting. Similarly, income was significantly associated with wasting. In terms of feeding practice, mothers were inclined to introducing supplementary foods at an early age.

Recommendations

Growth monitoring and promotional activities should be promoted as a community-based intervention. The issue of poverty also need to be addressed since nutritional status of children depends heavily on the improvement in the socio-economic status of their households. Similarly, the current government policy, the Infant and Young Child Feeding Policy, should incorporate intervention to promote appropriate feeding during pregnancy, early initiation of breastfeeding and correct complementary feeding.

Key words: Income; wealth; education; rural; Association; stunting; underweight; child; breastfeeding practice.

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LIST OF ACRONYMS

CI	Confidence Interval
HAZ	Height-for-age z scores
MAL-ED	Malnutrition and Enteric Infections: Consequences for Child Health and Development
NFCS	National food consumption survey
NFCS: FB-I	National food consumption survey: Fortification Baseline I
OR	Odds Ratio
PROBIT	Promotion of breastfeeding Intervention Trial
SAVACG	South African Vitamin A Consultative Group
SD	Standard deviation
SES	Socio-economic status
UN	United Nations
UNICEF	United Nations children fund
WAZ	Weight-for-age z score
WHO	World Health Organisation
WHZ	Weight-for-height z score

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Globally, child growth and health are important Public health indicators for monitoring the nutritional status and health in population. These indicators are used because the rates of infant and children growth are most rapid during postnatal periods. During these periods, the child becomes sensitive to the surrounding environment. Hence, the physical growth and development are sensitive indicators of the quality of the social, economic and political environment in which children live (Bogin & Loucky, 1997; Little, Spalding, Walsh, Keyes, Wainer, Pickens, Royster, Villanacci & Gratton, 2009; de Onis, Victora, Garza, Frongillo & Cole, 2001). As noted by Eveleth and Tanner (1990), a child's growth velocity reflects the child's state of health better than any other single index. They further explain that the average values of children's heights and weights accurately reflects the state of a nation's health and the average nutritional status of its citizens, provided allowance has been made for genetic influence on growth (Schell, 1986).

The prenatal stage and infancy are increasingly recognised as critical stage for the development of undernutrition (Maleta, Virtanen, Espo, Kulmamla & Ashorn, 2003; Shrimpton, Victora, de Onis, Lima, Blossner & Clugston, 2001).

Postnatally, infant growth reflects both the contribution of nutrients and the stresses from the environment. Nutritional deficiencies lead to growth retardation. Also, there is a high requirement for additional nutrients as a result of diseases. Failure to meet these requirements will lead to poor growth. Thus, the nutritional status is a net measure of nutrition. It indicates what the human body takes in (diet), the rate of nutrients utilization and absorption of nutrients (Komlos, 1994; World Health Organisation (WHO), 1995a, Blossner & de Onis, 2005).

The pattern of infant growth may have long-term health and developmental consequences (Corbett & Drewett, 2004; Emond, Blair, Emmett & Drewett, 2007; Singhal & Lucas, 2004; Gluckman, Hanson & Pinal, 2005; Olness, 2003, United Nations (UN), 2010), particularly in most developing countries, where infants typically have low birth-weight (Wen, Kramer & Usher, 1995) but not early in infancy (He, Ma, Chen, Mei, Dai, Luo, Jiang, Lui, He, Yeung & Anderson, 2001).

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Globally, poor physical growth underlie approximately one-third of the under 5 mortality (UN, 2010; Blosner & de Onis, 2005) and approximately 5 million children die each year due to causes that are directly or indirectly related to malnultrition (Gross & Webb, 2006). The prevalence of poor physical growth is disproportionately higher in developing countries where approximately 42% of children are stunted and 38% are underweight (Olness, 2003) compared to USA where approximately 1% and 2% are stunted and underweight (United Nations Children Fund (UNICEF), 2006). Recent data has not shown a sign of improvement. In 2011, 165 million children under the age of 5 years are stunted globally (UNICEF, 2013) while 148 million of these children (approximately 90.0%) live in low- and middle-income countries (UNICEF, 2014). An estimated 101 million (nearly 16.0%) of children under 5 were underweight with 30 million of these (nearly 21.0%) found in sub-Saharan Africa. Similarly, 52 million children under 5 were moderately or severely wasted and approximately 9.0% of under 5 children in sub-Saharan Africa were wasted (UNICEF, 2013). Stunting affects children in poorer countries and from poor households (UNICEF, 2014; Black, Victora, Walker, Butta, Christian, de Onis *et al*., 2013).

In 1995, about 2.5 million South African children were undernourished (The Community Agency for Social Enquiry (CASE), 1995). A study conducted by the South African Vitamin A Consultative Group (SAVACG) in 1994 on children aged 6 – 72 months showed the national prevalence of stunting, underweight and wasting as being 22.9%, 9.3% and 2.6%, respectively (SAVACG, 1995). A similar study conducted by the National Food Consumption Survey (NFCS) in 1999 showed the prevalence of stunting, underweight and wasting as being 21.6%, 10.3% and 3.7%, respectively. The prevalence of undernutrition was highest in rural areas (Labadarios, Steyn, Maunder, MacIntyre, Swart, Gericke, Huskisson, Dannhauser, Voster & Nesamvuni, 2000).

It has been established that postnatal growth trajectories are not only affected by many factors such as breast feeding (Kramer, Guo, Platt, Shapiro, Collet, Chalmers, Hodnett, Sevkoyskava, Dzikovich, Vanilovich & PROBIT Study Group, 2002), but also partly controlled by infant sex, birth order and degree of physiological intra-uterine constraints (Baker, Michaelson, Rasmussen & Sorensen, 2004; Cameron, 2006). Other factors vary by population. For instance, there is paucity of information linking socio-economic status to infant growth in developed countries while there is overwhelming evidence that socio-economic status is related to infant growth in developing countries (Lui, Jalil & Kalberg,

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1998; Ashworth, Morris & Lira, 1997; Di Pietro, Costigan, Hilton & Pressman, 1999; Abubakar, de Vijver, Van Baar, Mbonani, Kalu, Newton & Holding, 2008; Urke, Bull & Mittelmark, 2011).

The literature is inconsistent, with some research suggesting that the magnitude of association between socio-economic status and child growth is moderate (Shin, 2005; Dessai & Alva, 1998; Wamani, Tylleskar, Astrom, Tumwine & Peterson, 2004), whereas others suggest strong relationship (Mosley & Chen, 1984; Abubakar et al., 2008; Fosto & Kuate-Defo, 2005).

Three commonly-used indicators that are derived from growth measures are height-for-age, weight-for-age and weight-for-height. Although they are related, each has specific meaning in terms of the processes or outcomes of growth impairment (Gibson, 1990; Ricci & Becker, 1996; Frongilo, de Onis & Hanson, 1997). Height-for-age and weight-for-height have been recommended by Food and Agricultural Organisation/United Nations Children Fund/World Health Organisation (FAO/UNICEF/WHO) expert committee on nutritional status in children (Waterlow, Buzina, Keller, Lane, Nichaman & Tanner, 1977; WHO Multicentre Growth Reference Study Group, 2006). Stunting, or low height-for-age, refers to retardation in linear growth as measured by total body length or height. It implies that shortness is pathological, and indicates a process of failure to reach full linear growth potential due to sub-optimal health and/or nutritional conditions (WHO, 1995a). Stunting represents a chronic state of malnutrition because it takes longer for impaired skeletal growth to become noticeable. However, wasting, or low weight-for-height, measures the relationship of body mass (tissue or fat) to length; which represents lower than expected body mass. It is usually used to describe a recent and severe process that has led to significant weight loss, often resulting from acute starvation and/or severe disease (WHO, 1995b; World Bank, 2006). Underweight, or low weight-for-age, represents a combination of both stunting and wasting. A child is considered as being stunted, wasted or underweight if she/he has low height-for-age, low weight-for-height or low weight-for-age (that is, two z-scores below the international reference), respectively (World Bank, 2006).

Although, the South African government devised strategies, such as the Integrated Nutrition Programme (INP), to address nutritional deficiencies in children, more still needs to be done. This is because malnutrition continues to affect the lives of millions of children in South

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Africa (Swart, Sanders & McLachlan, 2009). The authors provided the 2005 National Food Consumption Survey in South Africa, which reported the national prevalence of stunting, wasting and underweight as being 18%, 9.3% and 4.5%, respectively. Recent data indicate that this condition has not improved. For example, National prevalence of stunting, wasting and underweight still stand at 18%, 5% and 10% respectively while nutritional status varies between provinces and within provinces (Department of Health, 2013). Consequently, the need to examine the relationship factors influencing nutritional status of children is justified.

The purpose of this study is to explore the relationship between socio-economic status and the growth of infants in Dzimauli Village, Limpopo Province, South Africa.

1.2 Problem Statement

Dzimauli Village is a small agricultural village in Mutale Municipality with poor infrastructure. People living in Dzimauli Village are mainly from low socio-economic status, with high unemployment rates and a heavy burden of disease (Integrated Development Plan (IDP), 2007). The poor socio-economic status of the village may influence infant growth due to poor access to education, high rates of unemployment and a lack of clean water and safe sanitation practices (Girma & Genebo, 2002).

The 1999 National Food Consumption Survey reported the prevalence of stunting, underweight and wasting as being 21.6%, 10.3% and 3.7%, respectively. The prevalence of undernutrition was highest in rural areas (Labadarios *et al.*, 2000; Bosman, Herselman, Kruger & Labadarios, 2011).

However, the statistics do not distinguish specific areas and little is known concerning the relationship between socio-economic status and infant growth in Dzimauli Village, despite the fact that malnutrition continues to affect the lives of millions in South Africa. Therefore, the need to study the influence of socio-economic status on infant growth in Dzimauli Village is important.

1.3 Rationale for the study

Generally, in Africa, the increasing mortality rates due to malnutrition among children require serious government policy to address the situation. There is an urgent need for health education regarding nutrition and diet and various nutritional supplementation schemes need

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to be implemented in Africa to combat the mortality rates caused by malnutrition (Kumari, 2005).

In South Africa, a significant proportion of the population lives in the rural areas, lacking basic services and being overburdened by poverty, particularly women and children. The available data about the nutritional status of children under 5 years in South Africa reflects the worst and most miserable situation among children under 5, especially in the marginalized rural areas. Consequently, there is a need for research to highlight the problem and draw attention to the children situation. Currently there is a dearth of information concerning the impact of socioeconomic factors and infants growth in Dzimauli Village, Limpopo Province. There is, therefore, a need to examine the socioeconomic correlates of growth of rural South African infants in order to inform public health policy concerning infants' feeding practices.

1.4 Significance of the study

It is envisaged that findings of this study might help in understanding the factors influencing malnutrition and to devise cost-effective and culturally acceptable interventions. Furthermore, the study might assist in prioritizing prevention and control of malnutrition in public health agendas and direct programmes on the need to integrate information, screening and services. Above all, the study might benefit the primary care of infants and also contribute in reducing infant morbidity and mortality in South Africa.

1.5 General Objective

The general objective of this study is to investigate the relationship between socioeconomic status and physical growth of infants at Dzimauli Village.

1.6 Specific Objectives

The specific objectives of the study are:

- To assess the relationship between maternal education and growth of infants at Dzimauli Village.
- To examine the association between household income and growth of infants at Dzimauli Village.

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- To investigate the association between the household wealth index and the growth of infants at Dzimauli Village.

- To explore the relationship between feeding practices and growth of infants at Dzimauli Village

1.7 Research Hypotheses

1. The level of maternal education will not have a significant relationship with the growth of infants at Dzimauli Village.
2. Household income as measured by average monthly income would not have significant effect on the growth of 12 months old children at Dzimauli Village.
3. The household wealth index would not have a significant effect on the growth of infants at Dzimauli Village.
4. The feeding practices of mothers will not have a significant influence on the growth of infants at Dzimauli Village.

1.8 Definition of Terms

- **Relationship** (Syn: Association, correlation, [statistical] dependence, relationship) Statistical dependence between two or more events, characteristics, or other variables. An association is present if the probability of occurrence of an event or characteristic, or the quantity of a variable, depends upon the occurrence of one or more other events, the presence of one or more other characteristics, or the quantity of one or more other variables (Last, 2001).

- **Socio-economic status:** Socio-economic status is a construct that reflects one's access to collectively desired resources, be they material goods, money, power, friendship networks, healthcare, leisure time or educational opportunities (Oakes & Rossi, 2003). In this study, Socio-economic status refers to maternal education, household income and wealth index.

- **Feeding practice:** The giving of food either by a bottle, cup or hand-feeding (Skykes, 1988). Feeding infants on either breastmilk or artificial milk (Auerback, Renfrew & Minchin, 1991). In this study, feeding practice refers to the type of feeding used to feed infants in Dzimauli Village (breast-feeding, complementary feeding and formula feeding).

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- **Growth:** is defined as an increase in something (Longman, 2012). In this study, physical growth refers to changes in height, weight, and body composition.

- **Infant:** infant is a Child not more than 12 months of age (WHO, 2003). In this study, infant refers to a child from birth to 12 months of life.

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CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter contains a review of literatures on similar studies that have been done in various countries, including South Africa. It is divided into two sections. The first section presents a critical review of relevant literatures. The second section discusses epidemiological theory guiding the work. The appropriateness and limitations of the model are also highlighted.

2.2. Child Growth

2.2.1 Infant and young child growth patterns

The foetal stage signifies a period during which growth is at its highest in human life. This stage is followed by infancy during which most children will double their birth weight by 5 – 6 months and triple it by one year. Their body length and head circumference will increase by 55% and 40% respectively. However, during the second year of life, an average child grows by about 12 cm in length and gains about 3.5 kg in weight. After that stage, growth rate slows down to nearly constant at the start of 4 – 5 years, with an average annual weight and height increments of about 2 kg and 6 cm, respectively. The growth rate will remain constant during the middle childhood, although some gender differences will become apparent in height, only minimal differences will be seen in weight. The growth rate continues to be constant during adolescence until onset of puberty where growth surge begins and secondary sexual characteristics appear. Thereafter, growth rate slows down until adulthood (Sun, 2006).

Nutritional needs during infancy are high due to the infant's high growth rate, high proportion of metabolically active tissues (such as the brain) and frequent occurrence of childhood illness. Attainment of these high nutritional demands can be hindered by physiological factors (such as immaturity of the gastrointestinal and excretory systems), developmental stage (inability to search for food and eat), neurological impairment, psychological disorders and social and educational disadvantage (Williams, 2005)

Child growth, however, follows a certain rhythm which can be disturbed by nutritional deficits, excesses or childhood illnesses. This shows the importance of monitoring child growth and development (Williams, 2005). Anthropometric measurements are simple, cheap and cost-effective in assessing child growth and their nutritional status. The most commonly

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used anthropometric measurements include weight, height and head circumference. However, other measurements such a skin fold thickness, waist circumference and mid-upper arm circumference may also be assessed. These anthropometric measurements can then be compared to those of a reference population to determine growth deficits or excesses. This can be achieved by plotting the anthropometric measurements against those of a reference population in order to graphically observe child growth patterns. Alternatively, anthropometric measurements can be transformed into age-specific anthropometric indices such as height-for-age, weight-for-age, weight-for-height and BMI (Sun 2006; WHO, 1995a). Thereafter, the anthropometric indices can be expressed as z-scores (Standard Deviation (SD)-scores), percentiles or percent of the median. Therefore, the use of SD-scores is the preferred method for reporting anthropometric data in public health nutrition because it allows for statistical calculations such as mean values (WHO, 1995a).

2.2.2 The history of child growth references

Child growth references are used worldwide both in public health and clinical practice. They are used in public health as early warning signals, where emergencies related to food and nutrition are predicted. Child growth references are also used in evaluation of child care practices and in nutrition screening to identify population groups at risk of malnutrition. In clinical practices, child growth references are used for growth monitoring and promotion as well as for identification of abnormal deviations of growth (WHO, 1995a). The first international child growth reference was developed by the National Centre for Health Statistics (NCHS) of the United States of America (USA) (Hamil, Drizd, Johnson, Reed, Roche & Moore, 1979). The WHO endorsed the NCHS reference for international use in the late 1970s (de Onis, 2008), which helped in the identification of child malnutrition and also allowed international comparisons.

Although the NCHS/WHO international growth curves have served many useful purposes throughout these years, the suitability of these curves, for international purposes, was challenged in the mid-1990s because of a number of drawbacks. First, the sample was relatively homogeneous with regard to ethnicity and socioeconomic status. Second, measurements were made only every 3 months, which is not ideal for adequately characterizing growth during early life. Third, most of the infants in the study were bottle-fed, and if they were breast-fed it was for a short duration. Work conducted by WHO

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demonstrated that international reference is sufficiently flawed; that it interferes with the sound health and nutritional management of infants and young children (de Onis, 2008). It was observed that healthy breastfed infants living in environments supporting achievement of genetic growth potential grew less rapidly and deviated significantly from the reference. Weight-for-age and weight-for-height z-scores of breastfed infants were found to deviate from the reference populations from two to three months of age (Agostonic, Grandi, Siliano, Torcoletti, Giovannini & Riva, 1999; Victora, Morris, Barros, de Onis & Yip, 1998; WHO, 1995b). This deviation of the growth patterns of healthy breastfed children was considered to be sufficient to lead health workers to faulty decisions like premature introduction of complementary feeds or supplementation with other milks (Victora *et al.*, 1998; WHO, 1995b). In poverty-stricken communities where the burden of infectious diseases is high, the consequences of such practices could be life-threatening.

As a result, WHO began planning in 1994 for new references that reflect how children should grow in all countries, rather than merely describing how they grew at a particular time and place (de Onis, 2008). The new WHO child growth standards were then developed, based on the WHO Multicentre Growth Reference Study (MGRS) (1997 – 2003) which collected primary growth data and related information from 8 440 affluent children from widely differing ethnic backgrounds and cultural settings (Brazil, Ghana, India, Norway, Oman and United States) (de Onis, 2008; Garza & de Onis, 1999). Studies comparing growth patterns of children on the NCHS/WHO and the new WHO child growth standards found that stunting and obesity increased for all age groups when assessed by the new WHO standards. It was further observed that underweight reduced mainly in infancy (de Onis, Onyango, Borghi, Garza & Yang, 2006; Nuruddin, Meng, Hadden & Azam, 2009). Consequently, the WHO growth standards are the preferred standards to use in monitoring child growth.

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2.2.3 Relevance of child growth in human health

Children are especially vulnerable among all age groups as demonstrated by the high number (11 million a year worldwide) of them dying in the first year of life (Black, Allen, Bhutto, Caulfield, de Onis, Ezzati, Mathers & Rivera, 2008; UNICEF, 2008). As noted in section 2.2.1 above, child growth can be disrupted by nutritional deficit/excesses and illnesses, thus making monitoring of child growth an important aspect of ensuring good health. Growth attainment is insufficient to evaluate the health of a child adequately. It does however provide

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a good indicator of attainment of well-being (WHO, 1995b). Children's growth provides a 'sentinel' indicator of the health and socio-economic development or status of the community in which they live. An example is the use of child underweight as an indicator for the attainment of Millennium Development Goal #1, which is to reduce extreme poverty and hunger by half by 2015 (UN, 1990). The prenatal period and early childhood are increasingly considered as critical stages for development of undernutrition (Maleta *et al.*, 2003; Shrimption et al., 2001; Dietz, 1994). According to the World Bank (2006), the period between prenatal growth up to two years of life 'window of opportunity' is a crucial period in which efforts to reduce child malnutrition are most likely to be effective. Hence, it is important to monitor child growth to avoid negative consequences of poor physical growth.

2.3 Prevalence of childhood malnutrition

2.3.1 Global Prevalence

Globally, undernutrition is known to affect mostly children in developing countries. There has been a gradual decrease in childhood undernutrition (anthropometric) worldwide, although the decrease is not consistent in all UN regions and sub-regions (de Onis *et al.*, 2000). It was estimated that 33% of children under five years in developing countries were stunted in the year 2000. Among the developing regions, Africa was estimated to have highest prevalence of stunting (35.2%), with some sub-regional variations. West Africa was highest (34.9%) and North Africa the lowest (20.2%) (de Onis, Frongillo & Blossner, 2000). In numerical terms, South Asia has the highest number of stunted children. Furthermore, 90% of the developing countries' chronically stunted children live in Asia and Africa. Although, India has the highest number of stunted children all over the world, its prevalence is low due to its population size (UNICEF, 2009).

In a study conducted by de Onis, Blossner, Borgi, Frongillo and Morris (2004), global prevalence of childhood underweight was estimated to go down from 26.5% in 1990 to 17.6% in 2015 among children under five years. Childhood underweight was, however, estimated to increase in Africa from 24.0% to 26.8% by the year 2015. The estimated prevalence of childhood underweight (0.9% in developed countries and 19.3% in developing countries) reflects a big gap between the two worlds (de Onis *et al.*, 2004).

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de Onis and Blossner (2003) and Svedberg (2006) reported comparable changes in child stunting (from 34% to 24%) and underweight (from 27% to 21%) globally between 1990 and 2005. Table 2.1 shows the estimates of child undernutrition based on the new growth standards in 2005.

Table 2.1: Global estimates of childhood undernutrition based on the World Health Organisation child growth standards (Adapted from Black *et al., 2008)*

		Children < 5 years in millions	Percentage stunted (95% CI[1])	Percentage severely wasted (95% CI)	Percentage underweight (95% CI)
Africa		141 914	40.1 (36.8-43.4)	3.9 (2.2-5.7)	21.9 (19.8-24.0)
	Eastern	48 807	50.0 (42.3-57.9)	3.6 (1.5-8.4)	28.0 (23.6-32.9)
	Middle	20 197	41.5 (38.3-44.8)	5.0 (2.0-12.0)	22.5 (19.2-26.1)
	Northern	22 171	24.5 (17.3-33.9)	3.3 (1.2-8.9)	6.8 (2.8-15.3)
	Southern	6 075	30.2 (25.4-35.6)	2.7 (1.0-6.8)	11.4 (8.0-15.7)
	Western	44 663	37.7 (33.5-42.1)	4.3 (1.8-9.6)	23.9 (21.0-26.9)
Asia		35 6879	31.3 (27.5-35.1)	3.7 (1.2-6.2)	22.0 (18.5-25.6)
	Eastern	95 070	14.5 (13.5-15.5)	0.7 (0.3-1.6)	5.1 (4.8-5.4)
	South-central	181 481	40.7 (34.2-47.7)	5.7 (2.4-12.8)	33.1 (26.6-40.3)
	South-eastern	54 970	34.3 (26.5-43.5)	3.6 (1.4-8.8)	20.7 (17.2-24.6)
	Western	25 358	20.6 (10.0-38.8)	1.6 (0.4-5.8)	8.9 (2.8-24.2)
Latin America		56 936	16.1 (9.4-22.8)	0.6 (0.2-1.0)	4.8 (3.1-6.4)
Developing regions		555 729	32.0 (29.3-34.6)	3.5 (1.8-5.1)	20.2 (17.9-22.6)

[1]CI: confidence interval

About 178 million (about 32% of) children under five in developing countries were stunted (Black *et al.*, 2008). Globally 36 countries accounted for 90% of all stunted children and South Africa is included (Black *et al.*, 2008). In Sub-Saharan Africa, male pre-school children are found to be more likely to be stunted when compared with their female counterparts. This was found to be more pronounced in children of the lowest socio-economic status group (Wamani, Astrom, Peterson, Tumwine & Tylleskar, 2007).

2.3.2 Prevalence in South Africa

The prevalence of child malnutrition is as shown in Table 2.2 below. The anthropometric status of the children has marginally changed over a period of 15 years. Stunting is reported as the most prevalent adverse anthropometric outcome, followed by combined overweight and obesity in children younger than nine years (SAVACG, 1996; Labadarios, Steyn, Maunder, MacIntyre, Gericke, Swart, Huskisson, Dannhauser, Vorster, Nesamvuni & Nel,

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2005, Labadarios, Steyn, Maunder, Kruger, Gericke, Kuzwayo, Ntsie, Steyn, Schloss, Dhannsay, Jooste, dannhausser, Nel, Molafe & Kotze, 2008). The prevalence of stunting (18%), underweight (9.3%) and wasting (4.5%), implies that undernutrition is of low severity nationally. However, national prevalence of child malnutrition masks the variations in nutritional status of children by age group and area of residence. It has been found that children aged 1 – 3 years are the most affected by both forms of malnutrition (Figure 2.1).

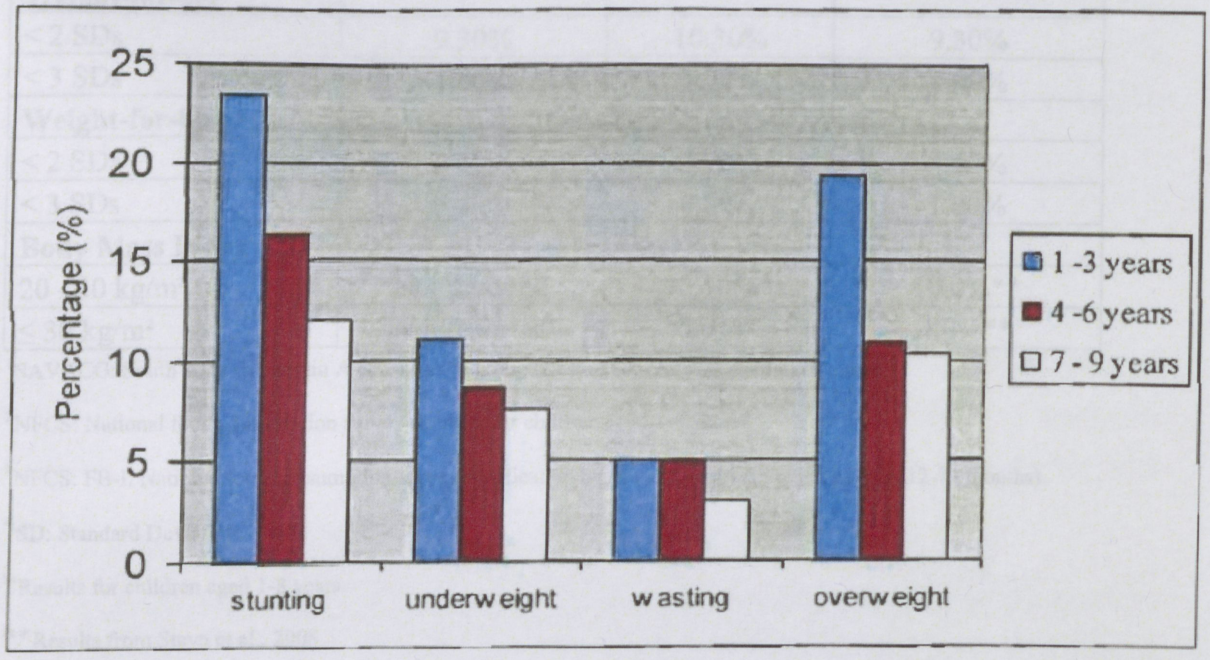

Figure 2.1: Anthropometric status of South African children aged 1-9 years by age group (Labadarios *et al., 2008)*

According to Labadarios *et al.* (2008), children living in rural areas, especially rural formal areas, are most affected by undernutrition.

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Table 2.2: Prevalence of child malnutrition in South African children over 15 years (SAVACG, 1996; Labadarios *et al.*, 2005; Labadarios *et al., 2008)*

ANTHROPOMETRIC PARAMETER	SAVACG[1] 1994	NFCS[2] (1999)	NFCS: FE-I[3] (2005)
Height-for-age			
< 2 SDs[4]	22.90%	21.60%	18.00%
< 3 SDs	6.60%	6.50%	5.10%
Weight-for-age			
< 2 SDs	9.30%	10.30%	9.30%
< 3 SDs	1.40%	1.40%	1.00%
Weight-for-height			
< 2 SDs	2.60%	3.70%	4.50%
< 3 SDs	0.40%	0.80%	1.00%
Body Mass Index			
20 - 30 kg/m²	Not reported	12.10%*	10.0%**
≤ 30 kg/m²	Not reported	5.0%*	4.0%**

[1]SAVACG: South African vitamin A consultative group (Results for children aged 6-71 months)

[2]NFCS: National food consumption survey (Results for children aged 1-9 years)

[3]NFCS: FB-I: National food consumption survey fortification baseline (Results for children aged 12-71 months)

[4]SD: Standard Deviation

*Results for children aged 1-8 years

**Results from Steyn et al., 2005

Table 2.3: Anthropometric status of children 1-3 years of age in South Africa, 1999 (NFCS, 1999)

ANTHROPOMETRIC PARAMETER	PROVINCE									SOUTH AFRICA		
	EC	FS	Gua	KZN	Mpu	NC	Lim	NW	WC	RSA	URBAN	RURAL
NUMBER	142	93	233	215	55	70	136	113	141	1198	617	581
% H/A < - 2SD	23.20%	39.80%	26.20%	25.10%	29.10%	30.00%	19.90%	31.90%	14.20%	25.50%	20.90%	30.30%
% W/A < - 2 SD	10.60%	20.40%	9.90%	8.50%	7.30%	27.10%	14.00%	18.60%	9.90%	12.40%	9.70%	15.10%
% W/H < - 2 SD	2.80%	3.20%	1.30%	2.30%	1.80%	12.90%	11.00%	5.30%	1.40%	4.00%	2.60%	5.50%

As can be seen in Table 3, at provincial level, the NFCS study found that the prevalence of stunting was the highest in the Northern Cape, (31%), Free State (30%), Mpumalanga (26%), then North West (24%), Northern Province (23%) and Eastern Cape (20%). The prevalence of malnutrition in Limpopo was 19.9% for stunting, 14.0% for underweight and wasting was at 11.0% (NFCS, 1999).

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2.4 Socio-economic status and infant growth

2.4.1 Introduction

Socio-economic status (SES) remains a topic of interest in the study of children's growth and development. This is because of the belief that high SES families afford their children a range of goods, services, parental actions and social connections that benefit the children. There is also a concern that many low SES children lack access to the same resources and experiences, thus they are at risk of developmental problems (Brook-Gunn & Duncan, 1997). In this section, a review of literatures regarding the association between socio-economic status and infant growth is presented.

2.4.2 Socio-economic status

The sensitivity of growth to various factors in the social environment is quite remarkable. The socioeconomic status (SES) of a family is usually determined by such factors as: parental educational or social class and household income (Marmot, 2004). Children of lower SES families are smaller, and they often mature less rapidly than children of higher SES households (Bogin, 1988).

Social variables such as income, number of children in the household, parental education, occupational status, per capita income, and the degree of urbanization) do not influence growth directly. According to Bielicki and Welon (1982), these variables must be viewed as influencing growth via some "primary" environmental factors, with which social variables are correlated. The authors list four primary factors: nutrition, morbidity, physical workload, and greater growth promoting psychological stimuli from parents, schools, and peers (Bielicki & Welon, 1982).

Smith and colleagues conducted a study to investigate why urban malnutrition rates are lower than those of rural areas. They found that economic status of a child's household has a strong and positive association with his or her nutritional status (Smith, Ruel & Ndiaye, 2005). The results of the study showed that specifically in Latin American and Caribbean, the link appeared to be the strongest. Poor households often have low access to food and inadequate resources for health care. One of the determinants of population health is economic inequality, independent from poverty and household income (Larrea & Kawachi, 2005).

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Patterns of socio-economic data for considering geographical and environmental factors have been studied by Farrow, Larrea, Hyman and Lema (2005) using a spatial analysis framework. They were found to give better understanding about the processes linked to food poverty.

In a study conducted by Rahman and Chowdhury to investigate the impact of socio-economic, demographic and community factors on stunting, the number of children living in a household was found to be significantly associated with stunting. Households with only one child have a lower risk of stunting than those with more than one children (Rahman & Chowdhury, 2007). The total number of children within a household influences the resources available to each child, in terms of financial, time, attention and vulnerability to infection. In a crowded household, exposure of an individual child to infection is also increased (Sereebutra, Solomons, Aliyu & Jolly, 2006).

The effect that the number of children might have on growth-influencing factors is also obvious. The greater the number of children, the less the amount of money available for each family member. According to Bielicki and Welon (1982), in Poland, the annual per capita consumption of principal food items (such as meat, eggs, butter, cheese, fruits, and vegetables) in the households of salaried workers and private farmers declines dramatically with any increase with the number of persons in the household. Since the number of persons in a household is correlated strongly with the number of children in a family, the preceding suggests that the number of dependants in the home may affect growth primarily through nutrition (Bielicki & Welon, 1982).

Although socio-economic status can be assessed in many ways, the most commonly used measures are education, income (White, 1982) and wealth (Oliver & Saphiro, 1995; Krishna, Oh, Lee, Lee, Perkins, Heo, Ro & Subramanian, 2015). Therefore, the use of maternal education, household income and wealth index to measure socio-economic status is justified.

2.4.2.1 Relationship between maternal education and infant growth

Education may increase individuals' cognitive abilities (Erikson, 2001). These abilities may increase their power to solve problems, improve decision-making or increase access to other resources. For example, higher education will be necessary for many highly-qualified jobs, which will generally be better paid and have healthier working conditions.

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The mode of action of parental education on growth is more complex. It manifests itself largely through income and nutrition. Education is important in ensuring child survival. For example, educated mothers are more likely to seek professional health care. As the skills and methods of the mother are enhanced, food distribution within the household is also affected. High literacy rates among females correlate with decreases in infant mortality rates, increases in family nutrition, and decreases in population growth (Frongillo & Hanson, 1995).

A study in India showed that for a better use of healthcare services, maternal education was found to be a more significant, powerful and positive predictor when considering all other background factors such as maternal residence, work status , caste and religion, age, sex and birth order of the children. Mothers who have at least middle school education are 40 to 60 percent more likely to use in a better way the health care facilities for the treatment of their children suffering from infectious diseases (Acute respiratory infection (ARI) and diarrhoea and so on) compared to illiterate mothers. Women educated with at least some years of primary school education are two times more likely to be utilizing modern healthcare services compared to illiterate women (Govindasamy & Ramesh, 1997).

Bielicki and Welon (1982) suggest that the effect of parental education on growth (more specifically, on stature and menarcheal age) may reflect differential parental utilization of the available income, rather than the actual amount of money available per member of the family. Research has also shown that the effect of maternal education is stronger than that of paternal education (Bielicki & Welon, 1982). Educated mothers are more conscious about their children's health. Literate mothers can easily introduce new feeding practices scientifically, which help to improve their children's nutritional status (Das, Hossain & Islam, 2008). Mothers who are educated may have a strengthened capacity to substitute with less expensive sources of nutrients at the periods of recessions, thereby mitigating the risk of undernutrition of their children. However, those mothers who have limited education and low economic status have less chance for such type of substitution (Weil, Cooper, Alicobusan, Wilson, Reich, Bradley & John, 1990).

In a study conducted in Indonesia and Bangladesh, greater formal education levels achieved by both mothers and fathers were associated with decreased odds of child stunting (Semba, de Pee, Sun, Sari, Akthar & Bloem, 2008). This cross-sectional study conducted in two countries, showed that maternal and paternal education were strong predictors of child stunting.

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However, the relative importance of maternal and paternal education might vary in different settings. In Indonesia, increasing maternal education was associated with greater reduction in the odds of stunting than that of paternal education (Semba *et al.,* 2008). Mothers have been generally the primary caregivers for the children, thus their level of education had a stronger effect on child stunting than that of fathers. On the other hand, in Bangladesh, increasing paternal education was associated with greater decreases in the odds of stunting than that of maternal education (Semba *et al.,* 2008; Rahman & Chowdhury, 2007). The low social status of women and their limited influence on household decision-making were the reasons why - in Bangladesh - paternal education might be a stronger predictor of child stunting than maternal education.

Several studies, for example, NFCS and NFCS -FB:I, found that child undernutrition decreases with increasing maternal education while child obesity increased (Kruger, Swart, Labadarios, Dannhauser & Steyn, 2008; Labadarios *et al.,* 2005). Armar-Klemusu, Ruel, Maxwell, Lewin and Morris (2000) found poor maternal education to be a limiting factor in good child practices, health-seeking behaviour and hygiene in Ghana. Maternal formal education may also indirectly contribute to child nutrition indirectly by increasing household income (Frost *et al.,* 2005), but if this would lead to inadequate child care through use of alternative helpers, these benefits may be reversed (Ukwuani & Suchindran, 2003).

Among the explanatory variables that represent determinants of child malnutrition, women's education was found to have the strongest impact on malnutrition (Smith & Haddad, 2000). So therefore, the level of maternal education has influence over how resources are used which in turn influence child growth.

2.4.2.2 Association between household income and infant growth

Income has been suggested as the best measure of material condition (Erikson, 2001). It is often measured at household level, which tends to elevate the income of married and cohabitants compared with singles, and household income is often adjusted for number of adults and children living in the household. It is a general resource which can be transformed into other resources. As a result of this characteristic, those with higher income can be considered as having more control over life (Erikson, 2001). It is also the most dynamic indicator as it varies over time more than other indicators do. In determining living standards,

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income plays a key role in terms of housing, consumption and recreation. The effect of family income on the growth-influencing factors is obvious: families with greater income will consume greater amounts of foods that are principal sources of animal protein, minerals, and vitamins, as well as other nutrients that are considered essential for growth (Bielicki & Welon, 1982; Post, Kemper, Welten & Coudert, 1997).

Studies have shown that children in low income households are prone to experience more infectious diseases such as diarrhea, measles, acute respiratory infection (ARI) and other poor health outcomes (Brooks-Gunn & Duncan, 1997; Currie, Shields & Price, 2007; Louise, Qian, Lise, Maria-Victoria, Louise & Frohlich, 2005; Rosenbaum, 1992; Scholar, Hickson & Ray, 1999).

The association between child health and income can be explained by one major explanation. Families with high socio-economic status may be able to provide better health care services, goods, services, adequate diet and resources to their children that can lead to a positive effect keeping their children away from them experiencing poor health outcomes (Brooks-Gunn & Duncan, 1997).

Poor socioeconomic condition and poverty are highly associated with childhood morbidity and mortality. Children of households who have a poor income and who have a low socioeconomic status have a higher risk of death at infancy and childhood and are at risk of many acute and chronic illnesses (Spencer, 2000).

Income sources have a significant impact on the nutritional profiles of the household's members. A study conducted in Pakistan revealed that the number of income sources has a positive impact on child nutritional status. It has been found that the prevalence of wasting among children is more in the households with one income source. Households have less wasted children with two or more income sources compared to households having one income source (ACF- Pakistan, 2012).

Several studies have assessed the relationship between income and health in developing countries (Cortez, 2002; Gwatkin, Rustein & Johnson, 2000; Houweling, Kunst & Mackenbach, 2003; Thomas, Strauss & Henriques, 1987). For instance, Cortez compared mother's and father's income to determine the better predictor of nutritional status of children. The study found that mother's income emerged as a stronger predictor of child

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nutritional status than father's income both in urban and rural regions (Cortez, 2002). Similarly, Thomas *et al.* (1987) used survey data from Brazil to test whether household characteristics affect child survival, height and weight. The study found household income to make a significant, however small contribution to child survival and child height (Thomas *et al.*, 1987). It can be concluded therefore that several researchers have found an association between income and child growth.

2.4.2.3 Association between household wealth index and infant growth

The modern understanding of wealth is the abundance of valuable resources or material possessions. In a larger understanding of wealth, an individual, community, region or country that possesses an abundance of such possessions or resources to the benefit of the common good is known as wealthy. When analyzing a family's SES; the household income, earner's education and occupation are examined, as well as combined income. The main factors include income, education, occupation, age and gender of the household head.

To measure socio-economic status (SES), studies have used variables such as ownership of land (Filmer & Pritchett, 2001), farm animals and whether living in rented or owner-occupied housing (Schellnberg, Schellnberg, Mushi, Savigny, Mgalula, Mbuya & Victoria, 2003), literacy or education level of the head of household, demographic conditions (for example, the ratio of the number of people to the number of rooms in the household to proxy crowding), and other economic proxies such as occupation of head of household (Rustein & Johnson, 2004; Galobardes, Shaw, Lawlor, Lynch & Davey, 2006).

In the Demographic Health Surveys (DHS), information is collected on durable asset ownership, access to utilities and infrastructure (for example sanitation facility and source of water), and housing characteristics (for example number of rooms for sleeping and building materials) (Department of Health, Medical Research Council, OrcMacro, 2007). The wealth index is calculated using easy to collect data on household's ownership of selected assets, such as televisions and bicycles, materials used for housing construction, and types of water access and sanitation facilities. Socio-economic status (SES) or household wealth can be measured on multiple levels (Filmer & Pritchett, 1998). In the past it was mostly determined using an individual's education level, sometimes in combination with their occupation. Current approaches for measuring household wealth include 'direct' measures of economic

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status, including income, expenditure, and financial assets (for example savings and pensions), and 'proxy' measures (for example household durable assets, housing characteristics and access to utilities and sanitation).

The direct measures approach involves collecting data on income, expenditure, and financial assets such as savings and pensions. Wealth index is then constructed using such data. Direct measures can be expensive to collect and may require complex statistical analyses that are beyond the scope of many population wealth indices. In developing country settings in particular, large seasonal variability in earnings and a high rate of self-employment, together with potential recall bias and false reporting, may render such data inaccurate or even unreliable.

The proxy measures approach involves the use of data collected on household durable assets, housing characteristics and access to utilities and sanitation. Proxy measures are thought to be more reliable, since they require only data collected using readily available household questionnaires supported by direct observation. From a public health point of view, the proxy wealth index approach is more useful than that of direct measures, since it explains the same, or a greater, amount of the differences between households than an income/expenditure index, while requiring far less effort from respondents, interviewers, data processors and analysts.

The use of wealth and the wealth index has gained a growing recognition within poverty and health research as an alternative to income and expenditure (Mwageni, Masanja, Juma, Momburi, Mkilindi, Mbuya, Kasale, Reid & de Savigny, 2005). Hence, a growing amount of studies exists focusing on the influence of wealth on child health in developing countries (Mosley & Chen, 1984; Mwageni *et al.*, 2005). Studies including wealth and the specific health outcome of child malnutrition also exist, though they are few.

In the study conducted by Mwageni *et al.* (2005) to determine wealth indices for 12 604 individuals in rural households using the wealth index as SES indicator, the results showed significant gradients in both access and outcome measures across wealth quintiles, even though the study was done in a relatively homogenous rural area. The odds ratio for the infants, child and under - 5 mortality were 1.46, 1.41 and 1.53, respectively in poorest compared to least poor quintiles in rural Tanzania (Mwageni *et al.*, 2005). Also, Pebley and Goldman (1995) conducted a study to determine predictors of adverse child growth in

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Guatemala and found land distribution to be among important influences (Pebley & Goldman, 1995).

Research has documented statistically significant relationships between household wealth and childhood health and stunting (Fotso & Kuate-Defo, 2005; Mosley & Chen, 1984; Ricci & Becker, 1996). For instance, Fotso & Kuate-Defo (2005) conducted a study to explore the influence of SES (using wealth index as a proxy) on child health in five African countries and found that children from the poorest SES group were from 1.5 (Burkina Faso) to 3.2 (Cameroon) times more likely to be stunted compared to their counterparts belonging in the richest SES group (Fotso & Kuate-Defo, 2005).

In a longitudinal study of eight cohorts of children in four countries, Krishna and colleagues found baseline wealth index to be significantly associated with higher physical growth rates and lower odds of stunting (Krishna *et al.*, 2015). Compared to community SES and household social position, measured by education and occupation, household wealth emerged as the strongest predictor of child nutritional status (Fotso & Kuate-Defo, 2005). Consequently, the use of wealth index to assess socio-economic status is the most favoured measure of socio-economic status.

2.5 Feeding practices

2.5.1 Association between feeding practices and infant growth

Proper feeding practices during infancy are essential for attaining and maintaining proper nutrition, health, and development of infants and children (Brown, Creed-Kanashiro & Dewey, 1995; Dewey, Cohen, Brown and Rivera, 1999; Butte, Wong, Hopkinson, Smith & Ellis, 2000; Kumar, Goel, Mittal & Misra, 2006). Results of studies on infant and child feeding have indicated that inappropriate feeding practices can have profound consequences for the growth, development, and survival of infants and children, particularly in developing countries (Sakisaka, Wakai, Kuroiwa, Flores, Kai & Rasmussen, 2006).

2.5.1.1 Breast-feeding

Breast-feeding has always been acknowledged as the optimal way to feed an infant, although recommendations regarding practices have changed as more and more information have become available (Gibney, Margett, Keane & Arab, 2004). The mother's milk until the child is 4-6 months old is the essential food for babies, for their physiological and psychological

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needs and can improve their growth status too (Illingworth, 1987). Hence, the benefits of full breastfeeding on growth may be most pronounced early in life (Eckhardt, Suchindran, Gordeon-Larsen & Adair, 2001).

The health benefits of breastfeeding for infant development are also widely acknowledged. However, the age at which breastfed infants are first given complementary foods is of public health importance because the risk of diarrheal disease from contaminated complementary foods, and the potential risk of growth faltering if foods are inappropriately delayed. The WHO recommends a period of six months as the optimal duration of exclusive breastfeeding (WHO, 2002). Furthermore, the WHO's recommendations on children feeding includes breastfeeding for two years and beyond (WHO, 2011). However, some studies have found an increase from mild to severe malnutrition in children who were breastfed during the second year (Victora, Huttly, Barros, Martines & Vaughan, 1991; Caulfield, Bentley & Ahmed, 1996; Marquis, Habicht, Black & Rasmussen, 1997).

Some explanations have been offered for the negative association between breastfeeding and growth, seen in poor communities. Some researchers have suggested that breastfeeding may reduce the consumption of complementary foods, without an equivalent increase in human milk intake thereby diminishing total energy intake. The negative association may also suggest that decisions to continue breastfeeding occur as a direct response to child's poor health. Thus the negative association reflects reverse causality, where the outcome (i.e., linear growth) is a causal factor of the predictor (i.e., breastfeeding), and not vice versa (Marquis *et al.,* 1997); increased breastfeeding does not lead to poor growth; rather, the child's poor health and growth leads to increased breastfeeding. Thus any decision on whether or not breastfeeding should be encouraged after the first year of life should take into account the characteristics of the population (Victora *et al.,* 1991).

A study was conducted in Peru to determine the validity of the assumption that weaning is a non-reversible event. The results demonstrated that the recommendation of relactation, reintroducing breastfeeding sometime after the child has been weaned, should even be considered when children have been prematurely weaned and human milk would improve their nutritional and health status (Marquis, Dias, Bartolini, de Kanashiro & Rasmussen, 1998).

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Therefore, for achieving optimal growth, development and health, after exclusively breast-feeding for the first six months, the infants should be given nutritious complementary foods. In addition, breastfeeding should be continued up to the age of two years or beyond (WHO, 2011).

2.5.1.2 Complementary feeding

Complementary foods are foods given in addition to breast milk and the process of feeding them is called complementary feeding (WHO, 2000). Determining how mixtures of family foods can meet the extra needs of young children during their vulnerable time is important. In order to keep young children healthy, complementary foods should be nutritious, clean and safe, and served in adequate amounts for feeding. Long-term low quality food and poorly balanced nutrition are potential reasons for the high prevalence of stunted growth (Sakisaka *et al.*, 2006).

Complementary feeding that promotes dietary diversity, through the inclusion of a variety of foods in the diets of children in the 1 -3 age group, is recommended (Onyango, Koski & Tucker, 1998). It has been shown that measures of dietary diversity are relatively simple and were shown to be associated with nutrient adequacy and nutritional status. On the other hand, because dietary diversity also tends to increase with income and wealth, the association between dietary diversity and child nutrition may be confounded by socioeconomic factors. Arimond and Ruel (2004) conducted a study to examine the association between dietary diversity and height-for-age (HAZ) z scores for children 6 – 23 months old using data from 11 Demographic and Health Surveys (DHS). The results showed that there was an association between the child's dietary diversity and nutritional status independently of socioeconomic factors, and that dietary diversity may indeed reflect dietary quality (Arimond & Ruel, 2004).

Similarly, a study concerning complementary feeding done in both urban and rural areas of Guatemala compared the dietary variety and/or diversity, and origins of complementary foods given to urban and rural Guatemalan infants in the second semester of life (Enneman, Harmandez, Campos, Vossenaar & Solomons, 2009). The findings showed that differences between types of selected and consumed foods were observed although no geographical differences were found.

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A study was done to determine variation in dietary patterns and its influence on physical growth among Ecuadorian children less than 60 months of age from households of highland and coastal Ecuador. Overall, marked growth stunting was seen in both regions, but was more pronounced in the highland children. The high levels of stunting were mostly established in the first 12 months of life (Leonard, Dewalt, Stansbury & McCaston, 2000). Recommendations on complementary feeding vary considerably between countries, mainly because of the limited scientific evidence of the health effects of different foods given during the complementary feeding period (Michaelsen, Larnkjaer, Lauritzen & Molgaard, 2010).

Studies relating infant feeding practices and growth in different populations do not have consistent results. A study in Indonesian did not find a significant correlation between the feeding of additional foods and weight from birth to twelve months, except at two weeks when there was a negative correlation (Kusin, Kardjati, van Steenbergen & Renqvist, 1991). However, in a study of infants in rural China the duration of exclusive breast feeding was found to be positively associated with growth, suggesting a negative effect on growth of early supplementary feeding (Guldan, Zhang, Zhang, Hung, Zhang, Fu & Fu, 1993).

Nommsen, Heinig and Lonnerdal (1989) conducted a study in California in which they found no difference between the weight-for-age, weight-for-length and length-for-age z scores of infants, at age one year, introduced to solids before twenty-three weeks and those introduced after twenty-three weeks. In rural Filipino infants younger than six months, breastfeeding had a strong positive effect on growth (Adair, Popkin, van Derslice, Akin, Guilkey, Black, Briscoe & Flieger, 1993). This positive effect was diminished by supplementary feeding, even after adjusting for the incidence of diarrhea. Thus it seems likely that the growth reduction associated with supplementary feeding reflected a trading of breast-milk intake for inferior weaning foods. However, in Ghanaian infants the growth from birth to six months was faster in those given a traditional fermented weaning porridge as a supplementary food than in those who were exclusively breast-fed (Armar-Klemesu *et al.*, 1991).

In rural Thai infants, from birth to six months of age, breast-milk intake in grams and energy intake from breast-milk alone were significant predictors of weight, while energy intake from supplements was not (Jackson, Imong & Silpraset, 1988). However, in infants older than six

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months weaned infants were heavier and ate more protein than unweaned infants. This reflected the low protein concentration of the breast milk, as compared to the weaning food.

A longitudinal study of Bedouin Arab infants found that infants who were breast fed (exclusively or in combination with other foods) had a reduced rate of stunting at age six months, compared with weaned infants (Forman, Guptill, Chang, Sarov, Berendes, Naggan & Hunt, 1990). However, considering only the exclusively breast-fed infants the relative risk of stunting at six months was not significantly different from one, reflecting either a beneficial effect of supplementary feeding or the small size of the exclusively breast-fed group. Infant feeding practices from six to twelve months were not associated with stunting, but infants who were stunted at six months were at a greater risk of being stunted at twelve months.

A study by Lutter, Mora, Habicht, Rasmussen, Robson and Herrera (1990) found the effect of supplementary feeding on the growth of breast-fed children to be highly dependent on its timing. They fed a high-energy supplement to children at risk of malnutrition over the first year of life, and compared their growth to that of unsupplemented controls. Supplementation had the greatest effect on growth between three and six months (the period of weaning) and between nine and twelve months (the time of peak diarrhoea incidence). However, as the mothers themselves were also supplemented during pregnancy and lactation, it was not possible to ascribe the growth advantage purely to the supplementary food received by the child. Furthermore, the authors cautioned against the risk of disrupting breastfeeding patterns when supplementary feeding is introduced before six months.

The period between six and twelve months has been described as a critical transition period when the exposure to environmental pathogens is most intense, the likelihood of inadequate nutrient intake most probable, and the emotional trauma of less intimate maternal-infant contact most stressful (Gibney *et al.*, 2004).

It can be seen therefore that studies relating feeding practices and growth in different populations show inconsistent results. Some studies found significant association between feeding practice and child growth whereas, others did not.

2.6 Conceptual Based Literature

Over the past two decades studies have been conducted on child growth, which led to the development of theories on poor growth. These theories have been applied to individual

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factors that help to formulate strategies to improve child growth. Four such theories are contrasted here. However this work will be based on the ecological model of growth.

2.7 The ecological model of growth

Reifsnider, Allan, and Percy (2000) developed the ecological model of growth using the ecology of human development model, epidemiological model and the child health assessment interaction model. Each of these previously existing models may be used separately to study stunted growth. However each has its limitations. Studies on stunting must consider multiple factors, not just one factor.

The ecology of human development fails to include the concept of 'agent – host interaction'. However, it is a vital component of epidemiological model. The latter, on the other hand, considers an ecological approach important to explain a disease (Mausner & Kramer, 1985) but does not focus on human development. The child-health assessment interaction model considers the environment as a separate component, apart from the child and the mother.

The ecological model of growth regards a child as the host who interacts with the mother within the micro-system. The child contributes such characteristics as temperament and susceptibility to infection to the operation of the model. This model considers nutritional resources such as food quantity and quality, feeding and weaning practices as agents of stunted growth. It is the interaction between the agent and the host that result in stunted growth. The child's home environment is regarded as the micro-system. The various biological, social, and physical environment within which the child lives are studied for their impact on the host or the agent. The micro-system is made up of the child's home environment – both physical and emotional, the parent – child interaction and the management of the daily livelihood activities are all items that make up the micro-system. The meso-system is conceptualized to include the community because that is where the child interacts with external factors outside the home (Reifsnider, Gallagher & Forgione, 2005). Other important determinants of stunted growth include the child's day care, the child's mother's and father's work, the child's health care system, and the mother's cultural values about health, food, growth and children.

Reifsnider (1995) and Reifsnider *et al.* (2000) are two studies of child growth aimed at reducing stunted growth in toddlers and determining factors associated with childhood

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overweight. The two studies used the ecological model of growth (Figure 2.2) as their theoretical framework.

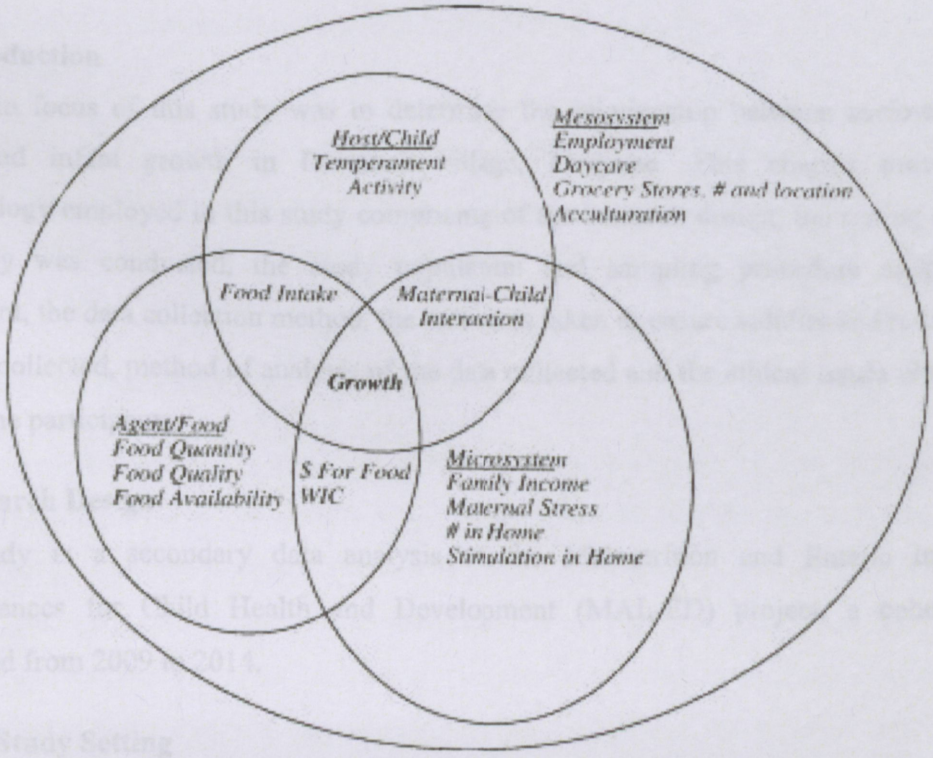

Figure 2.2: Ecological Model of Growth (Source: Reifsnider *et al.*, 2005).

The ecological model of growth serves as a guide in the development of an intervention designed to promote growth in low-income children who received Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) services (Reifsnider *et al.*, 2005).

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CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This main focus of this study was to determine the relationship between socio-economic status and infant growth in Dzimauli village, Limpopo. This chapter presents the methodology employed in this study comprising of the research design, the setting in which the study was conducted, the study population and sampling procedure adopted, the instrument, the data collection method, the measures taken to ensure validity and reliability of the data collected, method of analysis of the data collected and the ethical issues observed to protect the participants.

3.2 Research Design

This study is a secondary data analysis of the Malnutrition and Enteric Infections: Consequences for Child Health and Development (MAL-ED) project, a cohort study conducted from 2009 to 2014.

3.3 The Study Setting

This study was conducted at Dzimauli Village, located in Mutale Local Municipality, Vhembe District of the Far North region of the Limpopo Province of South Africa. The Municipality is a rural and mountainous place, characterized by agricultural livelihood, low socioeconomic status, and poor infrastructure, with waterfalls and many rivers across the villages. Mutale Municipality has a total population of 91870. Mutale Municipality makes 7% of the entire Vhembe District population, which is the second lowest recorded municipality in the district followed by Musina. More than 85% of the municipality's population lives tribal areas (Statistics South Africa (SSA), 2011). The majority (99%) of the people residing in the municipality speak Tshivenda as their first language. The population of Mutale Municipality is dominated by the youth making up 36% of the people aged 15–35 years, followed by those aged 5–14 years at 25.1%. Only 3% of the population had a tertiary education and 10% had no schooling at all (SSA 2011). There are 23 751 households in Mutale Municipality, with an average of 3.8 persons per household. The majority of these households (87%) live in formal dwellings, followed by those who live in traditional dwellings at 9.9 %. Dzimauli village is predominately semi-rural with poor infrastructure,

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lack of electricity, proper sanitation, poor roads, and poorly-equipped schools. The village relies mainly on subsistence farming (IDP, 2007).

3.4 The Study Population, Sampling Procedure and Sample Size

3.4.1 The Study Population

In this study, all the children recruited for the MAL-ED research at Dzimauli Village constituted the total population. A total of 314 children enrolled in the MAL-ED study at birth. The infants were being followed at regular intervals up to 24 months of age and up to 36 months of age when feasible.

3.4.2 Sampling Procedure

The sample was selected from the sampling frame which consists of 314 children. Simple random sampling method was used to select children (0 – 12 months old) from the sampling frame. Each child in the sampling frame was given an equal chance of being selected in the sample. The sampling frame listed children from 1 to 314 based on the Personal Identification Number (PID) for each child. The sample of children was then drawn by going through the list from 1 to 314 and selecting children who have spent twelve months in the MAL-ED study. However, only study participants who met the inclusion criteria were considered for this study.

Table 3.1: The Sampling Frame

PID Number	MALE	FEMALE	TOTAL
SA 1 C0001 – SA 1 C0365	139	141	280
SA 2 C0005 – SA 2 C0057	5	9	14
SA 3 C0002 – SA 3 C0049	6	4	10
SA 4 C0011 – SA 4 C0041	2	3	5
SA 5 C00 23 – SA 5 C0055	3	2	5
TOTAL	155	159	314

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3.4.2.1 Sample size

Sample size was calculated using the formula below, where N is the total number of participants, n is the sample size and e is the accepted level of error of 0.05 (Guilford & Frucher, 1973).

$$n = \frac{N}{1 + (N \times e^2)}$$

$$n = \frac{314}{1 + (314 \times 0.05^2)}$$

$$n = \frac{314}{1 + 0.785}$$

$$n = \frac{314}{1.785}$$

$$n = 175.9103641456583$$

$$n \approx 176$$

The inclusion criteria

Children who have spent twelve months in the MAL-ED study (children who have Monthly Assessment Form A (MOA) and those with twelfth Monthly Assessment Form B (MOB).

3.5 Data Collection Instrument

A review of MAL-ED study records of all children who were involved in the study was done and data was extracted using data collection form. The data collection form consisted of open-ended, closed-ended and dichotomous (yes/no) questions to measure the variables of interest.

The data collection form consisted of four sections (Appendix I) as follows:

- Section A: demographical characteristics e.g. age, gender, marital status and relationship to child, head of household, mother and child's primary caregiver.
- Section B: socioeconomic status e.g. household wealth, maternal education, and household income.

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- Section C: feeding practices e.g. breastfeeding, complementary and formula feeding.
- Section D: child anthropometry e.g. weight, height and head circumference.

The data collection form was prepared in English language.

3.6 Validity and Reliability

3.6.1 Validity

In order to achieve face validity and content validity, an extensive review of literature and instruments from similar studies conducted locally and internationally was carried out during the instrument design process to provide some assurance of validity. In addition, the data collection form was submitted to experts from the Department of Public Health at the University of Venda for evaluation of its content validity.

3.6.2 Reliability

The reliability of the instrument was determined by using the test-retest method. The data collection form was used to collect data on the same subjects on two occasions. The first set of responses was then compared with the second set. The correlation coefficient was applied to test the reliability of the tests.

3.7 Data Collection

A letter of permission to conduct the study was written to the MAL-ED project group through the chair and access was granted to the records. Data was collected using a data collection form, where the records of participating children in the MAL-ED study was reviewed and the data of interest was entered into the data collection form. Data collection was done at MAL-ED office at University of Venda with the aid of two research assistants appointed prior to the exercise. The data was collected on weights, heights and head circumference of children from birth (age 0) to twelve (12) month in a one (1) month period, indicating their sex, educational level of mothers, mother's age, infant's feeding practice used by the mother and the household income. Demographic and socio-economic status data were also collected. In addition, data on the child's dietary diversity was also collected.

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3.8 Data Analysis

Data obtained from completed data collection form was entered into Microsoft Excel and then transferred to SPSS 20 (The Statistical Package for the Social Sciences) for analysis. In SPSS, frequency checks were run for missing and extreme values. First, descriptive analyses were done to provide general information on characteristics of the study populations and then they were followed by analyses to find the associations between variables. Descriptive statistics, namely frequencies and percentages were used for categorical data while means and standard deviations for continuous data, were calculated. Chi-Square test was carried out to assess relationship between socio-economic status (maternal education, household income and wealth) and infant growth (stunting, underweight and wasting) on one hand, feeding practices and infant growth on the other. A p-value of $p<0.05$ was considered statistically significant and taken to imply an association between the variables being compared. Thereafter, binary logistic regression analysis was conducted to determine association between socio-demographic factors and anthropometric measurements. Both independent and dependent variables were recoded into categorical variables (dichotomized) before being entered in the binary logistic regression model to determine independent predictors of stunted growth, underweight and wasting. Odds Ratio (OR) and 95% Confidence Interval (CI) were calculated for all associated factors at $p<0.05$ level of significance. The anthropometric data of the infants was assessed using the WHO Anthro software version two ® and they were expressed as z-scores for each of the anthropometric indices of malnutrition against the new WHO child growth standards. An infant was considered stunted, underweight or wasted if his or her height-for-age z score, weight-for-age z score or weight-for-height z-score is more than two standard deviations (SDs) below the reference median, respectively.

3.9 Ethical Considerations

3.9.1 Permission to Conduct the Study

The permission to conduct the study was obtained from the Higher Degrees Committee of the School of Health Sciences at the University of Venda, the University Higher Degrees Committee, and from the MAL-ED project. (Appendix II)

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3.9.2 Ethical Clearance

This study was approved by the University of Venda Health, Safety and Research Ethics Committee and an ethical clearance certificate was issued to that effect in July, 2015 to conduct the study. The project number is SHS/15/PH/11/2007. (Appendix III)

3.9.3 Confidentiality

The information on the study participants was treated confidentially. Access to completed data collection form was restricted to the researcher only.

3.9.4 Anonymity

This was achieved by identifying MAL-ED study participants by their personal identification number only. Names of the study participants were blinded from the researcher and his assistants.

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CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

In this chapter, the results of the study are presented and are discussed with the literature.

4.2 Demographic Characteristics of the Respondents

Table 4.1 shows the demographic characteristics of the household heads. There were more males (69.1%) than females (30.9%). Most males (18.8%) and females (9.7%) were in the age group (40 – 49) years.

Table 4.1: Age and sex distribution of household heads

AGE (YEARS)	SEX DISTRIBUTION				TOTAL	
	MALE		FEMALE			
	Number	Percentage	Number	Percentage	Number	Percentage
20 - 29	8	4.8	0	0.0	8	4.8
30 - 39	29	17.6	5	3.0	34	20.6
40 - 49	31	18.8	16	9.7	47	28.5
50 - 59	20	12.1	16	9.7	36	21.8
60 -69	15	9.1	7	4.2	22	13.3
70 - 79	8	4.8	3	1.8	11	6.7
80 -89	2	1.2	4	2.4	6	3.6
90 - 99	1	0.6	0	0.0	1	0.6
TOTAL	**114**	**69.1**	**51**	**30.9**	**165**	**100.0**

Socio-demographic characteristics of the head of households are presented in Table 4.2. Ninety-four percent (n=155) of the households were headed by the father, grandmother or the grandfather of the child. Seventy-five percent (n=123) of the household heads are married but few (4%; n=7) were never married. Ninety-two percent (n=152) of the respondents have attended schools. However, less than one percent (n=1) was attending school at the time of the survey.

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Table 4.2: Socio-demographic characteristics of household heads

Variables	Number	Percentage
Relationship to child (n=165)		
Father	70	42.4
Grandmother	47	28.5
Grandfather	38	23.0
Other	10	6.1
Marital status (n=165)		
Never married	7	4.2
Married	123	74.6
Divorced	15	9.1
Widowed	20	12.1
Ever attended school (n=165)		
Yes	152	92.1
No	13	7.9
If younger than 25, are you currently attending school or college? (n=186)		
Yes	0	0
No	1	0.5
NA	185	99.5

Table 4.3 shows the age and gender distribution for household heads when they got married for the first time. There were more males (71.5%) than females (28.5%). Most household heads (both males and females) got married for the first time within the age bracket (20 – 29) years.

Table 4.3: Age and sex distribution of household heads according to their age when married for the first time

AGE (YEARS)	SEX DISTRIBUTION				TOTAL	
	MALE		FEMALE			
	Number	Percentage	NO	Number	Number	Percentage
10 -19	3	1.9	16	10.1	19	12.0
20 - 29	85	53.8	25	15.8	110	69.6
30 - 39	22	13.9	4	2.5	26	16.5
40 - 49	3	1.9	0	0.0	3	1.9
TOTAL	**113**	**71.5**	**45**	**28.5**	**158**	**100.0**

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Information about age and sex distribution of household heads according to the number of years of schooling they completed is presented in Table 4.4. More females (62.5%) completed high school than males (48.0%), while more males (17.1%) completed primary school than females (9.9%).

Table 4.4: Age and sex distribution of household heads according number of years of schooling completed

AGE (YEARS)	SEX DISTRIBUTION				TOTAL	
	MALE		FEMALE			
	Number	Percentage	Number	Percentage	Number	Percentage
1- 7	26	17.1	15	9.9	27.0	27.0
8 -12	73	48.0	22	14.5	62.5	62.5
13 - 16	11	7.2	4	2.6	9.9	9.9
≥ 17	1	0.7	0	0.0	0.7	0.7
TOTAL	**111**	**73.0**	**41**	27.0	**100**	**100.0**

Table 4.5 presents the demographic characteristics of mothers. Eighty-four percent (n=155) of mothers are in the age brackets (20 – 29) and (30 – 39) years. Fifty-five percent (n=102) are married, 52.0% (n=65) were married for the first time at the age of 20 to 29 years. Majority (63.0%; n=118) got pregnant for the first time at 14 to 19 years. All the mothers (n=186) reported having attended school. However, 81.0% (n=151) reported to have completed high school. Sixteen percent (n=29) of the mothers reported that they were currently attending school. About 75.0% reported maximum of three pregnancies in their lifetime. This is the same as the number of life births in their lifetime. However, 91.0% (n=170) reported all the children are still alive; while 20.0% (n=3) lost two children to death. Eighty-seven percent (n=161) of the mothers reported that they are the primary care-giver for the infants.

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Table 4.5: Demographic characteristics of mothers

Variables	Number	Percentage
Age (years) (n=186)		
10 – 19	14	7.5
20 – 29	94	50.6
30 – 39	61	32.8
40 – 49	17	9.1
Marital status (n=186)		
Never married	62	33.3
Married	102	54.8
Divorced	17	9.1
Widowed	5	2.7
Age when married for the first time (n=124)		
10 – 19	58	46.8
20 – 29	65	52.4
30 – 39	1	0.8
Ever attended school (n=186)		
Yes	186	100.0
No	0	0.0
Number of years of schooling completed (n=186)		
1 – 7	21	11.3
8 – 12	151	81.2
13 – 16	14	7.5
≥17	0	0
If younger than 25, are you currently attending school or college? (n=186)		
Yes	29	15.6
No	37	19.9
NA	120	64.5
Age when became pregnant for the first time (n=186)		
14 – 19	118	63.4
20 – 24	55	29.6
25 – 29	14	7.0
Number of pregnancies in lifetime (n=186)		
1 – 3	139	74.7
4 – 6	45	24.2
7 – 9	2	1.1
Are all of the children still alive? (n=186)		
Yes	170	91.4
No	16	8.6
Mother the primary care giver (n=186)		
Yes	161	86.6
No	25	13.4

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Demographic characteristics of the care-givers are presented in Table 4.6. Seventy-two percent (n=18) of the care-givers were grandmothers. Sixteen percent (n=4) of the caregivers fall within the age group (65 – 74). Forty percent (n=8) of caregivers were married for the first time within the age range of 15 – 19 years. Seventy-six percent (n=19) reported having attended school or college. However, 58% (n=11) reported that they completed high school.

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Table 4.6: Demographic characteristics of primary caregivers

Variables	Number	Percentage
Relationship to child (n=25)		
Father	1	4.0
Grandmother	18	72.0
Sibling	1	4.0
Other	5	20.0
Age (Years) (n=25)		
25 – 34	3	12.0
35 – 44	6	24.0
45 – 54	8	32.0
55 – 64	4	16.0
65 – 74	4	16.0
Marital status(n=25)		
Never married	5	20.0
Married –only wife	12	48.0
Married first wife	2	8.0
Married second or higher wife	1	4.0
Divorced	2	8.0
Widowed	3	12.0
Age when married for the first time (n=20)		
15 – 19	8	40.0
20 – 24	5	25.0
25 – 30	7	35.0
Relationship to head of household (n=25)		
Wife/partner	11	44.0
Self	5	20.0
Daughter	1	4.0
Aunt	1	4.0
Other	7	28.0
Ever attended school or college? (n=25)		
Yes	19	76.0
No	6	24.0
Number of years of schooling completed (n=19)		
1 – 7	8	42.1
8 – 12	11	57.9
13 – 16	0	0
17 and above	0	0

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4.3 Socio-economic characteristics of the households

Information about the socio-economic characteristics of the sampled households is presented in Table 4.7. Fifty-five percent (n=103) of the households have stayed in the house for more than twenty years and have between five and nine rooms in the house. About 69.0% (n=129) of the households use between one and three rooms for sleeping while 62.0% (n=115) of the households had between five and nine people who usually sleep in the households. Majority (96.0%; n=178) of the households do not pay for domestic workers. Thirty-eight percent (n=71) of households have piped water in their dwelling, with only 2.0% (n=3) having unprotected well as their main source of water; 92.0% (n=113) had their piped water supply sometimes interrupted for more than twenty-four hours. Majority (66.0%; n=123) of the households use piped water sources for cooking and hand washing. Seventy-eight percent (n=144) of the households do not pay or barter for water; and 76.0% of the households have their water sources located elsewhere (not in the yard/plot). Majority (72.0%; n=134) of the households spent nineteen minutes maximum to get water from the water source; which is mostly (93.0%; n=172) done by adult women. Eighty-nine percent (n=165) of the households do not treat their water to make it safe for drinking. Of those who treat their water, 68.0% (n=13) add bleach/chlorine. Fifty-three percent (n=98) of the respondents reported always washing their hands after helping their infants defecate whereas few (7.0%; n=13) never wash their hands after helping their infants defecate; 52.0% (n=97) would always wash their hands before preparing food while 10.0% (n=18) reported never washing their hands before preparing food. Sixty percent (n=111) reported always washing their hands after using toilet while 9.0% (n=16) reported never washing their hands after using toilet. Thirty-four percent (n=64) of the respondents reported using the toilet paper while 19.0% (n=35) never use toilet paper. Only a few (2.0%; n=4) of the households have flush to pipe sewer system while the majority (95.0%; n=176) have pit latrine without flush.

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Table 4.7: Socio-economic characteristics of the households

Variables	Number	Percentage
Length of time the family stayed in the house (n= 186)		
< 1 year	2	1.1
1 – < 5 years	22	11.8
5 - < 10 years	16	8.6
10 - < 20 years	43	23.1
≥ 20 years	103	55.4
Number of rooms in the house (n=186)		
1- 4	63	33.9
5 - 9	103	55.4
10 - 14	17	9.1
15 - 19	3	1.6
Number of rooms in the house used for sleeping (n=186)		
1 - 3	129	69.4
4 - 6	57	30.6
Number of people who usually sleep in the household (n=186)		
1 - 4	59	31.7
5 - 9	115	61.8
10 - 14	12	6.5
Household pay domestic workers? (n=186)		
Yes	8	4.3
No	178	95.7
Main source of drinking water for household members (n=186)		
Piped into dwelling	1	0.5
Piped to yard/plot	71	38.2
Public tap/stand pipe	52	27.9
Tube well/borehole	7	3.8
Protected well	12	6.5
Unprotected well	3	1.6
Surface water	40	21.5
Is piped water supply continuous or is it sometimes interrupted? (N=123)		
Continuous	10	8.1
Sometimes interrupted	113	91.9

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Variables	Number	Percentage
How long does the interruption usually last? (n=114)		
3 - 7 hours	1	0.9
8 - 11 hours	1	0.9
12 - 24 hours	7	6.1
More than 24 hours	105	92.1
Main source of water used for other purposes such as cooking and hand washing (n=186)		
Piped into dwelling	1	0.5
Piped to yard/plot	71	38.2
Public tap/stand pipe	51	27.4
Tube well/borehole	7	3.8
Protected well	13	7
Unprotected well	3	1.6
Surface water	40	21.5
Household pay or barter for water (n=185)		
Yes	41	22.2
No	144	77.8
Water source location (n=186)		
In own yard/plot	44	23.7
Elsewhere	142	76.3
Length of time it takes to go to water source, get water and come back (n=186)		
0 -19	134	72
20 - 29	11	5.9
30 - 39	23	12.4
40 - 49	11	5.9
50 - 59	2	1.1
60 - 69	5	2.7
Main person in the household responsible for fetching water from the source (n=186)		
Adult women	172	92.5
Adult men	5	2.7
Male under 15 years	3	1.6
Other	6	3.2

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Variables	Number	Percentage
Do you treat your water in any way to make it safer to drink? (n=186)		
Yes	21	11.3
No	165	88.7
How do you treat water to make it safer to drink? (n=19)		
Let it stand and settle	3	15.8
Add bleach / chlorine	13	68.4
Boil	3	15.8
Do you wash your hand after helping your child defecate? (n=186)		
Never	13	7
Rarely	22	11.8
Sometimes	53	28.5
Always	98	52.7
Do you wash your hand before preparing food? (n=186)		
Never	18	9.7
Rarely	14	7.5
Sometimes	57	30.6
Always	97	52.2
Do you wash your hand after using toilet? (n=186)		
Never	16	8.6
Rarely	12	6.5
Sometimes	47	25.3
Always	111	59.7
Do you use toilet paper? (n=186)		
Never	35	18.8
Rarely	31	16.7
Sometimes	56	30.1
Always	64	34.4
Kind of toilet facility used by household members (n=186)		
No facility/bush/field or bucket toilet	6	3.2
Pit latrine without flush	176	94.6
Flush to piped sewer system	4	2.2

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Table 4.8 presents information about toilet facilities and electricity supply for the households. Majority (97%; n=178) of the households do not share their toilet facility with any other household. Of those who share their toilet facility, 67.0% (n=4) share with another household but 17.0% (n=1) household share with 3 or 10 households, respectively. Most (88.0%; n=163) have electricity but majority (85.0%; n=138) households reported it was sometimes interrupted. Among the households whose electricity supply is sometimes interrupted, 18.0% (n=25) reported it usually last for more than 24 hours and they mostly use other sources of power. Few (2.2%; n=3) use chargeable lights.

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Table 4.8: Toilet facility and electricity supply for the studied households

Variables	Number	Percentage
Do you share this toilet facility with other households (n=184)		
Yes	6	3.3
No	178	96.7
Number of households using the toilet facility (n=9)		
1	4	66.6
3	1	16.7
10	1	16.7
Does the household ever have electricity? (n=186)		
Yes	163	87.6
No	23	12.4
Is your electricity continuous year-round or is it sometimes interrupted? (n=163)		
Continuous	25	15.3
Sometimes interrupted	138	84.7
How long does the interruption usually last? (n=138)		
Less than 3 hours	27	19.6
3 to 7 hours	23	16.6
8 to 11 hours	35	25.4
12 to 24 hours	28	20.3
More than 24 hours	25	18.1
In the case of discontinued power supply, what source does this household usually use? (n=138)		
Chargeable lights	3	2.2
Other	133	96.4
None	2	1.4

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Information about ownership of some assets by the households is presented in Table 4.9. Majority of the households own most of the assets with the exception of electric fan (28.0%), computer (12.9%) and bicycle (14.5%). Almost half of the household own agricultural land and heat their houses. However, majority of the households do not own cows, bulls or buffalos (89.2%); chicken or duck (66.7%). Wood is used as the primary source of fuel used by most of the households (72.3%) while more than half (67.6% use open fire for cooking in their houses. Most (45.7%; n=85) cook inside the house.

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Table 4.9: Distribution of households according to ownership of assets

Variables	Number	Percentage
Does your household have an iron? (n=186)		
Yes	157	84.4
No	29	15.6
Does your household have a mattress? (n=186)		
Yes	182	97.8
No	4	2.2
Does your household have a sofa? (n=186)		
Yes	105	56.5
No	81	43.5
Does your household have a table (n=186)		
Yes	154	82.8
No	32	172
Does your household have an electric fan? (n=186)		
Yes	52	28
No	134	72
Does your household have a radio or transistor? (n=186)		
Yes	146	78.5
No	40	21.5
Does your household have a computer? (n=186)		
Yes	24	12.9
No	162	87.1
Does your household have a television? (n=186)		
Yes	153	82.3
No	33	17.7

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Variables	Number	Percentage
Does your household have a mobile phone? (n=186)		
Yes	182	97.8
No	4	2.2
Does your household have refrigerator? (n=186)		
Yes	141	75.8
No	45	24.2
Does your household have a watch or clock? (n=186)		
Yes	90	48.4
No	96	51.6
Does your household have a bicycle? (n=186)		
Yes	27	14.5
No	159	85.5
Does any member of your household have a bank account? (n=186)		
Yes	163	87.6
No	23	12.4
Does this household own agricultural land? (n=186)		
Yes	92	49.5
No	94	50.5
Do your household own cows, bulls or buffaloes? (n=186)		
Yes	20	10.8
No	166	89.2
Does your household own chicken or ducks? (n=186)		
Yes	62	33.3
No	124	66.7

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Variables	Number	Percentage
Do you ever heat your house? (n=186)		
Yes	95	51.1
No	91	48.9
What primary source of fuel is used for heating your household? (n=95)		
Electricity	26	27.4
Kerosene	1	1.0
Wood	68	71.6
What type of cooking stove is mainly used in your household? (n=185)		
Kerosene stove	3	1.6
Gas stove	2	1.1
Open fire	125	67.6
Open fire or stove with chimney or hood	3	1.6
Closed stove with chimney	3	1.6
Electric heaters	48	25.9
Other	1	0.6
Is cooking done inside the house outside the house or both? (n=186)		
Inside the house	85	45.7
Outside the house	27	14.5
Both inside and outside the house	74	39.8

Table 4.10 presents information about main material of the floor, roof and exterior walls and average income. Majority (91.0%; n=170) of the households use cement/concrete as the main material for the floor and exterior walls of their houses, respectively. Eighty-two percent of the households used metal roofing and has a separate room used as a kitchen. All (100.0%) households speak Tshivenda. The average monthly income for the households in the study was in the band (0 – 2 999) rand with mean R3 353.87, standard deviation R3 599.12, minimum R280.00, maximum R25 000.00 and the range is R24 720.00.

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Table 4.10: Main material of the floor, roof and exterior walls and average monthly income

Variables	Number	Percentage
Main material of the floor (n=186)		
Earth/sand/clay/mud/dung	8	4.3
Ceramic tiles or vinyl	8	4.3
Cement/concrete	170	91.4
Main material of the roof (n=186)		
Thatch	17	9.1
Metal	152	81.7
Wood	2	1.1
Tiles	12	6.5
Slate	3	1.6
Main material of the exterior walls (n=186)		
Mud	13	7
Cement/concrete	170	91.4
Stone	1	0.5
Metal	1	0.5
Other	1	0.5
Do you have a separate room which is used as a kitchen? (n=186)		
Yes	152	81.7
No	34	18.3
The primary way members of the population are distinguished (n=186)		
Caste	0	0
Race	0	0
Tribe	0	0
Language spoken	186	100
Religion	0	0
None	0	0
If language, what language do you speak? (n=186)		
Tshivenda	186	100

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4.3.1 Food insecurity

The proportions of households that had used any of the different coping strategies related to food insecurity are shown in Table 4.11. Twenty-one percent (n=35) of the households had reported that they sometimes did not have enough food and 22.0% (n=36) reported they sometimes were unable to eat the kind of foods they preferred because of lack of resources. Twenty percent (n=33) of the respondents reported that they sometimes have to eat a limited variety of foods due to a lack resources, whereas only 3.0% (n=5) of the respondents reported to often have to eat some foods they really did not want due to a lack of resources to obtain other types of food. Two percent (n= 4) of the households reported to have to eat a smaller meal often than they felt they needed because there was not enough food and 15.0% (n=24) of the households reported that they sometimes have to eat fewer meals in a day because there was not enough food. Nine percent (n=14) of the households reported that they sometimes do not have food to eat of any kind because of lack of resources to get food. Few (4.3%; n=7) of the households reported that they sometimes go to sleep at night hungry because there was not enough food and 3.0% (n=5) of the households reported that they sometimes go a whole day and night without eating anything because there was not enough food.

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Table 4.11: Different coping mechanisms related to food insecurity

Different coping mechanisms[1]	Number	Percentage
Not have enough food (n=164)		
No	90	54.9
Rarely	35	21.3
Sometimes	35	21.3
Often	4	2.4
Not able to eat the kind of foods you preferred because of lack of resources (n=164)		
No	85	51.8
Rarely	36	22.0
Sometimes	36	22.0
Often	7	4.3
Have to eat a limited variety of foods due to a lack of resources (n=164)		
No	90	54.9
Rarely	36	22.0
Sometimes	33	20.1
Often	5	3.0
Have to eat some foods that you really did not want to eat because of a lack of resources (n=164)		
No	90	54.9
Rarely	35	21.3
Sometimes	34	20.7
Often	5	3.0
Have to eat a smaller meal than you felt you needed because there was not enough food (n=164)		
No	105	64.0
Rarely	28	17.1
Sometimes	2	16.5
Often	4	2.4

[1] The respondent was asked if the household had used any of the 9 coping mechanisms due to food shortage

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Different coping mechanisms[1]	Number	Percentage
Have to eat fewer meals in a day because there was not enough food (n=164)		
No	110	67.1
Rarely	29	17.7
Sometimes	24	14.6
Often	1	0.6
No food to eat of any kind because of lack of resources (n=164)		
No	141	86.0
Rarely	8	4.9
Sometimes	14	8.5
Often	1	0.6
Go to sleep at night hungry because there was not enough food (n=164)		
No	151	92.1
Rarely	4	2.4
Sometimes	7	4.3
Often	2	1.2
Go a whole day and night without eating anything because there was not enough food (n=164)		
No	157	95.7
Rarely	1	0.6
Sometimes	5	3.0
Often	1	0.6

[1] The respondent was asked if the household had used any of the 9 coping mechanisms due to food shortage

Based on the different coping mechanisms (Table 4.11), a new food insecurity category was developed. Table 4.12 shows that 44.0% (n=72) of the households had food security. Fifteen percent (n=24) of the households was mildly food insecure and 27.0% (n=44) of the households was moderately food insecure. The rest 15.0% (n=24) of the households was however severely food insecure.

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Table 4.12: Distribution of households according to household food insecurity categories

Food insecurity category*	Number	Percentage
Food secure	72	44.0
Mildly food insecure	24	14.6
Moderately food insecure	44	26.8
Severely food insecure	24	14.6

*Household food insecurity access scale category according to Coates, J., Swindale, A. and Bilinsky, P. (2007): FANTA III

4.4 Feeding Practices

4.4.1 Milk intake

Table 4.13 and 4.14 show the type of milk intake of the infants at 1, 3, 6, 9 and 12 months and the feeding practices selected by their mothers. Exclusive breastfeeding (defined as breast milk given to the infant without additional liquids or solids) for periods longer than three months was uncommon in the study area.

Table 4.13: Type of milk intake consumed by infants at various periods from birth to 12 months

Age (Months)	Breast milk		Formula		Breast milk and Formula	
	Number	Percentage	Number	Percentage	Number	Percentage
1 (n=186)	153	82.3	9	4.8	24	12.9
3 (n=185)	137	74.0	14	7.6	34	18.4
6 (n=183)	140	76.5	19	10.4	24	13.1
9 (n=61)	50	82.0	6	9.8	5	8.2
12 (n=43)	35	81.4	5	11.6	3	7.0

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Table 4.14: Feeding practices selected by mothers

Practices	1 Mo* (%)**	3 Mo (%)	6 Mo (%)	9 Mo (%)	12 Mo (%)
Exclusive breastfeeding	60.5	9.6	0.6	0.0	0.0
Breast milk and formula	17.1	8.4	0.6	0.0	0.0
Breast milk, formula and solids	1.6	12.7	12.7	8.2	7.3
Breast milk and solids	14.0	61.4	75.7	82.0	78.0
Formula	6.2	1.8	0.6	0.0	0.0
Formula and solids	0.8	6.0	9.9	9.8	14.6

*Mo = Month; **%=Percentage

By the end of the first month, 153 infants were receiving breast milk, but only 60.5% were exclusively breastfed. Formula milk alone was given to 6.2% of the infants, and 12.9% were given a combination of breast milk and formula milk.

The number of exclusively breastfed infants decreased dramatically to 9.6% by the end of the third month and to 0.6% by the end of the sixth month, however, 92.5% of the infants were still being breastfed by the end of the third month. This percentage dropped slightly to 89.6% by the sixth month which was maintained (90.2%) at the end of the ninth month.

Although the study participants were from a semi-rural area relying on farming as a means of living, none of the mothers reported giving animal milk to their infants.

4.4.2 Supplementary foods

Early introduction of solid foods was a common practice in this study population, and most mothers used to chose a variety of combinations as evident in Table 4.14. Mothers were inclined to feeding their infants a combination of breast milk, formula and solids; breast milk, formula and solids; or breast milk or formula. At third month, the most common practice was breast milk and solid.

As the infants grew, several supplementary foods were fed to infants (Table 4.15): the most common ones are rice, porridge, bread, noodles and other food made from grains. The infants

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were usually given a combination of these supplements in some cases as early as the first month. Commercial infant cereals were given to 6.7% and 11.2% of the infants at third and sixth months, respectively.

Table 4.15: Primary supplementary foods introduced into infants' diets in addition to milk

	Grains		None	
Age (Months)	Number	Percentage	Number	Percentage
1 (n=186)	18	9.7	168	90.3
3 (n=185)	135	73.0	50	27.0
6 (n=183)	178	97.3	5	2.7
9 (n=61)	60	98.4	1	1.6
12 (n=41)	41	100.0	0	0.0

During the third month, only one (0.7%) infant received egg and other fruits and vegetables, respectively. By the sixth month, only one (0.6%) infant received grains, roots and tubes; (0.6%) received flesh food; (0.6%) infant received egg and (8.4%) received vitamin-A-rich fruits and vegetables.

By the ninth month, infants were being fed a variety of food: (3.3%) and (31.1%) infants received legumes and nuts and dairy products respectively and (3.3%) vitamin-A-rich fruits and vegetables. However, (1.6%) were fed with other fruits and vegetables.

During the twelfth month, the trend in the ninth month continued but improved: (56.1% infants received dairy products; (41.5%), (26.9%) and (14.6%) infants received other fruits and vegetables; legumes and nuts as well as grains, roots and tubers, respectively. However, only (7.3%) infants received vitamin-A-rich fruits and vegetables.

In addition to these supplements, some infants received some liquids as follows: water 79 (42.5%); tea 1 (0.5%); other liquid 14 (7.5%) at the first month.

By the third month, some infants received: water 107 (57.8%); tea or coffee 5 (2.7%); fruit juice 5 (4.7%) and other liquid 14 (7.6%).

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By the sixth month, some infants received: water 147 (80.3%); tea or coffee 16 (8.7%); fruit juice 8 (4.4%) and other liquid 12 (6.6%).

At the end of the ninth month, some infants received: water 60 (98.4%); tea or coffee 14 (23.3%); fruit juice 2 (3.3%) and other liquid 3 (4.9%).

By the twelfth month, some infants received: water 36 (87.8%); tea or coffee 28 (68.3%); fruit juice 1 (2.4%) and other liquid 9 (22%).

4.5 Growth

Table 4.16 shows the mean ± standard deviation (SD) values of infant anthropometric measurement and their z scores. Figure 4.1 shows the changes in mean z scores for the height – for –age (HAZ), weight – for – height (WHZ), and weight – for – age (WAZ) over a period of 12 month. Table 4.17 shows the point prevalences of infants who were above or below ± 2SD for the WHO reference curves. As shown in Table 4.17 the prevalence of stunting (HAZ< - 2 SD) increased from 11.3% at birth to 24.2% at 12 month. The infants gained weight rapidly, especially during the first and third months.

Table 4.16: Mean anthropometric parameters of the population at different intervals*

Variables	Birth (n=186)	1 month (n=186)	3 month (n=186)	6 month (n=186)	9 month (n=184)	12 month (n=186)
Weight (kg)	3.31 ± 0.49	4.20 ± 0.60	6.05 ± 0.80	7.47 ± 1.05	8.31 ± 1.18	8.95 ± 1.28
Height (cm)	49.68 ± 2.12	52.65 ± 2.40	58.50 ± 2.55	64.50 ± 2.56	68.83 ± 2.57	72.11 ± 2.63
Head circumference (cm)	35.62 ± 1.62	37.29 ± 1.42	40.28 ± 1.51	42.84 ± 3.49	44.78 ± 1.50	45.81 ± 1.52
HAZ**	-0.71 ± 1.09	-0.83 ± 1.18	-0.99 ± 1.18	-0.99 ± 1.11	-0.99 ± 1.11	-1.2 ± 1.06
WAZ***	-0.43 ± 1.03	-0.32 ± 1.04	-0.15 ± 1.09	-0.26 ± 1.2	-0.36 ± 1.2	-0.46 ± 1.18
WHZ****	-0.05 ± 1.28	-0.57 ± 1.34	0.94 ± 1.28	0.56 ± 1.31	0.29 ± 1.23	0.13 ± 1.19

* Data are presented as mean ± standard deviation.
**HAZ= height/age z score; ***WAZ= weight/age z score; ****WHZ= weight/height z score

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Table 4.17: Percentage of infants falling within the WHO growth reference categories

Age (Month)	HAZ*			WAZ***			WHZ****				
	% < -3SD**	Normal	% < -2SD	% < -3SD	Normal	% < -2SD	% < -3SD	% < - 2SD	Normal	% < +2SD	% < +3SD
0 (n=186)	1.1	87.6	11.3	1.6	90.9	7.5	1.6	8.1	85.4	4.9	0.0
1 (n=186)	3.4	83.2	13.4	0.5	92.5	7.0	1.1	4.3	82.2	11.9	0.5
3 (n=186)	3.2	77.9	18.9	0.5	95.2	4.3	0.5	1.6	71.8	20.7	5.4
6 (n=186)	2.7	76.3	21.0	1.1	91.9	7.0	1.6	2.2	82.7	10.8	2.7
9 (n=184)	2.2	74.4	23.4	0.5	90.8	8.7	0.0	1.6	90.3	5.9	2.2
12 (n=186)	3.8	72.0	24.2	1.6	87.1	11.3	1.6	3.2	87.7	5.9	1.6

*HAZ =height-for-age z score; **SD= standard deviation; ***WAZ= weight-for-age z score; ****WHZ= weight-for-height z score

Low birth weight (birth weight < 2.5 kg) was found in 6.5% of the infants, with mean values of 3.172 ± 0.4599 at birth, 11.3% of the infants were stunted, 8.1% were underweight, and 7.5% were wasted as described by HAZ, WAZ and WHZ scores, respectively.

There was a progressively lower mean HAZ score with advancing age until the 12 month. The greatest decline occurred in the first month. In contrast, the mean WAZ were all below zero. The increase in stunting during the first month in relation to the weight gain can be understood if WHZ scores are considered. These were below zero at birth and first month but increased greatly by the third month.

At birth, low WHZ scores were seen in about 8% of the infant. These phenomenon normalised itself by the third month and then steadily declined at twelfth month. The prevalence of stunting (- 2 SD) remained between 13 % and 24% from the first month to twelfth month.

The growth (in terms of length) of individual infants was then tracked over the twelve month period. Their HAZ scores revealed that, in general, infant born with extremely low z scores (- 2SD) remained with low z scores for the first twelve month of life. Among infants in this group, only 7% showed catch-up growth (moving from < - 2SD to within ± 2 SD) by first

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month and 8.1% by twelfth month. By 12 month, there was significant difference between the mean HAZ scores of the group stunted at birth and the non-stunted at birth.

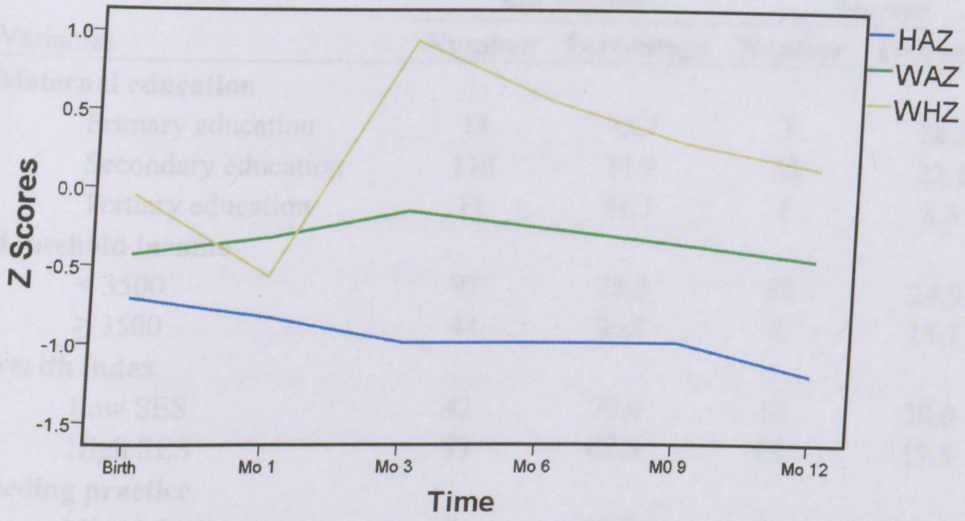

Figure 4.1: Tracking of mean HAZ, WAZ, and WHZ scores of infants from birth to 12 month.
HAZ= *z* score for height-for-age; WAZ= *z* score for weight-for-age; WHZ= *z* score for weight-for-height.

4.5.1 Gender Differences

There were few gender differences in the infant's growth patterns. There were significant differences observed in the first, third and ninth months. Female infants had higher mean z-scores for HAZ in the third and ninth month than their male counterpart but lower mean z- score in the first month.

4.5.2 Socio-demographic Factors and Infant Anthropometric Measurements

Table 4.18 shows the result of bivariate analysis between maternal education and anthropometric measurement (height-for-age z score). A sample of 180 infants was taken and evaluated to determine whether there was association between maternal education and infant growth (stunting). About 141 infants were not stunted whereas 39 infants were stunted.

There is no relationship between maternal education and infant growth (stunting) (χ_2 (2) = 0.407, p>0.05). This implies that the proportion of mothers with primary education who have stunted infants is not significantly different from the proportion of mothers with primary education whose infants were not stunted. The same is true for the proportion of mothers with secondary education and mothers with tertiary education.

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Table 4.18: Bivariate association of height-for-age (HAZ) z scores with demographic variables

Variables	Height-for-Age z scores				
	Not Stunted		Stunted		
	Number	**Percentage**	**Number**	**Percentage**	**p-value**
Maternal education					0.407
Primary education	14	73.7	5	26.3	
Secondary education	116	77.9	33	22.1	
Tertiary education	11	91.7	1	8.3	
Household income					0.154
< 3500	97	75.2	32	24.9	
≥ 3500	44	86.3	7	13.7	
Wealth index					0.084
Low SES	42	70.0	18	30.0	
High SES	99	82.5	21	17.5	
Feeding practice					0.836
Mixed feeding	2	66.7	1	33.3	
Complementary feeding	23	74.2	8	25.8	
Formula feeding	5	83.3	1	16.7	

* Significant at $p<0.05$

The result of bivariate analysis between household income and infant anthropometric measurement (height-for-age z score) is presented in Table 4.18. A sample of 180 infants was taken and evaluated to determine whether there was association between household income and infant growth (stunting). One hundred and forty-one infants were not stunted whereas 39 infants were stunted. More than half of the infants were not stunted.

There is no relationship between household income and infant growth (stunting) (χ_2 (1) = 0.154, $p>0.05$).

This implies that the proportion of households with low income who have stunted infants is not significantly different from the proportion households with high income whose infants were not stunted.

Table 4.18 shows the result of bivariate analysis between wealth index and anthropometric measurement (height-for-age z score). A sample of 180 infants was taken and evaluated to determine whether there was association between household wealth and infant growth (stunting). One hundred and forty-one infants were not stunted whereas 39 infants were stunted. More than half of the infants were not stunted.

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There is very strong evidence that there is no relationship between household wealth and infant growth (stunting) (χ_2 (1) = 2.983, p>0.05).

This implies that the proportion of households with low socio-economic status who have stunted infants is not significantly different from the proportion households with high socio-economic status whose infants were not stunted.

A sample of 40 infants was taken and evaluated to determine whether there was association between feeding practice and anthropometric measurement (height-for-age z score). Thirty infants were not stunted whereas 10 infants were stunted. The result of bivariate analysis between feeding practice and infant growth (stunting) is shown in Table 4.18. More than half of the infants were not stunted.

There is very strong evidence that there is no relationship between feeding practice used by mothers and infant growth (stunting) (χ_2 (2) = 0.358, p>0.05).

This implies that the proportion of mothers who used mixed feeding for their stunted infants is not significantly different from the proportion of mothers who used mixed feeding for their infants who were not stunted. The same is true for the proportion of mothers who used complementary feeding and mothers who used formula feeding.

The result of bivariate analysis to determine the relationship between maternal education and anthropometric measurement (weight-for-age z score) is displayed in Table 4.19. A sample of 179 infants was taken and evaluated to determine whether there was association between maternal education and infant growth (underweight). One hundred and sixty-five infants were not stunted whereas 14 infants were stunted.

The data was analysed using a Chi-square test of independence. The null hypothesis was accepted, χ_2 (2) = 3.442, p>0.05. More than half of the infants were not underweight.

There is very strong evidence that there is no relationship between maternal education and infants being underweight.

This implies that the proportion of mothers with primary education whose infants were underweight is not significantly different from the proportion of mothers with primary

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education whose infants were not underweight. The same is true for the proportion of mothers with secondary education and mothers with tertiary education.

Table 4.19 shows the result of bivariate analysis between household income and anthropometric measurement (weight-for-age z score). A sample of 179 infants was taken and evaluated to determine whether there was association between household income and infant growth (underweight). One hundred and sixty-five infants were not underweight whereas 14 infants were underweight.

The data was analysed using a Chi-square test of independence. The null hypothesis was accepted, χ_2 (1) = 1.944, p>0.05. More than half of the infants were not stunted.

There is very strong evidence that there is no relationship between household income and infant being underweight.

This implies that the proportion of households with low income who have underweight infants is not significantly different from the proportion households with high income whose infants were not underweight.

Table 4.19: Bivariate association of weight-for-age (WAZ) z scores with demographic variables

	Weight-for-Age z scores				
	Not underweight		Underweight		
Variables	**Number**	**Percentage**	**Number**	**Percentage**	**p-value**
Maternal education					0.179
Primary education	17	85.0	3	15.0	
Secondary education	134	92.4	11	7.6	
Tertiary education	14	100	0	0	
Household income					0.163
< 3500	114	90.5	12	9.5	
≥ 3500	51	96.2	2	3.8	
Wealth index					0.012*
Low SES	50	84.7	9	15.3	
High SES	115	95.8	5	4.2	
Feeding practice					0.450
Mixed feeding	3	100.0	0	0.0	
Complementary feeding	28	90.3	3	9.7	
Formula feeding	6	100	0	0	

* Significant at p<0.05

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A sample of 179 infants was taken and evaluated to determine whether there was association between household wealth and anthropometric measurement (weight-for-age z score). One hundred and sixty-five infants were not underweight whereas 14 infants were underweight (Table 4.19). More than half of the infants were not underweight. The Standardised Residual is 2.0 for Low SES and underweight. This implies underweight infants from low SES households contributed most to the significant relationship between household wealth and infant growth (underweight).

There is very strong evidence that there is relationship between household wealth and infant being underweight (χ_2 (1) = 6.262, p<0.05).

The Standardised Residual is 2.0 for Low SES and underweight. This implies underweight infants from low SES households contributed most to the significant relationship between household wealth and infant growth (underweight).

The proportion of households from low socio-economic status who have underweight infants is significantly different from the proportion households from high socio-economic status whose infants were not underweight.

Table 4.19 show the result of bivariate analysis between feeding practice and anthropometric measurement (weight-for-age z score). A sample of 40 infants was taken and evaluated to determine whether there was association between feeding practice and infant growth (underweight). Thirty-seven infants were not underweight whereas 3 infants were underweight. More than half of the infants were not stunted.

There is very strong evidence that there is no relationship between feeding practice used by mothers and infants being underweight (χ_2 (2) = 0.358, p>0.05).

The proportion of mothers who used mixed feeding with their underweight infants is not significantly different from the proportion of mothers who used mixed feeding for their infants were not underweight. The same is true for the proportion of mothers who used complementary feeding and mothers who used formula feeding.

The result of bivariate analysis between maternal education and anthropometric measurement (weight-for-height z score) is shown in Table 4.20. A sample of 177 infants was taken and evaluated to determine whether there was association between maternal education and infant

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growth (wasting). Ninety-eight infants were not wasted whereas 79 infants were wasted. More than half of the infants were not wasted.

There is very strong evidence that there is no relationship between maternal education and infants being wasted (χ_2 (2) = 1.568, p>0.05).

This implies that the proportion of mothers with primary education whose infants were wasted is not significantly different from the proportion of mothers with primary education whose infants were not wasted. The same is true for the proportion of mothers with secondary education and mothers with tertiary education.

Table 4.20: Bivariate association of Weight-for-height (WHZ) z scores with demographic variables

	Weight-for-Height z scores				
	Not Wasted		Wasted		
Variables	Number	Percentage	Number	Percentage	p-value
Maternal education					0.457
Primary education	9	42.9	12	57.1	
Secondary education	82	57.3	61	42.7	
Tertiary education	7	53.8	6	46.2	
Household income					0.037*
< 3500	63	50.0	63	50.0	
≥ 3500	35	68.6	16	31.4	
Wealth index					0.487
Low SES	30	50.8	29	49.2	
High SES	68	57.6	50	42.4	
Feeding practice					0.189
Mixed feeding	3	100.0	0	0.0	
Complementary feeding	17	58.6	12	41.4	
Formula feeding	3	50.0	3	50.0	

* Significant at p<0.05

Table 4.20 show the result of bivariate analysis between household income and anthropometric measurement (weight-for-age z score). A sample of 177 infants was taken and evaluated to determine whether there was association between household income and infant growth (wasting). Ninety-eight infants were not stunted whereas 79 infants were stunted. More than half of the infants were not wasted.

There is very strong evidence that there is relationship between household income and infant being wasted (χ_2 (1) = 4.372, p>0.05).

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The proportion of households with low income who have wasted infants is significantly different from the proportion households with high income whose infants were not wasted.

A sample of 177 infants was taken and evaluated to determine whether there was association between household wealth and anthropometric measurement (weight-for-height z score). Ninety-eight infants were not wasted whereas 79 infants were wasted. The result of bivariate analysis is displayed in Table 4.20. More than half of the infants were not wasted.

There is very strong evidence that there is no relationship between household wealth and infant being wasted (χ_2 (1) = 0.483, p>0.05).

The proportion of households from low socio-economic status with infants who are wasted is not significantly different from the proportion households from high socio-economic status whose infants were not wasted.

Table 4.20 shows the result of bivariate analysis between feeding practice and anthropometric measurement (weight-for-height z score). A sample of 38 infants was taken and evaluated to determine whether there was association between feeding practice and infant growth (wasting). Twenty-three infants were not wasted whereas 15 infants were underweight. More than half of the infants were not wasted.

There is very strong evidence that there is no relationship between feeding practice used by mothers and infants being wasted (χ_2 (2) = 3.328, p>0.05).

The proportion of mothers who used mixed feeding with infants who are wasted is not significantly different from the proportion of mothers who used mixed feeding whose infants were not wasted. The same is true for the proportion of mothers who used complementary feeding and mothers who used formula feeding.

Several dichotomized household level independent predictors were entered into a binary logistic model. The dependent variables were height-for-age, weight-for-height and weight-for-height z scores, respectively.

The effect of different variables on height-for-age (HAZ), weight-for-age (WAZ) and weight-for-height (WHZ) have also been presented in Table 4.21 and described in this section. The odds ratio are generally small for many variables but have been presented. Table 4.21 shows

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the result of the multivariate analysis concerning the association between socio-demographic factors and infants anthropometric measurements at 12 months.

Table 4.21: Association between socio-demographic factors and infants anthropometric measurements at 12 months

Variables	HAZ*	OR** (95%CI***)	WAZ****	OR (95%CI)	WHZ****	OR (95%CI)
Food security category						
Food insecure	73	0.720 (0.249 - 2.084)	73	4.841 (0.571 - 41.039)	71	1.379 (0.582 - 3.265)
Food secure	59		58		59	
Ownership of sofa						
No	55	0.415 (0.101 - 1.712	54	0.220 (0.010 - 4.973)	55	2.045 (0.686 - 6.096)
Yes	77		77		75	
Ownership of radio or transistor						
No	26	0.468 (0.111 - 1.978)	25	3.027 (0.308 - 29.725)	24	1.933 (0.600 - 6.230)
Yes	106		106		106	
Ownership of computer						
No	114	0.688 (0.123 - 3.856)			114	0.647 (0.178 - 2.353)
Yes	18				16	
Ownership of television						
No	22	1.178 (0.165 - 8.431)	22	0.213 (0.010 - 4.571)	22	0.669 (0.145 - 3.085)
Yes	110		109		108	
Ownership of refrigerator						
No	32	1.231 (0.192 - 7.890)	31	6.786 (0.324 - 142.159)	32	1.408 (0.283 - 7.002)
Yes	100		100		98	
Ownership of agricultural land						
No	70	4.677 (1.450 - 14.441)	68	2.301 (0.215 - 24.674)	69	0.659 (0.274 - 1.5850)
Yes	62		63		61	
Ownership of cows, bulls or buffaloes						
No	120	0.463 (0.061 - 3.515)			118	0.241 (0.043 - 1.346)
Yes	12				12	
Ownership of chicken or ducks						
No	86	2.590 (0.819 - 8.188)	86	6.186 (0.586 - 65.349)	86	1.519 (0.618 - 3.733)
Yes	46		45		44	
Separate kitchen						
No	26	2.036 (0.496 - 8.361)	26	0.767 (0.062 - 9.569)	26	0.970 (0.305 - 3.081)
Yes	106		105		104	
Marital status of household head						
Single	30	0.236 (0.064 - 0.864)	30	1.032 (0.109 - 9.376)	30	0.925 (0.323 - 2.645)
Married	102		101		100	

*WHZ=z score for weight-for-height; **OR=odds ratio; ***CI=confidence interval; ****HAZ= z scores for height-for-age

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Variables	HAZ*	OR** (95%CI***)	WAZ****	OR (95%CI)	WHZ*****	OR (95%CI)
Main source of drinking water						
Not piped	50	0.893 (0.290 - 2.749)	48	0.522 (0.072 - 3.799)	49	0.703 (0.290 - 1.705
Piped	82		83		81	
Water source location						
Elsewhere	102	0.780 (0.202 - 3.016)	100	0.876 (0.061 - 12.592)	100	1.651 (0.597 - 4.569)
Own dwelling/plot	30		31		30	
People who usually sleep in the house						
< 5	38	0.328 (0.019 - 1.355)	39	0.095 (0.005 - 1.711)	37	0.741 (0.256 - 2.144)
≥ 5	94		92		93	
Sex (child)						
Male	68	0.267 (0.085 - 0.837)	70	2.967 (0.406 - 21.690)	70	1.211 (0.518 - 2.831
Female	64		61		60	
Wealth index						
Low SES	45	0.739 (0.127 - 4.304)	44	0.095 (0.004 - 2.277)	45	0.518 (0.121 - 2.210)
High SES	87		87		85	
Average income (rand)						
< 3500	91	0.892 (0.255 - 3.116)			90	0.279 (0.100 - 0.780)
≥ 3500	41				40	
Maternal education						
Primary	11	0.384 (0.064 - 2.296)	13	0.141 (0.010 - 2.033)	13	0.455 (0.109 - 1.903)
Secondary/Tertiary	121		118		117	
Household head age (years)						
< 29	7	0.184 (0.017 - 1.950)	7	0.072 (0.001 - 3.500)	7	0.875 (0.135 - 5.658)
≥ 29	125		124		123	
Household head education						
Primary	33	2.126 (0.549 - 8.232)	33	0.233 (0.022 - 2.276)	32	0.487 (0.178 - 1.284)
Secondary/Tertiary	99		98		98	
Mother's age						
< 19	11	2.100 (0.322 - 13.693)	11	0.320 (0.010 - 10.117)	11	0.897 (0.186 -4.330)
≥ 19	121		120		119	
Mother's marital status						
Single	45	0.505 (0.160 - 1.591	46	0.452 (0.064 - 3.194)	45	1.114 (0.446 - 2.787)
Married	87		85		85	

*WHZ=z score for weight-for-height; **OR=odds ratio; ***CI=confidence interval; ****HAZ= z scores for height-for-age

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4.5.3 Height-for-age

The outputs from logistic regression analysis for the height-for-age (HAZ) z score and twenty-two variables are presented in Tables 4.22 and 4.23. The dependent variable was coded as: Not stunted = 0; Stunted = 1. The overall percentage correctly classified cases by the model is 76.5 in Block 0 and $p < 0.033$ for the Omnibus test. The Chi-square value is 35.718 with 22 degree of freedom whereas the Chi-square value for the Hosme & lemeshow test is 11.896 at a significant level of 0.156 with 8 degree of freedom. The Cox & Snell R square is 0.237 while Nagelkerke R square is 0.357 and the -2 log likelihood is 108.180.

The model correctly classified 82.6% of cases overall, an improvement over 76.5% in Block 0 (as indicated above). The Sensitivity is 96.0% while the Specificity is 38.7%. Ownership of agricultural land; Marital status of household head and Sex of child are the only variables that contributed significantly to the model ($p<0.009$; $p<0.029$ and $p<0.024$) respectively at sig. < 0.05.

The major factors influencing whether a child was stunted are ownership of agricultural land; marital status of household head and sex of child, other variables did not contribute to the model.

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Table 4.22: Logistics regression output for height-for-age (HAZ) z score

Variables	Number	Percentage
Case processing summary (n=186)		
Included in analysis	132	71.0
Missing cases	54	29.0
Dependent variable coding		
Not stunted = 0		
Stunted = 1		
Categorical variable coding (n=132)		
Food security category		
Food insecure	73	55.3
Food secure	59	44.7
Ownership of Sofa		
No	55	41.7
Yes	77	58.3
Ownership of radio or transistor		
No	26	19.7
Yes	106	80.3
Ownership of computer		
No	114	86.4
Yes	18	13.6
Ownership of television		
No	22	16.7
Yes	110	83.3
Ownership of refrigerator		
No	32	24.2
Yes	100	75.8
Ownership of agricultural land		
No	70	53.0
Yes	62	47.0

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Ownership of bulls or buffaloes		
No	120	90.9
Yes	12	9.1
Ownership of chicken or ducks		
No	86	65.2
Yes	46	34.8
Separate kitchen		
No	26	19.7
Yes	106	80.3
Household head marital status		
Single	30	22.7
Married	102	77.3
Main source of drinking water		
Not piped	50	37.9
Piped	82	62.1
Main source of water for cooking		
Not piped	50	37.9
Piped	82	62.1
Water source location		
Elsewhere	102	77.3
Own dwelling/plot	30	22.7
People who usually sleep in the house		
< 5	38	28.8
≥ 5	94	71.2
Sex (Child)		
Male	68	51.5
Female	64	48.5
Wealth index		
Low SES	45	34.1
High SES	87	65.9
Average income (rand)		
< 3500	91	68.9
≥ 3500	41	31.1

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Maternal education		
Primary education	11	8.3
Secondary education	121	91.7
Household head age (years)		
< 29	7	5.3
≥ 29	125	94.7
Household head education		
Primary education	33	25.0
Secondary education	99	75.0
Mother's age (years)		
< 19	11	8.3
≥ 19	121	91.7
Mother's marital status		
Single	45	34.1
Married	87	65.9
Block O		
Overall percentage correctly classified		76.5
Block 1		
Omnibus test of model coefficient		
Chi-square	35.718	
df	22	
Sig.	0.033	
Model summary		
- 2 log likelihood	108.180	
Cox & Snell R Square	0.237	
Nagelkerke R Square	0.357	
Hosme & Lemeshow		
Chi-square	11.896	
df	8	
Sig.	0.156	
Classification table[a]		
Overall percentage correctly classified		
Not wasted [b]		96.0
Wasted [c]		38.7

*df=degree of freedom; **Sig.=significant value; [a] The cut value is 0.500; [b] = sensitivity; [c] = specificity

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Table 4.23: Association between height-for-age (HAZ) z score and some variables

Variables	B [c]	S.E [d]	Wald	df [e]	Sig. [f]	Exp (B)	95% CI [a] for EXP (B) [b]	
							Lower	Upper
Food security	-0.328	0.542	0.367	1	0.545	0.720	0.249	2.084
Ownership of sofa	-0.879	0.723	1.478	1	0.224	0.415	0.101	1.712
Ownership of radio	-0.759	0.735	1.066	1	0.302	0.468	0.111	1.978
Ownership of computer	-0.374	0.880	0.181	1	0.670	0.688	0.123	3.856
Ownership of TV	0.164	1.004	0.027	1	0.87	1.178	0.165	8.431
Ownership of refrigerator	0.208	0.948	0.048	1	0.827	1.231	0.192	7.890
Ownership of agricultural land	1.521	0.586	6.730	1	0.009*	4.577	1.450	14.441
Ownership of cows, bulls of buffaloes	-0.771	1.034	0.555	1	0.456	0.463	0.061	3.515
Ownership of chicken or ducks	0.952	0.587	2.627	1	0.105	2.590	0.819	8.188
Separate kitchen	0.711	0.721	0.973	1	0.324	2.036	0.496	8.361
Household head marital status	-1.444	0.662	4.757	1	0.029*	0.236	0.664	0.864
Main source of drinking water	-0.113	0.573	0.039	1	0.844	0.893	0.290	2.749
Water source location	-0.248	0.690	0.129	1	0.719	0.780	0.202	3.016
People who usually sleep in the house	-1.115	0.724	2.372	1	0.124	0.328	0.079	1.355
Sex (child)	-1.322	0.584	5.128	1	0.024*	0.267	0.085	0.837
Wealth index	-0.302	0.899	0.113	1	0.737	0.739	0.129	4.304
Average income	-0.114	0.638	0.032	1	0.858	0.892	0.255	3.116
Maternal education	-0.957	0.912	1.100	1	0.294	0.384	0.064	2.296
Household head age	-1.690	1.203	1.974	1	0.160	0.184	0.012	1.950
Mother's age	0.742	0.957	0.601	1	0.438	2.100	0.322	13.693
Mother's marital status	-6.840	0.586	1.363	1	0.243	0.505	0.160	1.591
Household head education	0.754	0.691	1.193	1	0.275	2.126	0.549	8.232

[a] 95%CI=95% confidence interval; [b] EXP (B) = odds ratio; [c] B=gradient; [d] S.E=standard error; [e] df=degree of freedom; [f] Sig. =significant value

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4.5.4 Weight-for-age

The results of logistic regression analysis for the weight-for-age (WAZ) z score and selected variables are presented in Tables 4.24 and 4.25. The dependent variable was coded as: Not underweight = 0; Underweight = 1. The overall percentage correctly classified cases by the model is 92.4% in Block 0 and $p < 0.073$ for the Omnibus test. The Chi-square value is 28.564 with 19 degree of freedom whereas the Chi-square value for the Hosme and Lemeshow test show 1.592 at a significant level of 0.991 with 8 degree of freedom. The Cox & Snell R square is 0.196 while Nagelkerke R square is 0.470 and the -2 log likelihood is 42.105.

The model correctly classified 94.7% of cases overall, an improvement over 92.4% in Block 0 (as indicated above). The Sensitivity is 99.2% while the Specificity is 40.0%. No variable contributed significantly to the model at sig. < 0.05.

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Table 4.24: Logistic regression output for weight-for-age (WAZ) z score

Variables	Number	Percentage
Case processing summary (n=186)		
Included in analysis	131	70.4
Missing cases	55	29.6
Dependent variable coding		
Not stunted = 0		
Stunted = 1		
Categorical variable coding (n=132)		
Food security category		
Food insecure	73	55.7
Food secure	58	44.3
Ownership of Sofa		
No	54	41.2
Yes	77	58.8
Ownership of radio or transistor		
No	25	19.1
Yes	106	80.9
Ownership of television		
No	22	16.8
Yes	109	83.2
Ownership of refrigerator		
No	31	23.7
Yes	100	76.3
Ownership of agricultural land		
No	68	51.9
Yes	63	48.1

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Ownership of chicken or ducks		
No	86	65.6
Yes	45	34.4
Separate kitchen		
No	26	19.8
Yes	105	80.2
Household head marital status		
Single	30	22.9
Married	101	77.1
Main source of drinking water		
Not piped	48	36.6
Piped	83	63.4
Main source of water for cooking		
Not piped	48	36.6
Piped	83	63.4
Water source location		
Elsewhere	100	76.3
Own dwelling/plot	31	23.7
People who usually sleep in the house		
< 5	39	29.8
≥ 5	92	70.2
Sex (Child)		
Male	70	53.4
Female	61	46.6
Wealth index		
Low SES	44	33.6
High SES	87	66.4
Average income (rand)		
< 3500	89	67.9
≥ 3500	42	32.1

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Maternal education		
Primary education	13	9.9
Secondary education	118	90.1
Household head age (years)		
< 29	7	5.3
≥ 29	124	94.7
Household head education		
Primary education	33	25.2
Secondary education	98	74.8
Mother's age (years)		
< 19	11	8.4
≥ 19	120	91.6
Mother's marital status		
Single	46	35.1
Married	85	64.9
Block O		
Overall percentage correctly classified		92.4
Block 1		
Omnibus test of model coefficient		
Chi-square	28.564	
df	19	
Sig.	0.073	
Model summary		
- 2 log likelihood	42.105	
Cox & Snell R Square	0.196	
Nagelkerke R Square	0.470	
Hosme & Lemeshow		
Chi-square	1.592	
df	8	
Sig.	0.991	
Classification table[a]		
Overall percentage correctly classified		94.7
Not wasted [b]		99.2
Wasted [c]		40.0

df=degree of freedom; **Sig.=significant value; [a] The cut value is 0.500; [b] = sensitivity; [c] = specificity

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Table 4.25: Association between weight-for-age (WAZ) z score and some variables

Variables	B [c]	S.E [d]	Wald	df [e]	Sig. [f]	Exp (B)	95% CI [a] for EXP (B) [b]	
							Lower	Upper
Food security	1.577	1.091	2.091	1	0.148	4.841	0.571	41.039
Ownership of sofa	-1.513	1.590	0.905	1	0.341	0.220	0.010	4.973
Ownership of radio	1.107	1.166	0.903	1	0.342	3.027	0.308	29.725
Ownership of TV	-1.548	1.565	0.978	1	0.323	0.213	0.010	4.571
Ownership of refrigerator	1.915	1.552	1.552	1	0.217	6.786	0.324	142.159
Ownership of agricultural land	0.833	1.211	0.474	1	0.491	2.301	0.215	24.674
Ownership of chicken or ducks	1.822	1.203	2.295	1	0.130	6.186	0.586	65.349
Separate kitchen	-0.265	1.287	0.042	1	0.837	0.767	0.062	9.569
Household head marital status	0.031	1.145	0.001	1	0.978	1.032	0.109	9.736
Main source of drinking water	-0.650	1.013	0.412	1	0.521	0.522	0.072	3.799
Water source location	-0.133	1.360	0.010	1	0.922	0.876	0.061	12.592
People who usually sleep in the house	-2.352	1.474	2.546	1	0.111	0.095	0.005	1.711
Sex (child)	1.088	1.015	1.149	1	0.284	2.967	0.406	21.690
Wealth index	-2.354	1.621	2.109	1	0.146	0.095	0.004	2.277
Maternal education	-1.960	1.362	2.071	1	0.150	0.141	0.010	2.033
Household head age	-2.628	1.980	1.762	1	0.184	0.072	0.001	3.500
Mother's age	-1.138	1.762	0.418	1	0.518	0.320	0.010	10.117
Mother's marital status	-0.793	0.997	0.663	1	0.426	0.452	0.064	3.194
Household head education	-1.503	1.186	1.604	1	0.205	0.223	0.022	2.276
Constant	3.904	2.736	2.037	1	0.154	49.620		

[a] 95%CI=95% confidence interval; [b] EXP (B) = odds ratio; [c] B=gradient; [d] S.E=standard error; [e] df=degree of freedom; [f] Sig. =significant value

4.5.5 Weight-for-height

The results of logistic regression analysis for the weight-for-height (WHZ) and selected variables are presented in Tables 4.26 and 4.27. The dependent variable was coded as: Not wasted = 0; Wasted = 1. The overall percentage correctly classified cases by the model is 56.2% in Block 0 and $p < 0.294$. The Chi-square value is 25.067 with 22 degree of freedom

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whereas the Chi-square for the Hosmer and Lemeshow is 10.718 at a significant level of 0.218 with 8 degree of freedom. The Cox & Snell R square is 0.175 and the – 2 log likelihood is 151.177.

The model correctly classified 70.8% of cases overall, an improvement over 56.2% in Block 0 (as indicated above). The Sensitivity is 78.1% while the Specificity is 61.4%. Average income is the only variable that contributed significantly to the model ($p < 0.015$).

The major factor influencing whether a child is wasted is the average income of the household, other variables did not contribute significantly to the model.

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Table 4.26: Logistic regression output for weight-for-height (WHZ) z score

Variable	Number	Percentage
Case processing summary (n=186)		
Included in analysis	130	69.9
Missing cases	56	30.1
Dependent variable coding		
Not wasted = 0		
Wasted = 1		
Categorical variable coding (n=132)		
Food security category		
Food insecure	71	54.6
Food secure	59	45.4
Ownership of Sofa		
No	55	42.3
Yes	75	57.7
Ownership of radio or transistor		
No	24	18.5
Yes	106	81.5
Ownership of computer		
No	114	87.7
Yes	16	12.3
Ownership of television		
No	22	16.9
Yes	108	83.1
Ownership of refrigerator		
No	32	24.6
Yes	98	75.4
Ownership of agricultural land		
No	69	53.1
Yes	61	46.9

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Ownership of bulls or buffaloes		
No	118	90.8
Yes	12	9.2
Ownership of chicken or ducks		
No	86	66.2
Yes	44	33.8
Separate kitchen		
No	26	20.0
Yes	104	80.0
Household head marital status		
Single	30	23.1
Married	100	76.9
Main source of drinking water		
Not piped	49	37.7
Piped	81	62.3
Main source of water for cooking		
Not piped	49	37.7
Piped	81	62.3
Water source location		
Elsewhere	100	76.9
Own dwelling/plot	30	23.1
People who usually sleep in the house		
< 5	37	28.5
≥ 5	93	71.5
Sex (Child)		
Male	70	53.8
Female	60	46.2
Wealth index		
Low SES	45	34.6
High SES	85	65.4
Average income (rand)		
< 3500	90	69.2
≥ 3500	40	30.8

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Maternal education		
Primary education	13	10.0
Secondary education	117	90.0
Household head age (years)		
< 29	7	5.4
≥ 29	123	94.6
Household head education		
Primary education	32	24.6
Secondary education	98	75.4
Mother's age (years)		
< 19	11	8.5
≥ 19	119	91.5
Mother's marital status		
Single	45	34.6
Married	85	65.4
Block O		
Overall percentage correctly classified		56.2
Block 1		
Omnibus test of model coefficient		
Chi-square	25.067	
df	22	
Sig.	0.294	
Model summary		
- 2 log likelihood	151.177	
Cox & Snell R Square	0.175	
Nagelkerke R Square	0.235	
Hosme & Lemeshow		
Chi-square	10.718	
df	8	
Sig.	0.218	
Classification table[a]		
Overall percentage correctly classified		70.8
Not wasted [b]		78.1
Wasted [c]		61.4

*df=degree of freedom; **Sig.=significant value; [a] The cut value is 0.500; [b] = sensitivity; [c] = specificity

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Table 4.27: Association between weight-for-height (WHZ) z score and some variables

Variables	B [c]	S.E [d]	Wald	df [e]	Sig. [f]	Exp (B)	95% CI [a] for EXP (B) [b] Lower	Upper
Food security	0.321	0.440	0.533	1	0.465	1.379	0.582	3.265
Ownership of sofa	0.715	0.557	1.648	1	0.199	2.045	0.686	6.096
Ownership of radio	0.659	0.597	1.219	1	0.270	1.933	0.600	6.230
Ownership of computer	-0.435	0.658	0.436	1	0.509	0.647	0.178	2.353
Ownership of TV	-0.402	0.780	0.266	1	0.606	0.669	0.145	3.085
Ownership of refrigerator	0.342	0.818	0.175	1	0.676	1.408	0.283	7.002
Ownership of agricultural land	-0.417	0.448	0.867	1	0.352	0.659	0.274	1.585
Ownership of cows, bulls of buffaloes	-1.424	0.878	2.629	1	0.105	0.241	0.043	1.346
Ownership of chicken or ducks	0.418	0.459	0.830	1	0.362	1.519	0.618	3.733
Separate kitchen	-0.031	0.590	0.003	1	0.958	0.970	0.305	3.081
Household head marital status	-0.078	0.536	0.021	1	0.884	0.925	0.323	2.645
Main source of drinking water	-0.352	0.452	0.607	1	0.436	0.703	0.290	1.705
Water source location	0.501	0.519	0.932	1	0.334	1.651	0.597	4.569
People who usually sleep in the house	-0.300	0.542	0.307	1	0.580	0.741	0.256	2.144
Sex (child)	0.192	0.433	0.196	1	0.658	1.211	0.518	2.831
Wealth index	-0.658	0.741	0.791	1	0.374	0.518	0.121	2.210
Average income	-1.276	0.524	5.925	1	.015*	0.279	0.100	0.780
Maternal education	-0.788	0.730	1.164	1	0.281	0.455	0.109	1.903
Household head age	-0.134	0.953	0.020	1	0.888	0.875	0.135	5.658
Mother's age	-0.109	0.803	0.018	1	0.892	0.897	0.186	4.330
Mother's marital status	0.108	0.468	0.054	1	0.817	1.114	0.446	2.787
Household head education	-0.739	0.504	2.146	1	0.143	0.478	0.178	1.284
Constant	1.458	1.536	0.901	1	0.343	4.298		

[a] 95%CI=95% confidence interval; [b] EXP (B) = odds ratio; [c] B=gradient; S.E=standard error; [e] df=degree of freedom; [f] Sig. =significant value

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4.5.6 Independent predictors of stunting and wasting in multivariable analysis

Table 4.28 shows the result for the independent predictor of low height-for-age (stunting) and low weight-for-height (wasting) in multivariable analysis. Ownership of agricultural land; marital status of household head and sex of child are the only factors that predicted whether a child was stunted. The results were significantly different at $p < 0.05$. The chance for a child to be stunted at 12 month old when the household does not own agricultural land is five times more likely than when the household does own agricultural land. The chance for a child to be stunted when the household head is single is less than one time likely than when household head is married. The chance is less than one time likely to be stunted at 12 month old when the child is male than when the child is female. No factor predicted whether a child was underweight at $p< 0.05$. The only factor which predicted whether a child was wasted is household income. The result was significantly different at $p< 0.05$. The chance is less than one time likely to be wasted when the household income is less than R3500 than when the household income is more than R3500.

Table 4.28: Independent predictors of low height-for- age (stunting) and low weight for height (wasting) in multivariable modelling

Stunted (Low HAZ)	**B**	**S.E**	**Wald**	**df**	**Sig**	**Exp(B)**	**95%C.I.for EXP (B)**	
							Lower	**Higher**
Ownership of agricultural land: No versus Yes	1.521	0.586	6.730	1	0.009*	4.577	1.450	14.441
Marital Status of household head: Single versus Married	-1.444	0.662	4.757	1	0.029*	0.236	0.064	0.864
Sex of child	-1.322	0.584	5.128	1	0.024*	0.267	0.085	0.837
Constant	2.415	1.815	1.770	1	0.183	11.170		
Wasted (Low WHZ)								
Average Income: Less than 3500 versus greater than 3500	-1.276	0.524	5.925	1	0.015*	0.279	0.100	0.780
Constant	1.458	1.536	0.901	1	0.343	4.298		

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4.6 Discussion

The finding of the study indicated that, the father of the child was the head of the household in 42.0% of cases followed by the child's grandmother and grandfather in one out of three and one out of five households, respectively. This result is consistent with the findings of NFSC (1999) which found that in 42.0% of households the father was the head of the households. The NFSC (1999) also found that in 11.0% of the households the mother was the head of the households while in other households, the grandparents, especially the grandmothers, were the head of the household (NFSC, 1999). However, in the NutriGro study conducted in rural Limpopo and urban Gauteng, Kleynhans, MacIntyre and Albertse (2006) found that the father was the head of households in 29.7% of the cases. Similarly, the NFSC-FB-I study conducted in 2005 found that 50.0% of the households had males (father, husband) as the head of the family and the father was the respondent in one out of every three households. Further, the same study found the mother's husband and grandfather were respondents in 17.0% and 2.0% of the households respectively (Labadarios *et al.*, 2008). As in many other places in South Africa, decision making is primarily in the hands of household heads. In addition, husbands are bread winners and many (69.1%) households are headed by men. Hence, it is not surprising to note that households were headed by men.

In this study, the mothers were the caregivers (87.0%) while 9.7% of the children were taken care of by their grandmother. Kleynhans *et al.* (2006) found that children that lived in households where grandparents were caregivers had the highest rate of stunting. In rural areas of South Africa, it is usually the grandmothers that are the caregivers but evidence from a study in Limpopo, South Africa among children twelve to 24 months of age showed that children had a lower risk of stunting if the mother was the caregiver (Kleynhans *et al.*, 2006). Similarly, in a study conducted in Nigeria, 74.0% of the children were cared for by their parents and other people that cared for the children included grandparents, other family members and day care centres (Ogunba, 2008).

In the NFCS in 1999, 67.0% of mothers were caregivers for their own children during the day, whereas 28.0% of children were cared for by grandmothers, 6.0% by a neighbour, 2.0% by day care centres and 17.0% by other people.

In this study, the majority (62.0%) of the households had five to nine people in the households, with only 32.0% consisting of up to three people. Seven percent of households

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had more than nine people in the household. Most of the households in this study had one to three rooms being used for sleeping.

In South Africa stunted children often live in households that are bigger or have more people (Kleynhans *et al.*, 2006) and therefore the risk for stunting has been found to be highest in households with nine or more people in the household (Mamabolo, Albert, Steyn, Delemare-van de Waal & Levitt, 2005). In South Africa about 56% of households have a size of five to nine people (Kleynhans *et al.*, 2006). Elsewhere in Africa, the risk of children from a household in Zimbabwe and Ethiopia being stunted increased from 7% when it was only one child to 38% when the household had seven children younger than ten. In South Africa the size of a household can therefore be a predictor of malnutrition (Kleynhans *et al.*, 2006).

Some other socio-economic issues that are linked to stunting are the type of houses (especially in urban areas), type of toilet in the home, fuel used for cooking, presence of refrigerator or stove and television (NFSC, 1999; Steyn *et al.*, 2005) and educational level of the parents. In addition, Jayaseelan and Lakshman (1997) found that using dung or firewood as fuel was a risk factor for developing malnutrition while the possession of a flush toilet in the house had a positive effect on height (Christiaenson & Aldemay, 2001).

Only one in four households (25%) in South Africa appeared to be food secure (NFCS, 1999) with 35% of at risk households being food insecure (Hendricks, Eley & Bourne, 2006). In 2005 the condition appeared better, but there was still one in two households which were experiencing hunger, one in five households were food secure and one in three households were at risk of experiencing hunger. The highest percentage of hunger was in the Northern Cape (63%) (NFSC, 1999), with Eastern Cape and Limpopo having six out of ten households experiencing hunger. Hunger in general did not improve in 2005, due to lower incomes, lower education level of mothers and more participants living in informal dwellings (Labadarios *et al.*, 2008).

Just fewer than 21.0% of the households in the study sample reportedly did not sometimes have enough food to eat, which could be some indication of a low level of food insecurity. The reported lack of enough food to eat within households was, however, not associated with child growth. This could, perhaps be due to variation in the study population (55.0% reportedly had enough food to eat). The literature suggests that food insecurity maybe be associated with both forms of child malnutrition (Tanumihardjo *et al.*, 2007).

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Dzimauli village is a rural area with people engaged predominantly in agriculture. This suggests that most households could be food secure considering the availability of agricultural inputs and the enabling climate. Contrary to this, the lower nutritional status suggests the opposite. This could be resulting from the peasant farming which most people in the village practice; hence they are in general fairly poor. Similarly, agricultural productivity among small holders is limited by agricultural land shortage. With an increasing population growth, land holding size will continue to be a problem for a smallholder. In Dzimauli where half of the households own agricultural land, land is not yet a big problem. However, with the 10.8% growth in population observed (2001 - 2011) census (SSA, 2014), this becomes a threat on household plot size in future. The chance is five times more likely for a child to be stunted when the household does not own agricultural land.

The number of infants who continued to be breastfed until 12 months was high (85.3%), similar to that found by Coetzee and Ferrinho (1994) in their study, where 71.0% of mothers continued to breastfeed for 1 year or longer. This is also in line with what was found by Westphal, Philips and Irwig (1981), and later by Ladzani, Steyn and Nell (1988), that 80.0% of mothers were breastfeeding for at least 1 year.

Exclusive breastfeeding was uncommon in this present study. In South Africa, the South African Demographic and Health Survey (SADHS) showed that 20.1% of children were never breastfed and only 11.9% of infants zero to four months were exclusively breastfed (Hendricks *et al*., 2006).

In South Africa exclusive breastfeeding is not most widely practised (Kleynhans *et al*., 2006). The rate is low in Africa with less than one-third of infants younger than six months receiving exclusive breastfeeding. Over the period of ten to fifteen years exclusive breastfeeding increased in Africa from 33.0% in 1995 to 38.0% in 2008 (UNICEF, 2009). In a study undertaken in Malawi, infants were followed from birth to twelve months, only 13.3% of mothers exclusively breastfed their children (Kalanda, 2006).

Appropriate breastfeeding practices and duration of exclusive breastfeeding is based on the information the mother received on the importance of breastfeeding to fight infant morbidity and promote growth in infancy. According to WHO (2007), exclusive breastfeeding for six months is recommended. Mothers that have no education usually exclusively breastfed for a median of 1.1 months, whereas mothers with a higher education usually exclusively breastfed

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for only 0.4 month. Better education is usually linked to better socio-economic status and that can be the reason for better-educated mothers deciding not to breastfeed (Sowden, Marais & Beukes, 2009).

According to a study conducted in Bangladesh among babies six to 60 months old, 48.3% of babies received milk via a bottle and only 7.0% were breastfed (Iqbal, Yasmin & Kabir, 1999).

The infants in this study were introduced to supplementary feeds early in life. This finding is well documented in South Africa in both rural and urban areas (Ransome, Chalmers, Hermay & Reinach, 1988; Delport, Becker & Bergh, 1997; Ladzani *et al.*, 1998). Studies undertaken in rural and semi-rural areas of South Africa have found that maize and sorghum are usually fed to infants (Ladzani *et al.*, 1998; Steyn *et al.*, 1992), while those in urban areas usually feed their infants with commercial cereals (Ransome, Chalmers, Herman & Reinach, 1988; Delport *et al.*, 1997; Westphal *et al.*, 1981). The frequent consumption of cereal in this study might be due to maize being more commonly grown and used in the present study area.

The practice of early introduction of solids is not limited to South Africa because several researchers in other countries have described same pattern (Savage, Reiley, Edwards & Dumin, 1998; Zive, Mckay, Frank-Spoher, Broyles, Nelson & Nadar, 1992; Marques, Lira, Lima, Silver, Batista, Huttly & Ashworth, 2001). This practice has been attributed to several factors:

(1.) The mother's feeling that she does not have enough milk

(2.) Separation of the mother from the infant due to work or schooling

(3.) Breast-related problems, and

(4.) Lack of adequate information from the health workers about importance of breastfeeding (Ross, van Middelkop & Khoza, 1985; Ransome, *et al.*, 1988; Savage *et al.*, 1998).

Furthermore, common beliefs in this community are that infants have to be given herbal mixtures early in life, and mothers take advice from older relatives as to how to feed their children. Usually these would be the basic traditional way of introducing food early in life with the belief that the infant's digestive system has to be given something heavy for it to

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function properly (Mamabolo, Alberts, Mbeyane, Steyn, Nthangeni, Delemarre-van De Waal & Levitt, 2004).

Several researchers have studied infant growth and early introduction of supplements. They have associated prelacteral feeds such as teas and sugared water with stunting and wasting in children (Marques *et al.*, 2001; Cohen, Brown, Canahuati, Rivera & Dewey, 1994). Further, exclusively breastfed infants have been found to grow more rapidly in length than formula-fed infants during the first 6 months, especially in environment that are socio-economically disadvantaged. This has been attributed to the protective effects of breastmilk against infections, which are known to retard growth (Deway *et al.*, 1992; Hop, Gross, Gray, Sastroamidjojo, Schultink & Lang, 2000; Villalpando & Lopez-Alacon, 2000).

In a study undertaken in Malawi among infants up to twelve months old, 83.5% of breastfed babies received water at three months, 65.2% received porridge and 33.1% received other food (Kalanda, 2006). In another study carried out in Bangladesh, children six to twelve months old started solids at mean age of eight months (Iqbal *et al.*, 1999). Another study was conducted in Tanzania among three to 36 months old children. The study found the highest prevalence of malnutrition at the age when the child is weaned from breastfeeding and starts with solids (Mamiro, Kolsteren, Roberfroid, Tatala, Opsomer & van Camp, 2005). Globally 60.0% of six to nine months olds received solids, semi-solid or soft food while being breastfed. The quality of food given is not always known, but may not be the right type of food for the child's age, and can be inadequate for the child's age, has insufficient protein, fat and micronutrients for growth and development and may not be given frequently enough (UNICEF, 2009). A study undertaken in Limpopo among children twelve to 24 months of age found that mothers in rural areas often start earlier with solids (Kleynhans *et al.*, 2006). The same study also found that most of the food given is home prepared (65.0%), 12.0% are commercially prepared and 25.0% are both home prepared and commercial foods. Mothers started with water at less than one month of age in 72.29% of cases and 20.75% started with water when their children were older than one month of age. Solids are started at less than one month of age (36.2%) and 63.8% started with solids when their children were older than one month of age. Predictors of malnutrition include starting solids too soon and giving complementary foods before three month old (43.0%) (Kleynhans *et al.*, 2006). In the same study, Kleynhans *et al.* (2006) found that only 7.72% of infants had been breastfed for one

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month or less, with only 17.89% breastfed for one to twelve months of age and 74.39% breastfed for thirteen months.

In the current study, solid foods were mostly introduced between one to six months. However, no significant association was found between feeding practice and growth of infants.

The NFCS found that one in four children were malnourished in tribal or rural areas (NFCS, 1999). Other researchers from South Africa have also reported that rural areas had more stunted children (Kleynhans *et al.*, 2006). The NFCS found that rural areas were more threatened, as 70.0% of the poorest lived in rural areas (NFCS, 1999).

However, in this study, due to large number of infants introduced to supplements at an early age, this study did not consider the differences that might have been present between infants breastfed for longer periods and those who were introduced to supplements early in life.

Being male was associated with reduced risk of stunting. Several studies in Sub-Saharan Africa have found male preschoolers to be at increased risk of stunting compared with their female counterparts (Wamani *et al.*, 2007; Zere & McIntyre, 2003). In a study conducted by Saito, Korzenik, Jeket and Bhattacharji (1997) in Tamil Nadu, India among children younger than four years old, poor nutritional status was directly associated with gender of the child. In most studies, more males are malnourished. In a study conducted in Bangladesh on malnutrition in children 6 to 60 months old, there were an equal number of males and females (240 males and 239 females) (Iqbal *et al.*, 1999) and a study in Nairobi and Ethiopia, found that in the malnourished group of children three to 36 months old, 51.2% were males and 48.8% were females (Abate, Kogi-Makau and Muroki, 2001). Christiaensen and Alderman (2001) found that more boys than girls younger than five years old had malnutrition in Ethiopia. Mahgoub, Nnyepi and Bondeke (2006) also found that in the age group of children zero to three years old in Botswana, malnutrition was more prevalent in males than in females. This study therefore correlates well with the above-mentioned data, as a significantly higher percentage of males had stunted growth (95% CI [0.085 : 0.837]. For the link between male gender and stunting, the only possible explanation is that, in general, boys are breastfed longer than girls (World Bank, 2007).

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Birthweight is a predictor of malnutrition (Kleynhans *et al.*, 2006) and there is a direct connection between maternal and child nutrition (Negas, Whiting, Henry, Belachew & Hallemariam (2015). In a study done by Falbo and Alves (2002), the median birth weight of children was 2.80kg. The study was done in Brazil between 1999 – 2000 and 88.9% of the children with severe malnutrition were younger than six months and 42.4% had low birth weight. Similarly, a study conducted by Ramakrishnan (2004) found that the prevalence of low birth weight babies was 10.0% for Sub-Saharan Africa but this is not very reliable because two-thirds of births in Africa are never reported. In this study 4.8% (n=9) of the infants had a birth weight of less than or equal to 2.50kg.

In a study done in Limpopo, South Africa, children were followed from birth up to three years of age. The result of the study showed that when a child has a greater height at one year it protects the child against stunting. Normal length and weight at one year are very important as this can predict the nutritional status of the child at three years of age (Mamabolo *et al.*, 2005).

At birth, a smaller proportion of infants were stunted, underweight and wasted. This finding could have resulted from several factors affecting utero growth, including maternal diet, maternal age, parity, pre-pregnancy weight and maternal weight gain during pregnancy (Strauss and Dietz, 1999; Fraser, Brocket & Ward, 1995). Since maternal diet information was not available, it was not possible to determine the effect of maternal diet on the nutritional status of infants at birth. However, it is suspected that maternal diet played a major role leading to the small proportion of underweight at birth.

The infants showed a progressive decline in HAZ scores with time, with the lowest z scores recorded around 12 month. The high frequency of stunting between 6 and 12 month (approximately 24.0%) is comparable to that found in Limpopo Province by the South African Vitamin A Consultative Group (Labadarios & VanMiddlekoop, 1995; Mamabolo *et al.*, 2005). They found that 23.4% of 12 to 23-month old infants were stunted (height-for-age < -2SD) and 6.8% were severely stunted (height-for-age < -3SD).

Regarding individual growth of the infants in this study, the stunted infants tend to remain stunted with little catch-up growth (8.1%) and stunting itself was evident in the infants by the first month. This is different from the findings of Rivera and Ruel (Rivera & Ruel, 1997) in Guatemalan infants where stunting was evident by the third month.

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The most likely explanation for the large growth deficit in the first month and onwards is feeding practices introduced from birth onward, in particular the early introduction of supplementary feeding during the early months in many infants. One of the dangers associated with introduction of food, and subsequent contamination may lead to infection such as diarrhea, which has been reported to reduce linear growth (Lartey, Manu, Brown, Pearson & Dewey, 2000). Due to possible consequences of food contamination, particularly in poor community, the WHO has recommended that exclusive breastfeeding be practiced for at least 6 months.

The mean WAZ scores paint a different picture in that they were all below zero from birth to 12 month period. The implication of this is that there is an increase in adiposity and/or oedema in these infants due to consumption of carbohydrate-rich foods that replace breast milk. This theory is also supported by the WHZ scores, which remained above zero from the third month up to the twelfth month. The practice of giving tea with sugar added to the "empty calories" provide to the infants.

The theory of growth deficit as an outcome of early introduction of solids is also reflected in the percentage of infants who had length and weight deficits (< -2SD). Examining the WHZ scores reveal that the number of infants with scores above 2 SD increased dramatically from 4.9% to 20.7% and then declined steadily thereafter, reaching 5.9% by 12 month. This is an indication of a high prevalence of overweight and stunted children.

A low prevalence of underweight was observed in these infants at 1 year accompanied by a higher prevalence of stunting. Such phenomenon has been described (Cesar, Victora, Morris & Post, 1996; Post & Victora, 2001; Walsh, Dannhauser & Joubert, 2002; Gorstein, Sullivan, Yip, de Onis, Trowbridge, Fajans & Clugston, 1994) and is attributed to body proportionality. Post and Victora (2001) found that wasted infants tend to have large abdominal, head and chest circumferences. They speculated that these could account for the increased weight resulting in normal or even increased WHZ scores, as seen by the increased percentages of infants who are overweight.

Baughcum, Powers, Johnson, Chambelin, Deeks, Jain and Whitaker (2001) examined infant feeding practices in Kentucky and Cincinnati, where they found that women in lower socio-economic categories are more likely to overfeed their infants. It appeared that the mothers were more concerned about hunger experienced by their infants irrespective of current weight

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than were mothers from higher socio-economic status. Furthermore, the poorer mothers were more likely to introduce solids earlier.

In this study, a high percentage of infants who were overweight (WHZ > 2SD) between 1 and 9 month was observed. It is suspected that this finding is the result of early introduction of solid foods, which were competing with milk as a primary source of nutrition and source of energy.

Because educational status, wealth index and household income can be considered as proxy measures for socio-economic status, the risks between poverty and stunting are clearly indicated. However, the socio-economic status of the study sample as a whole might be contributing to the observed pattern of a high prevalence of stunting accompanied by overweight which is common in populations with low socio-economic status.

All (100%; n=186) mothers in this study reported having attended school with 81.0% of mothers reported to have completed high school. This result show an improvement on the NFCS (1999) which found that only a quarter of mothers in South Africa had an education. Of these, 25.0% had primary school, 27.0% high school, and 8.0% a tertiary level. Steyn, Labadarios, Maunder, Nel and Lombaard (2005) used the anthropometric measurements of the NFCS of children 12 to 108 months old and found that stunting was directly linked to caregiver and maternal education level.

In this study, there was no significant association between the education level of the mother and child being stunted. This is inconsistent with the findings of the NFCS that higher levels of maternal education were associated with lower levels of stunting, underweight and wasting in all age groups (NFCS, 1999). A significant correlation between level of education and anthropometry was thus confirmed (Labadarios *et al.*, 2005). In South Africa, maternal education is associated with reduced risk of stunting in children (Steyn *et al.*, 2005). A study done in KwaZulu Natal Province, found maternal schooling for a minimum of five years to be protective against child stunting and underweight (Chopra, 2003).

Educational levels of parents in Ghana and India with severely malnourished children were lower than that of parents with healthy children (Jeyaseelan & Lakshman, 1997; Rikimaru, Yartey, Taniguchi, Kennedy & Nkrumah, 1998). Christiaenson and Alderson (2001) found that female education had a positive and statistical effect on a child's nutritional status.

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Maternal education is still an important issue to address, as the effect of female education on the nutritional status of children was two times larger than that of males. Mechanisms behind the association between mother's schooling and child health are still poorly understood. Mothers with post secondary schooling had fewer malnourished children than mothers with primary and secondary schooling. Mothers that were better educated fed their children better (Christiaenson & Alderson, 2001).

The average monthly income for the households in this study was between zero and 2 999 rand. Of the households that were included in the NFCS in 1999, less than 60% had a monthly income of R100 – R1000 (NFCS, 1999). When the NFSC Fortification Baseline (NFSC-FB-I) was repeated in 2005, 55% of the households had an income of R1 – R1000 per month (Labadarios *et al.*, 2008). Socio-economic status is linked to income and malnutrition (Pierecchi-Maiti, Louis-Borrione, Bartoli, Sanvoisin, Panuel, Pelissier-Alicat & Leonetti, 2006).

Household socio-economic status is often associated with child malnutrition (Zere & McIntyre, 2003; Jones, Griffith, Adair, Norris, Richter & Cameron, 2008) and therefore, the observed interaction between wealth index and infant being underweight was no surprise. The use of socio-economic status composites like wealth index as a proxy for long-term socio-economic status provide results consistent with the use of the individual variables and may help to make statistical models more prudent (Sheppard, Norris, Pettifor, Cameron & Griffiths, 2009). This however, takes away the opportunity of identifying the specific components of the socio-economic status which are associated with child anthropometric outcome. Principal component analysis has been used in child nutrition studies (Kennedy, Nantel, Brouwer & Kok, 2006; Filmer, & Pitcher, 1998) for creation of the wealth index but a recent study questions its appropriateness when many of the variables are of binary nature (Sheppard *et al.*, 2009).

For assessing wealth in this study, an index was constructed by principal component analysis and wealth index was found to be significantly ($p<0.05$) associated with child growth (positively with underweight).

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CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter contains a summary of the results obtained during the study. The results are discussed along with and compared with results obtained from similar previous studies, both within and outside South Africa. Conclusions were drawn based on the results and recommendations were made accordingly. Limitations of the study were also highlighted.

The main objective of this study was to investigate the relationship between socio-economic status and physical growth of infants at Dzimauli village during their first 12 months of life.

5.2 Summary

In South Africa, a significant proportion of the population lives in the rural areas, lacking basic services and being overburdened by poverty, particularly women and children. The available data about the nutritional status of children under 5 years in South Africa reflects the worst and most miserable situation among children under 5, especially in the marginalized rural areas. Consequently, there is a need for research to highlight the problem and draw attention to the children situation. Currently there is a dearth of information concerning the impact of socioeconomic factors and infants growth in Dzimauli Village, Limpopo Province. Therefore, the is a need to examine the relationship between socioeconomic status and correlates of growth of rural South African infants in order to inform public health policy concerning infants' feeding practices.

The study was a secondary data analysis of the Malnutrition and Enteric Infections: Consequences for Child Health and Development (MAL-ED) project, a cohort study conducted from 2009 to 2014. The study was conducted at Dzimauli Village, located in Mutale Local Municipality, Vhembe District of the Far North region of the Limpopo Province of South Africa. Dzimauli village is predominately semi-rural with poor infrastructure, lack of electricity, proper sanitation, poor roads, and poorly-equipped schools. The village relies mainly on subsistence farming (IDP, 2007).

The population for the study included all the children recruited for the MAL-ED research at Dzimauli Village. A total of 314 children were enrolled in the MAL-ED study at birth. The

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infants were being followed at regular intervals up to 24 months of age and up to 36 months of age when feasible. Simple random sampling method was used to select 186 children (0 – 12 months old) from the sampling frame. Children who have spent twelve months in the MAL-ED study (children who have Monthly Assessment Form (MOA); and with twelfth Monthly Assessment Form B (MOB) were included in the study.

The data of all children involved in the MAL-ED study were reviewed. The data collection form consisted of open-ended, closed-ended and dichotomous (yes/no) questions to measure the variables of interest (demographical characteristics e.g. age, gender, marital status and relationship to child, head of household, mother and child's primary caregiver; socioeconomic status e.g. household wealth, maternal education, and household income; feeding practices e.g. breastfeeding, complementary and mixed feeding; and child anthropometry e.g. weight, height and head circumference).The reliability of the instrument was determined by using the test-retest method.

A letter of permission to conduct the study was written to the MAL-ED project group through the chair and access was granted to the records. The permission to conduct the study was obtained from the Higher Degrees Committee of the School of Health Sciences at the University of Venda, the University Higher Degrees Committee, and from the MAL-ED project.

Descriptive statistics, namely frequencies and percentages were used for categorical data while means and standard deviations for continuous data, were calculated. Chi-Square test was carried out to assess relationship between socio-economic status (maternal education, household income and wealth) and infant growth (stunting, underweight and wasting) on one hand, feeding practices and infant growth on the other. A p-value of $p<0.05$ was considered statistically significant and taken to imply an association between the variables being compared. Thereafter, binary logistic regression analysis was conducted to determine association between socio-demographic factors and anthropometric measurements.

The major findings of the study are as follows:

- There were more males than females as heads of households. Most household heads were in the age group (40 – 49) years.

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- Mothers were the caregivers to majority of the children but grandmothers also took care of the children in few cases.
- There were five to nine people in most of the households.
- Few households reportedly did not sometimes have enough food to eat, which could be an indication of a low level of food insecurity.
- Majority of the infants were breastfed for longer period (up to 12 months) but exclusive breastfeeding was uncommon.
- Most of the infants were introduced to supplementary feeds as early as one month of age.
- There was no statistically significant relationship between feeding practice and growth of infants.
- There was an association between gender and stunting. Significantly higher percentage of males had stunted growth.
- A smaller proportion of infants were stunted, underweight and wasted at birth.
- The stunted infants tended to remain stunted with little catch-up growth and stunting was evident by the first month.
- There was a low prevalence of underweight accompanied by higher prevalence of stunting.
- A high proportion of infant was overweight between 1 and 9 months.
- All mothers reported having attended school and majority reported to have completed high school. However, there was no significant association between maternal education and infant growth.
- The average monthly income for the households was about R3000.00. There was no significant relationship between income and infant growth.
- There was an association between wealth and infant growth (underweight).

5.3 Conclusions

This study found that at birth many infants were underweight but fewer were stunted. Postnatally, the growth pattern changed during the first 12 month, with infants gradually becoming more stunted and more overweight because exclusive breastfeeding was uncommon in the study area. The null hypothesis was accepted in all cases in the bivariate analysis except in the case of household wealth index and infants being stunted as well as in

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the relationship between household income and possibility of infants being wasted. Post-natal factors that appeared to be associated with stunting were those related to socio-economic status, namely marital status of household heads and ownership of agricultural land, and child factor, namely child sex. The major factor influencing whether a child is wasted is average income of households. Furthermore, the infants were introduced to supplementary feeds at an early age.

5.4 Limitations of the Study

Several limitations of the study are worth nothing. Due to longitudinal design of the study, only associations could be established; causal relationships could not be described. As the study was questionnaire-based, questions that required a good memory were vulnerable to recall bias. In addition, some questions that might be sensitive were susceptible to socially desirable answers. In this study, several field workers were involved in measuring length, weight and head circumference of infants. As a result, measurement errors might have been introduced. Although the interviewers were trained, the instruments were validated while there was routine supervision of measurement techniques and procedures by direct observation, they are tools by which errors could be minimised they do not guarantee objectivity. Another noteworthy limitation of this study was that many variables entered into the multivariate analysis were binary and were assessed using only one question.

5.5 Recommendations

The following recommendations are made based on the conclusions above:

- Nutrition should be a priority at national and provincial levels because it is important for infant growth, human and social development and can also affect socio-economic development of South Africa in the long-term.

- Interventions should take a holistic approach and need to be multi-sectoral in terms of programmes. This is because there are many factors contributing to malnutrition.

- The current government policy, the Infant and Young Child Feeding Policy, should incorporate intervention to promote appropriate feeding during pregnancy, early initiation of breastfeeding as well as correct complementary feeding as advocated by UNICEF.

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- Interventions targeting parents must also consider the approval of male partner and grandmothers. Such interventions should include nutrition counselling, feeding and child care practices.
- Government need to improve on its current grant programs to improve access to quality foods among the poor members of the society.
- Staple vegetable foods must be promoted in a culturally acceptable manner as complementary food since they are cheaper and always available.
- Growth monitoring and promotional activities should be included in all health care programs. Also, growth monitoring and promotion should be promoted as a community-based intervention. This is because of lack of follow-up which occurs frequently among public health workers.
- The issue of poverty needs to be addressed because nutritional status of children depends heavily on improvements in the socio-economic status of households. Also, poverty alleviation will have significant impact on food insecurity and malnutrition since directly linked to economic growth.

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APPENDICES

Appendix 1: Research Data Collection Form

Participant Identification Number .....

Section A: Demographic Information

Head of household

1. Age .....
2. Sex male_____ (2) female_____
3. Relationship to child .....
4. Marital status 1. Married..... 2. Divorced..... 3. Widowed..... 4. Never married.....
5. Age when married for the first time .....
6. Have you ever attended school? 1. Yes ..... 0. No .....
7. Number of years of schooling completed .....
8. If younger than 25 years old, are you currently attending college or school? 1. Yes.... 0. No ....

Mother

9. Age .....
10. Marital status 1. Married..... 2. Divorced..... 3. Widowed..... 4. Never married.....
11. Age when married for the first time .....
12. Relationship to head of household .....
13. Have you ever attended school? 1. Yes ..... 0. No .....
14. Number of years of schooling .....
15. If younger than 25 years old, are you currently attending college or school? 0. Yes.... 1. No ....
16. Age when pregnant for the first time .....
17. Number of pregnancies in lifetime .....
18. Number of life birth in lifetime .....
19. Are all children still alive? 1. Yes ..... 0. No.....
20. Number of children who have died .....

Primary Caregiver

21. Relationship to child.....
22. Age .....
23. Marital status 1. Married..... 2. Divorced..... 3. Widowed..... 4. Never married.....
24. Age when married for the first time .....
25. Relationship to head of household.....
26. Have you ever attended school? 1. Yes ..... 0. No .....
27. Number of years of schooling .....
28. If younger than 25 years old, are you currently attending college or school? 1. Yes.... 0. No ....

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Section B. Socioeconomic status

29. Number of years the family has lived in the house.....
30. Number of rooms in the house .....
31. Number of rooms used for sleeping (excluding kitchen).....
32. Number of people sleeping in the household .....
33. Payment of domestic workers? 1. Yes..... 0. No.....
34. Main source of drinking water 01 Piped into dwelling... 02 Piped into yard/plot ... 03 Public tap/Stand pipe.... 04 Tubewell/Borehole..... 05 Protected well.... 06 Unprotected well.... 07 Surface water.... 08 Other.....
35. Is your piped water continuous or sometimes interrupted? 1. Yes..... 0. No .....
36. How often does the interruption last? .....
37. Main source of water for purposes other than drinking 01 Piped into dwelling... 02 Piped into yard/plot ... 03 Public tap/Stand pipe.... 04 Tubewell/Borehole..... 05 Protected well.... 06 Unprotected well.... 07 Surface water.... 08 Other.....
38. Do you pay or barter for water 1. Yes ..... 0. No .....
39. Where is water source located? .....
40. How long does it take to go there, get water and come back in one trip .....
41. Who is the main person in the household who go to fetch water from the source? .....
42. Do you treat water in any way to make it safer to drink? 1. Yes ..... 0. No .....
43. What do you usually do to the water to make it safer to drink? 01 Let it stand or settle ..... 02 Solar disinfection .... 03 Using a water filter... 04 Strain it through a cloth.... 05 Add bleach/chlorine.... 06 Boil ..... 07 Other .....
44. Do you wash your hands after helping your child defecate? 1. Yes ..... 0. No.....
45. Do you wash your hands before preparing food? 1. Yes..... 0. No .....
46. Do you wash your hands after using toilet? 1. Yes..... 0. No .....
47. Do you use toilet paper? 1. Yes ..... 0. No .....
48. Kind of toilet facility 01. No facility/bushfield/bucket toilet... 02. Pit latrine.... 03. Flush to piped sewer system.... 04. Flush to septic tank.... 05. Flush to pit latrine.... 06. Flush to somewhere else.... 07. Other.....
49. Do you share this toilet facility with other households? 1. Yes.... 0. No.....
50. How many households use this toilet facility? .....
51. Does your household ever have electricity? 1. Yes..... 0. No .....
52. Is your electricity supply continuous or sometimes interrupted? .....
53. If sometimes interrupted, how long do these interruptions usually last? .....
54. In case of discontinued power supply, what source does the household usually use?.....

Household assets

Do you have the following in your household?

55. Iron 1. Yes ..... 0. No.....
56. Mattress 1. Yes ..... 0. No.....
57. Chair or bench 1. Yes ..... 0. No.....
58. Sofa 1. Yes ..... 0. No.....
59. Cupboard 1. Yes ..... 0. No.....
60. Table 1. Yes ..... 0. No.....
61. Electric fan 1. Yes ..... 0. No.....
62. Radio or transistor 1. Yes ..... 0. No.....
63. Computer 1. Yes ..... 0. No.....
64. Television 1. Yes ..... 0. No.....
65. Mobile telephone 1. Yes ..... 0. No.....
66. Refrigerator 1. Yes ..... 0. No.....

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67. Watch or clock 1. Yes ..... 0. No.....
68. Bicycle 1. Yes ..... 0. No.....
69. Does any member of your household own a bank account 1. Yes ..... 0. No.....
70. Does your household own any agricultural land? 1. Yes ..... 0. No.....
71. How much agricultural land does this household own? .....
72. Does your household own cows, bulls, or buffaloes? 1. Yes ..... 0. No.....
73. Does your household own chicken or chicks? 1. Yes ..... 0. No.....
74. Do you ever heat your house? 1. Yes ..... 0. No.....
75. What is the primary source of fuel used for heating the household?.....
76. What type of cooking stove do you mainly use in your house? .....
77. Is cooking done inside the house, outside the house or both? .....
78. What is the main material of the floor? .....
79. What is the main material of the roof? .....
80. What is the main material of the exterior walls? .....
81. Do you have a separate room which is used as a kitchen? 1. Yes ..... 0. No.....
82. Primary method of distinguishing members of the population. 01. Caste... 02. Race.... 03. Tribe... 04. Language spoken.... 05. Religion.....
83. If caste, which caste.....
84. If race, which racial group? .....
85. If tribe, which tribal group? .....
86. If language spoken, which language? .....
87. If religion, what religion do you practice in your household? .....
88. What is the average monthly income for the entire household? .....

Food Security

89. In the past four weeks, did you worry that your household would not have enough food
    1. Yes ..... 0. No .....
90. In the past four weeks, were you or any household member not able to eat the kind of foods you preferred because of lack of resources? 1. Yes ..... 0. No .....
91. In the past four weeks, did you or any household member have to eat a limited variety of foods due to lack of resources? 1. Yes ..... 0. No .....
92. In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of resources to obtain any types of food? 1. Yes ..... 0. No .....
93. In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food? 1. Yes ..... 0. No .....
94. In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food? 1. Yes ..... 0. No .....
95. In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food? 1. Yes ..... 0. No .....
96. In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food? 1. Yes ..... 0. No .....

Section C: Feeding Practice

Intake of Specific Food

97. Breast milk 1. Yes ..... 0. No .....
98. Breast milk during night (frequency) .....
99. Breast milk during day (frequency) .....
100. Infant formula 1. Yes ..... 0. No .....
101. Infant formula during night (frequency) .....

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102. Infant formula during day (frequency) .....
103. Animal milk 1. Yes ..... 0. No .....
104. Animal milk during night (frequency) .....
105. Animal milk during day (frequency) .....
106. Plain water 1. Yes ..... 0. No .....
107. Tea, coffee, local examples 1. Yes ..... 0. No .....
108. Fruit juices 1. Yes ..... 0. No .....
109. Other liquids 1. Yes ..... 0. No .....
110. Semi-solid foods 1. Yes ..... 0. No .....
111. Porridges, bread, foods/drinks made from wheat, oat, barley or soy 1. Yes ..... 0. No .....
112. Rice, millet 1. Yes ..... 0. No .....
113. White potatoes, white yams, manioc, other roots 1. Yes ..... 0. No .....
114. Peanuts, peas, lentil 1. Yes ..... 0. No .....
115. Bananas 1. Yes ..... 0. No .....
116. Yogurt, keifer 1. Yes ..... 0. No .....
117. Onion, leeks, shallots, garlic 1. Yes ..... 0. No .....
118. Fermented foods or drink 1. Yes ..... 0. No .....

Section D: Child Anthropometry

119. Date of birth .....
120. Birth weight .....
121. Gender 1. Male..... 2. Female....

	Anthropometric measurement	Birth	1 Month	2 Month	3 Month	4 Month	5 Month	6 Month	7 Month	8 Month	9 Month	10 Month	11 Month	12 Month
122	Lenght (cm)													
123	Weight (Kg)													
124	Head circumference (cm)													

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Appendix II: Request for Permission Letter

University of Venda

DEPARTMENT OF PUBLIC HEALTH

TO: PROF. PO BESSONG

FROM: DR. AK TUGLI

DATE: SEPTEMBER 10, 2014

SUBJECT: REQUEST FOR PERMISSION TO ACCESS MAL-ED DATA

We write to formally request for permission to access MAL-ED project data for our Master of Public Health student named GBADAMOSI MOJEED (MPH Health Measurement). He is a year two MPH student working on his project. The project details are:

TOPIC: Relationship between socio-economic status and growth of 12 months old children at Dzimauli village, Vhembe District.

OBJECTIVE: To determine the relationship between socioeconomic status, feeding practices and physical growth of 12 months old children at Dzimauli village.

RESEARCH HYPOTHESES

1. The level of maternal education will not have any significant relationship with the growth of 12 months old children at Dzimauli village.
2. Household income as measured by average monthly income would not have significant effect on the growth of 12 months old children at Dzimauli village.
3. The SES of the mothers would not have any significant effect on the growth of 12 months old children at Dzimauli village.

SUPERVISORS: DR D. T. GOON & DR A.K. TUGLI

We promise to abide by ethical standards with regard to the use of the data so that the project integrity and interest is protected.

Thank you for your usual and anticipated co-operation.

Yours faithfully,

Dr. A.K. Tugli

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Appendix III: Ethical Clearance

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
Mr MA Gbadamosi

Student No:
11620685

PROJECT TITLE: Relationship between socio-economic status and infant growth in Dzimauli Village, Limpopo Province, South Africa.

PROJECT NO: SHS/15/PH/11/2007

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Prof DT Goon	University of Venda	Supervisor
Dr AK Tugli	University of Venda	Co-Supervisor
Mr MA Gbadamosi	University of Venda	Investigator - Student

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE

Date Considered: July 2015
Decision by Ethical Clearance Committee Granted
Signature of Chairperson of the Committee: .....
Name of the Chairperson of the Committee: Prof. G.E. Ekosse

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