An Analysis of Under-Five Nutritional Status in Lesotho:

The role of parity order and other socio-demographic characteristics

A RESEARCH REPORT SUBMITTED TO THE FACUTLY TO THE SCHOOL OF SOCIAL SCIENCES, UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN THE FIELD OF DEMOGRAPHY AND POPULATION STUDIES FOR THE YEAR 2009.

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Declaration

I, Sasha Frade hereby declare that this research report is my own original work. It is being submitted to the Faculty of Humanities and School of Social Sciences, University of the Witwatersrand in Johannesburg, South Africa. It is submitted in partial fulfillment of the requirements for the degree of Master of Arts in the field of Demography and Population Studies. I declare that this report has not been submitted before in part, or in full, for any other degree or examination at this or any other university.

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List of Abbreviations

ASFR	Age-Specific Fertility Rate
BMI	Body Mass Index
DHS	Demographic and Health Survey
GDP	Gross Domestic Product
LDHS	Lesotho Demographic and Health Survey
NCHS	National Center for Health Statistics
OECD	Organisation for Economic Cooperation and Development
SD	Standard Deviation
TFR	Total Fertility Rate
UNICEF	United Nations Children's Fund
WHO	World Health Organisation

Abstract

Introduction: Africa is plagued by severe malnutrition, which most avidly affects children under the age of five both in the short-term and long term, and has consequences for the individual child, the household and the community. This study wishes to inform those who are in the field of child development and health as well as to contribute to a general understanding of the nutritional effects of under-five children in Lesotho.

Methodology: With the use of the 2004 Lesotho Demographic and Health Survey (LDHS) data univariate, bivariate and multivariate analysis was used to assess child malnutrition. Logistic regression was used to assess the relationship between parity order and weight-for-height (wasting) and weight-for-age (underweight). Multinomial logistic regression was performed for the height-for-age (stunting).

Results: Only in height-for-age (stunting) and for the malnourished category in the multinomial logistic regression are statistically significant results encountered for the three anthropometric measures. Parity order becomes more significant once all the independent variables are taken into account in the second model.

Conclusion and Recommendations: The study found that 50% of children in Lesotho are of parity order 1 and 2, and that only a quarter of all children lived in urban areas. According to the computed wealth index only 27 of the children lived in households where the wealth index score was above 5, and the educational level of the mother showed a large disparity. The anthropometric measures showed great disparity in terms of total number and percentage of children in each nutritional level. Just over a quarter of all children are classified as stunted, and a further one in five children as severely stunted. Also, 12.3% of children under the age of five are underweight, and 3.65% are severely underweight. In the second model for the stunting measure it was found that malnourishment and severe malnourishment had a higher probability of occurring amongst those children at whose mother's had a higher educational level. This may be due to the fact that either mother's with a lower educational level have more time to care and support their children and that the public health system may have been effective in

disseminating key child health messages to the point that educational attainment may no longer be a determinant of child's nutritional status.

The mother's age at birth of the index child found that children born to older mothers have a higher likelihood of being stunted. The wealth index showed a surprising result in that those children, in general, in households that have a low wealth index (0 and 1) score were less likely to suffer from stunting than children in households with a higher wealth index score. It was found that children of lower birth orders were at more likely to be stunted or severely stunted than those children born at higher birth orders. Further research is required, especially for wasting where cases of malnourishment were too small to be statistically significant for mother's age at birth of the index child.

Chapter 1: INTRODUCTION

1.1 General Introduction

Malnutrition and its associated mortality and morbidity outcomes severely affect children under the age of five years. Unfortunately, until now much of this relationship and studies in which the relationship between the various determinants and variables that may or may not influence both child nutritional status and its consequences in children under the age of five have centered on either comparative studies, or predominantly on studies on the Asian continent. The situation in Africa has often been generalised, and specifically, Lesotho has not been widely researched. As one of the poorest sub-Saharan African countries, with the highest level of malnutrition, but lowest level of child mortality Lesotho provides some interesting antitheses that may help us to understand the relationship between malnutrition and child mortality better.

Furthermore, various views as to how the relationships between a number of socio-demographic variables affect child malnutrition have been investigated. It is perhaps most evident in the maternal-education debate, as though it is universally accepted that maternal education has a positive and beneficial effect on child health, there is a lack of consensus as to how maternal education is able to do this. Another aspect that has not been widely researched in the African continent is the issue of gender preference for children, though authors have found that Africa does not show the consistent and evident pattern of preference for either sex that is seen on the South Asian sub-continent.

It is, perhaps, not that African households may prefer one sex over the other that may affect the child's nutritional status, and survival probabilities, but that often children in the same household may compete for resources, both material and non-material such as their mother's attention and time. The issue of parity order becomes crucial for two reasons. First of all, children of higher parity may have a disadvantage from the beginning due to the natural depletion of the mother's body. Secondly, there is contention as to whether children of higher or lower parity are given more or less time and attention, as well as overall household resources. The hypotheses is that depending on three fertility indicators; namely age of mother at birth of the index child, number of children in the household, and the birth interval between the index child and the sibling that preceded them - low and high order births will have an advantage over middle order births - in other words, the first and last child. This is because with first children mothers may be inexperienced, and children who are born last may be competing for resources within the household with a higher number of children than their lower parity siblings.

Lesotho, presents an interesting scenario, in that the Total Fertility Rate (TFR) in the rural and urban areas are extremely different. However, Lesotho in general has the lowest TFR in Southern Africa (Ministry of Health and Social Welfare 2005: 9-10). The high poverty levels, but low fertility levels, presents us with a situation in which it is unknown whether children in Lesotho experience high or low nutritional status according to their parity, mother's education and whether the child is in a rural or urban residence.

1.2 Statement of the Problem

Nutritional status during childhood has consequences in childhood until adulthood. Deficiencies in nutrients or imbalances between them can have dire long-term effects for the individual (Kibel et al. 2007: 153). Thus, measuring the child's nutritional status is important because of both the long-term and short-term effects on the health, educational and the cognitive abilities of the child. There are also severe consequences and effects to the child's ability to function as a healthy, productive and self-supporting community member in the long-term, which is another reason for concern, and as such the study further wishes to add to an understanding on how to contribute to the betterment of society. Specifically in Lesotho, it has been found that children under the age of five years experience stunting or chronic malnutrition (37% of girls and 39% of boys). However, according to the Lesotho DHS report, only 4% of children in Lesotho under the age of five years experience wasting or acute malnutrition, and 20% of children under five are considered to be underweight (Lesotho DHS Report 2005: 173-176). These differential figures need to be more thoroughly assessed, and reasons as to why such high rates of stunting and under-nutrition, and yet such low figures of wasting occur.

1.3 Research Questions

1.3.1 Main Research Question

- Does parity order of children under the age of five years contribute to their nutritional status?

1.3.2 Subsidiary Research Questions

- How does the number of children in the household affect the index child's nutritional status?
- How does the mother's educational status affect the nutritional status of the index child?
- How does the birth interval between the index child and the sibling that preceded their birth affect their nutritional status?
- How does the geographic location, whether urban or rural, of the index child affect their nutritional status?
- How does the household's total wealth affect the index child's nutritional status?

1.4 Research Objectives

1.4.1 General

- To investigate if there is an association between parity order and nutritional status in children under the age of five years in Lesotho.

1.4.2 Specific

- To investigate whether there is an association between parity order and malnutrition.
- To examine whether higher number of children in the household affects the index child's nutritional status.

- To identify demographic and socio-economic factors that may place a child, of the same parity order, at a greater disadvantage in terms of their nutritional status.

1.5 Justification of Study

1.5.1 Global Context of Malnutrition

Malnutrition, through its synergistic relationship with infections and disease, has a powerful impact on child mortality. Majority of under-five child deaths (83%) are attributable to malnutrition, and malnutrition is implicated in 56% of all deaths of children aged 1 to 4 years. Furthermore, malnutrition is stipulated as the primary cause of death in almost 15% of all under five child mortality cases, and associated with 85% of the rest of the cases of child mortality under the age of five years (Pelletier, Frongillo, et al. 1995: 446; & Smith and Haddad 2000:1). However, perhaps most disconcerting are the long-term effects, in that malnutrition during childhood not only has consequences during childhood, but in adulthood as well. Deficiencies in nutrients or imbalances between them can have negative long-term effects for the individual (Smith, Ramakishnan, et al. 2003: 1). Malnourished children are also more prone to infections that are often fatal or disabilitating, and as such promotion of good nutrition is a key issue in the healthy development and long-term well-being of the child (Kibel et al. 2007: 153). As such stunting in children often results from poor feeding practices over long periods of time, repeated infections, and low socio-economic status of the household in which the child resides (Kibel et al. 2007: 527).

In developing countries, the major forms of illness among children are due to protein-caloric malnutrition, which is associated with over half of all child deaths and severe malnutrition, it also increases the risk of child mortality to up to ten fold. The problem is that there are separate and mutually re-enforcing determinants of nutritional status and infection – malnutrition and infectious diseases have been postulated to be “synergistic”. The bi-directional causal relationships in which malnutrition and infections are predisposed exacerbate one another; but more crucially nutritional status is fundamentally determined by the quality and quantity of food-intake (Chen, Hug & D'Souza 1989: 151). However, income and food availability are insufficient conditions, and though most previous studies of child malnutrition and its consequences have focused on economic factors, maternal education, and health service use and provisioning - none of these take into account the different pathways through which the various determinants of child malnutrition and mortality influence it (Smith & Haddad 2000: 9-13).

The relationship between food security and mortality and morbidity consequences is most clearly shown in children under the age of five years. In a study conducted by Scanlan (2004), it was estimated that as much as 25% of child mortality in lesser-developed regions can be attributed to children's low nutritional status (Scanlan 2004: 1808). Furthermore, studies have found that nutrition-related morbidity and mortality affect children differentially according to their age, sex, and parity order; over and above the socio-economic conditions of the household (Walter et al. 2004: 591; Sommerfelt & Stewart 1994: 1). Specifically and on a daily basis, many African children suffer from morbidity and mortality consequences due to malnutrition (Jooste et al. 1997; Bloss et al. 2004; Setwe 1994); and sub-Saharan Africa is the only region in the world where child malnutrition has been continuously increasing (Smith & Haddad 2000: 71). It is now projected that little progress will be made in sub-Saharan Africa to ameliorate child malnutrition by 2020 if nothing is done quickly and drastically. Under the most pessimistic projections, the number of malnourished children (and therefore those at heightened risk of mortality) is expected to increase to 55 million by 2020, or 32.4% of all children in sub-Saharan Africa (Smith & Haddad 2003: 81).

1.5.2 Lesotho Context of Malnutrition

Specifically, in Lesotho women are legally seen as minors under customary law. However, women who are under the age of 21 and women who are married are seen as minors under common law. Thus, women are not allowed to hold property, inherit, borrow money, and manage their own business, sign contracts and further need to have their father, husband or local (male) chief consent to them having a passport (Kendall *undated*: 3; and Mueller 1977: 158). However, though under customary and common law this seems to be the case, Lesotho's particular history which is linked to South Africa's migrant labour system places the country in an unknown situation in terms of child nutritional status and their survival probabilities. Lesotho and the Basotho men, in general, where highly linked to the South African economy. This, in recent times, has had a significant effect on the Basotho society, as the women of the family were often left to hold the family and household life together. As a poor country, remittances often helped (and still do) keep the family financially afloat. The mining industry in South Africa, which first precipitated the inflow of migrant labourers, has declined and mass retrenchments of non-South African mine-labourers has occurred. Many former Basotho miners have been forced to return home and this has drastically increased both the unemployment and poverty rate in Lesotho ("See Lesotho" *undated*: *www.seelesotho.com/index2.php?option=com _content&task=view & id=26:* 2). Another factor that differentiates Lesotho from other developing countries is that (still today) because many boys spend years as shepherds, generally there are more girls at school than boys, and those boys that are at school are generally older than the girls in their class ("See Lesotho" *undated*: *www.seelesotho.com/index2.php? option=com_content&task=view & id=26:* 3).

Therefore, unlike other studies where women have high status within the home and communities, and are thus able to control and uplift children's nutritional status and survival probabilities, this may not be the case in a society like Lesotho's. In fact, child survival time in Lesotho has been strongly associated with malnutrition, mother's education, residential area, monthly household income and illness and health conditions of the child (in decreasing order of strength). Furthermore, the majority of child deaths in Lesotho seem to occur in rural areas, where poor health conditions are prevalent, to children that belong to illiterate and uneducated mothers, who are malnourished and who come from low-income households (Worku 2003: 3-4; and El Tahir *undated*: 2).

Furthermore, when it comes to fertility differentials, Lesotho shows a particular rural-urban disparity. Rural areas have a disproportionately larger Age-Specific Fertility Rate (ASFR) than do urban areas, and the disparity is greatest among those women between the ages of 20 (98 per 1000) and 24 (206 per 1000) years. However, in general, Lesotho has the lowest TFR in the sub-Saharan African Region (Ministry of Health and Social Welfare 2005: 9-10). Of major concern, is that children in Lesotho experience high levels of malnutrition – ranging from 18% in 2000 to

20% in 2004 according to El Tahir (*undated*); and experience levels of stunting that increased from 21% in 2000 to 38% in 2004 (El Tahir *undated*: 1). Thirty-eight percent of children under the age of five years in Lesotho are stunted, 15% are severely stunted, 4% are wasted and one in five children under the age of five in Lesotho are classified as underweight; though all these effects are seen mainly in children aged 10 to 59 months. Furthermore, though the result is not significant, more males than females are found to be wasted, stunted and underweight and these results are most pertinent in the rural areas. Unlike in other studies conducted in developing countries, however, mother's status within the home (in relation to the control of resources the mother has) is found not to be associated with child malnutrition though mother's education is a significant factor (Ministry of Health and Social Welfare 2005: 21).

However, no study has conclusively reported nor investigated whether the parity order of children affects their nutritional status, and thus survival probabilities in either Southern Africa or Lesotho. Studies in Asia, however, have shown preferential treatment of children of different parity order with regard to their sex, age, age of mother at birth of the index child, their geographical location (whether rural or urban) and the birth interval between them and the sibling that preceded their birth (Som et al. 2006; Pal 1999; Walters et al. 2004; Shaikh et al. 2003). Hence, this study will examine whether parity order of the child, controlling for a number of demographic and socio-economic factors, affects the nutritional status of children under the age of five years. Identifying such an association may inform further studies in the region, and will assist programmatic interventions and policies that wish to eradicate malnutrition, decrease the incidence of child mortality and morbidity, and further advance and develop society in the long-run.

Chapter 2: LITERATURE REVIEW, AND THEORETICAL AND CONCEPTUAL FRAMEWORK

2.1 Literature Review

2.1.1 Women's Education, and their Status in the Home

It has been established that each extra year of maternal education decreases the risk of under-five child mortality between 2–9% (Kauffman & Cleland 1994: 196; Cleland and van Ginneken 1989: 80; and Sastray 1994: 17), depending on the regions and countries investigated. Numerous studies have found that every additional year of education that women acquire decreases the risk of under-five mortality. However, though this fact is universally accepted (Loaiza 1997: 34), the percentage points and how education is directly associated with a lower risk of under-five child mortality is not clearly understood (Kauffman & Cleland 1994: 196).

Another point of contention among researchers is how maternal education is able to influence a decrease in under-five mortality. Some authors have attributed the effect that maternal education has on the woman's status within the household. It is believed that women with low status have less control over their mental health, have tighter time constraints, less access to information and health services, and an overall lower self-esteem. These factors are then directly associated to the woman's own nutritional status and the quality of care they receive. In turn, women's status affects children's birth weights and overall chances of survival (Smith, Ramakishnan, et al. 2003: xi).

However, there is a second effect to women's education and status in the home; not only do they both increase women's control over household resources for themselves, but for their children as well. As is the case in most societies, women are the caregivers to young children and often bear the primary responsibility in their health and survival. Thus, the status women have within the household becomes critically important for the child's overall well-being and chances of survival (Smith, Ramakishnan, et al 2003: 8&9). Critically, after South Asia, sub-Saharan African women have the lowest ranking in the world in both child nutritional status as well as in the home and within communities; and furthermore it has been shown that sub-Saharan African women's relative decision-making power has a positive and above-moderate effect on their own children's nutritional status (Smith, Ramakishnan, et al 2003: 39-49).

A second group of authors believe that maternal education tends to decrease the risk of under-five mortality, not simply by increasing the women's status in the home, but due to the tendency of educated women to reproduce at lower risk age groups due to their postponement of marriage, earlier cessation of childbearing, and wider birth intervals between births (Cleland & van Ginneken 1989: 82). Basu (1994), however, sees fertility as seen as the number of births to each woman, as an intervening determinant in the maternal education-child mortality link. In fact, Basu believes that fertility behaviour due to maternal education is not in itself a pre-requisite for decreased under-five mortality. In fact, she believes that three factors determine how and if this relationship successfully leads to fewer deaths in children under the age of five years. The first is the age at which childbearing begins in relation to the spacing intervals between births, and the age at which childbearing ceases. Any combination of these three factors may result in negative or positive consequences to a child's survival probabilities (Basu 1994: 207-210).

The third group of researchers believes that maternal education, as a universally accepted determinant of lower under-five mortality, is decreasing in relative importance due to improvements in modern health care services and the passive reception of childbearing and health messages in society (Jain 1994: 199; and Brockerhoff & de Rose 1994:194). However, there are two caveats to this argument; the first is that it seems to hold true only to long-term urban residents (Brockerhoff & de Rose 1994: 194). The second caveat is that there are major disparities between societies, depending on the quality of both services and information that women receive (Brockerhoff & de Rose 1994: 192; Jain 1994: 199-201; & Basu 1994: 213). Female education, in the passive information that women receive, so far as it will affect the survival probabilities of children under the age of five, mostly accomplishes these goals.

The first of these goals is that it must facilitate changes in health-seeking behaviour in terms of care of the child both in preventive (medical and non-medical) and curative care – although it has been proven that there is a higher association between preventive care and child survival than with curative care; even after adjustments of maternal age, parity order, rural-urban residence and husband's occupation (Jain 1994: 201; and Cleland & van Ginneken 1989: 86). Secondly, such information and educational benefits vary depending on the context; in other words, passive reception of information may not be likely in settings where such information is either not provided or is not accessible to the vast majority of the population. Som et al. (2006) have found that in the Indian states of West Bengal and Assam, the nutritional status of children under the age of three years who were classified as malnourished or severely malnourished was inversely related to the parent's educational level.

2.1.2 Fertility Indicators

In a comparative study done for 38 DHS countries, it was found that almost all DHS countries have a consistent pattern linking fertility indicators (mother's age, parity and birth interval) to child malnutrition and the probability of child survival (Loaiza 1997: vii). Specifically, in sub-Saharan Africa, the mother's age had a relationship with the mother's nutritional status. The relationship found was that nutritional status of the mother varies with age, and that maternal Body Mass Index (BMI) was directly related to the child's birth weight and chances of survival.

However, of greater and of more critical importance, were parity order and the mother's last birth interval. The comparative study found that mothers of parity 4 to 5, and (in Africa) birth intervals of less than 2 years has the highest risk of child mortality and low nutritional status of the child (Loaiza 1997: 17). The parity order debate is associated with two arguments, which may not be mutually exclusive. The first is that women of higher parity may be more biologically depleted than their lower parity counterparts (Loaiza 1997: 17). Secondly, child development and survival is often also due to the physical and psychological attention given to the child – which is seen as an important factor in decreasing the risk of ill-health and increasing the speed and efficiency with which ill-health is recognised and treated (Basu 1994: 211).

The significance of birth order, and birth spacing, has been shown to have great effects on the measure of nutritional status of children. This has been shown in India (Som et al. 2006: 631) and in the Philippines, where Horton (1988) found that children of later birth orders and those with shorter birth intervals had a higher likelihood of being malnourished. Pal's (1999) analysis of childhood malnutrition in rural India found that due to the preference of boys over girls, girls of higher parity order were significantly more disadvantaged than boys of the same parity and birth interval (Pal 1999: 1164). However, Horton (1988) did find that being part of a large family partially offset the birth order effects - but, in general, those of later parity orders who were in large families were more malnourished; though this effect was only found in short-term nutritional effects (Horton 1988: 349).

Finally, mother's age at birth of the index child has also been measured against children's nutritional status. In West Bengal and Assam (India) the age of the mother at birth of the index child was highly related to nutritional outcomes. Children born to mothers between the ages of 20 and 29 years were more likely to suffer from negative nutritional outcomes than those born to older mothers. This was found in West Bengal (Som et al. 2006: 633) and in the Indian study of Goa and Kerala by Rajaram and colleagues (Rajaram, et al. 2003: 343). However, in Uganda it was found that older and less educated mothers were classified as a risk factor to children's nutritional status (Kikafunda et al. 1998: E45). Furthermore, in a Kenyan study by Bloss and colleagues (2004) it was found that irrespective of the mother's age at birth of the index child, children in their second year of life were more likely to be underweight and stunted relative to all other ages in the 0 to 5 age group (Bloss et al. 2002: 268).

2.1.3 Poverty and Socioeconomic Status

The comparative DHS study by Loaiza found that, especially in sub-Saharan Africa, socio-economic status of the mother seems to be a better predictor of malnutrition than maternal education (Loaiza 1997: 34). However, this relationship may in fact be synergistic, as Cleland and van Ginneken (1989) found that educated women also marry similarly educated and advantaged men, and thus enjoy relatively high living standards. In fact, a 1985 United Nations (UN) 15-country comparative analysis found that half of the gross effect of mother's education could be attributed to the economic advantage that they receive (Cleland & van Ginneken 1989: 83).

Bawah and Zuberi (2005) measure socio-economic status, as a proxy for living standards, and how socio-economic status affects child mortality in Southern Africa. Crucially the authors believe that though childhood mortality levels are a reflection of the level of poverty in Botswana, Lesotho and Zambia; rather than at Gross Domestic Product (GDP) per capita level, poverty and socioeconomic status at the household level is more a determinant of child's survival probabilities (Bawah & Zuberi 2005: 66). The same conclusion was drawn by Caldwell (1986) in a study conducted on child mortality in poor countries (Caldwell 1986: 172).

However, Bawah and Zuberi (2005) did find two surprising outcomes in the research that they conducted in the three sub-Saharan African countries. The first of these is that children of mothers in the 15-19 age groups appeared to have lower risks of mortality compared to the other age groups. The authors purport this to be a surprising finding because women of this age are probably at their first parity, are inexperienced in child care, but most of all have a lower socio-economic status than their older counterparts. Secondly, the authors also found that in all three countries chances of child mortality was lower for medium (between 6-10 people) and large (more than 10 people) households than children in smaller households. Again, the surprise in these results stems from the fact that one would expect overall household income to be lower in larger households (Bawah & Zuberi 2005: 67-68).

Although poverty and low socio-economic status may not be a determining factor in child mortality, poverty has been found to be a main underlying cause of malnutrition and its determinants (Miller & Krawinkel 2005: 279). Setwe (1994), on the other hand, found that mother's education and income were not significant predictors of a child's nutritional status in the former Bophuthatswana (Setwe 1994: 33). The results from the Bophuthatswana study differ considerably from results from the studies in India that found that nutritional status is affected by mother's education. These results also differ from those found in a study conducted in Uganda (2007) which found that the poorest 20% of households were more than twice as likely to suffer from stunting as children from the richer households, independent of child's age, sex, birth order and mother's age at birth (Hong 2007: 377). One can thus conclude that income, or at least household wealth, does have a significant influence on the child's nutritional status, but not necessarily on child survival probabilities.

2.1.4 Sex Preferences of Children

In developing countries in general, one of the most apparent variations in commitment to child survival is data on sex differences in mortality, which is believed to be a result of differential care of children of different sexes (Simmons 1989: 135). However, the gender preferences also come into play in nutritional status, where Chen, Hug & D'Souza (1989) found that at least some of the disparity in nutritional status between the sexes may be attributed to gender discrimination against one or the other gender in the intra-family allocation of food (Chen et al. 1989: 152). In most developing countries, documentation of sex differences in several major variables that affect child mortality influence other variables that are consistent with demographic findings of higher female than male mortality rates among children under the age of five (Chen et al. 1989: 158-159).

However, one must be aware that most detailed research on the reasons for the female disadvantage has been carried out in Asia (Hill & Upchurch 1995: 127); thus findings may be different in the African context. However, when conducting an analysis of DHS countries Hill and Upchurch (1995) found that, in a global review, an excess of female mortality is accounted for by two factors. The first of these is the relative contributions of specific causes of death which have different impacts by sex; and the second is the variability in the discrimination of gender - primarily in nutrition and health care services. Although for biological reasons female mortality is low in the 0-12 month age group, it invariably increases in ages 1 to 4 (Hill & Upchurch 1995: 128-129; Arnold 1992: 96; Arnold 1997: vii; and Sastray 1994: 11).

In the same study by Hill and Upchurch (1995) it was found that girls, in general, are less likely to be stunted than boys and, therefore, it seems unlikely that there is an association between stunting and the female mortality disadvantage. The same result is apparent for wasting, though differences between the sexes are minimal. Although the authors of this study did find that girls suffer less from chronic malnutrition than boys (Hill & Upchurch 1995: 141), there are authors that attribute this to biological reasons, rather than to differential allocation of household resources amongst boys and girls (Arnold 1992: 98). In fact, Arnold reports a United Nations Children's Fund (UNICEF) study of 39 countries where wasting was 1.3 times higher for boys than for girls, the same conclusion reached by the WHO. Similarly to Hill and Upchurch (1995), however, the same two studies found that girls do least well in all anthropometric measures at ages 2 to 3 years (Arnold 1992: 99).

Many of the studies conducted on children's nutritional status have attempted to find how nutritional status differs between male and female children, and a comparison of such studies has shown mixed results. In Indonesia, Walters et al. (2004) found that male children were more at risk of being malnourished than females of the same age (Walters et al. 2004: 591). The same results were found in the Indian districts of Kerala and Goa by Rajaram and colleagues (Rajaram et al. 2003: 390). However, Pal (1999) in a study of rural India found that females were more likely to be malnourished than males, as was found in urban pre-school children in India (Shaikh et al. 2003: 391). In sub-Saharan Africa, however, there is no consistent gender preference for children for the region, and there appears to be no significant differences in malnutrition between girls and boys of any age (Arnold 1997: 46).

2.1.5 Urban-Rural Differentials

In almost all variables and determinants associated with both child mortality and nutritional status a rural-urban differential is apparent. Where women's status is concerned, the autonomy females' gain is central to exceptionally decrease child mortality levels; but this is especially true in poor societies and highly evident in rural areas. This increased level of female autonomy, and its especially beneficial effect in rural areas makes it likely that educational differences by sex will be narrow (Caldwell 1986: 184).

Sastray (1994) also found that lifetime urban residents have child mortality levels 62% lower than their rural counterparts, though Sastray says the reasons for this are unknown (Sastray 1994: 22), we have established that this may either be due to better educational opportunities in the city or due the passive reception of information on child health and care that urban residents receive. Similarly to Sastray's conclusion, though, in India it was found that children living in rural areas had a higher proportion of malnourished children than those in the urban areas (Som et al. 2006: 629). However, studies in rural India (Pal, 1999), Indonesia (Walters et al. 2004: 390) and

Bolivia (Frost et al. 2005: 401) found a specific correlation between mother's literacy rate and the child's nutritional status, while male literacy was not significant to children's nutritional outcomes (Pal 1999: 1157).

2.2 Theoretical and Conceptual Framework

There are a number of theories that may be used as frameworks for child mortality; however, few of them deal specifically with child morbidity and/or nutritional status as a proxy for child's health. As such, the theoretical framework that has been chosen was specifically formulated to investigate child mortality and survival trends and patterns. However, this framework can be used in the study of child health and nutritional status as well. The framework is said to have been originally inspired by Davis and Blake's (1954) fertility framework in which intermediate or indirect variables and proximate or direct variables are distinguished (Caselli et al. 2006: 241).

Specifically, the Mosley and Chen (1984) framework further adds independent variables, listed at three levels – the household, community and individual levels (Mosley & Chen 1984: 36). Mosley and Chen combine the nutritional level of growth faltering, or nutritional status, of the child to the level of mortality in a specific birth cohort in order to create a general health index for the dependent variables. Once this has been computed, proximate determinants and intermediate variables are derived – classified into five categories, namely maternal factors linked to reproductive behaviour, environmental contamination, injury, personal illness control and nutritional deficiency (Caselli et al. 2006: 243; Mosley & Chen 1984: 27).

Furthermore, the richness and comprehensiveness of the framework lies in the combination of social and biomedical considerations – specifically the authors' note the strong interaction between the biologic proximate determinants (the *biological synergy*), and the social risk factors (the *social synergy*) (Caselli et al. 2006: 242; Ruzicka 1989: 9). Mosley and Chen have stipulated that such interactions are imperative in understanding child mortality and morbidity outcomes and that the framework was created to be used in the context of lesser-developed countries (Mosley & Chen 1984: 25). Thus, key to the model is the identification of a set of proximate determinants and intermediate variables that influence the risk of morbidity and mortality in children, within their local and cultural setting (Mosley & Chen 1984: 27). Only partial aspects of the Mosley and Chen framework will inform the study as the framework only deals with nutritional status in a partial manner, as one of its proximate determinants – all other proximate determinants will be excluded.

2.3 Conclusion

The literature review has found conflicting arguments for a number of the key areas investigated, and at this point it is not evident what results are to be found in Lesotho for children under the age of five years. Women's education could be a factor in whether children experience high levels of malnutrition or not, however the causal pathways as to how mother's educational level affects nutritional status and children's survival probabilities is not clearly understood, and authors are undecided on the issue. One fact is clear, however, maternal education does have an effect on child's nutritional status, and thus mothers of higher educational attainment have been universally found to have children of better nutritional status than mothers with lower educational levels.

Parity order and the birth interval between the index child and the sibling that preceded them was found to have a significant effect on child malnutrition in Loaiza's (1997) comparative study of 38 DHS countries. Loaiza found that in Africa those children born at birth intervals of 2 years or less, and those children born at slightly higher parity orders (four and above) had a higher likelihood of being malnourished.

However, what has not been found is the reasons as to how this relationship works and why. Two arguments put forward is that mothers may either be biologically depleted due to the close birth intervals, or may have less time available for each child due to the high number of children present. However, one may need to account that this could also depend on the mother's age at birth of the index child, as was found in the Indian studies conducted by Som and colleagues (2006) in West Bengal, and by Rajaram and colleagues (2003) in Goa and Kerala.

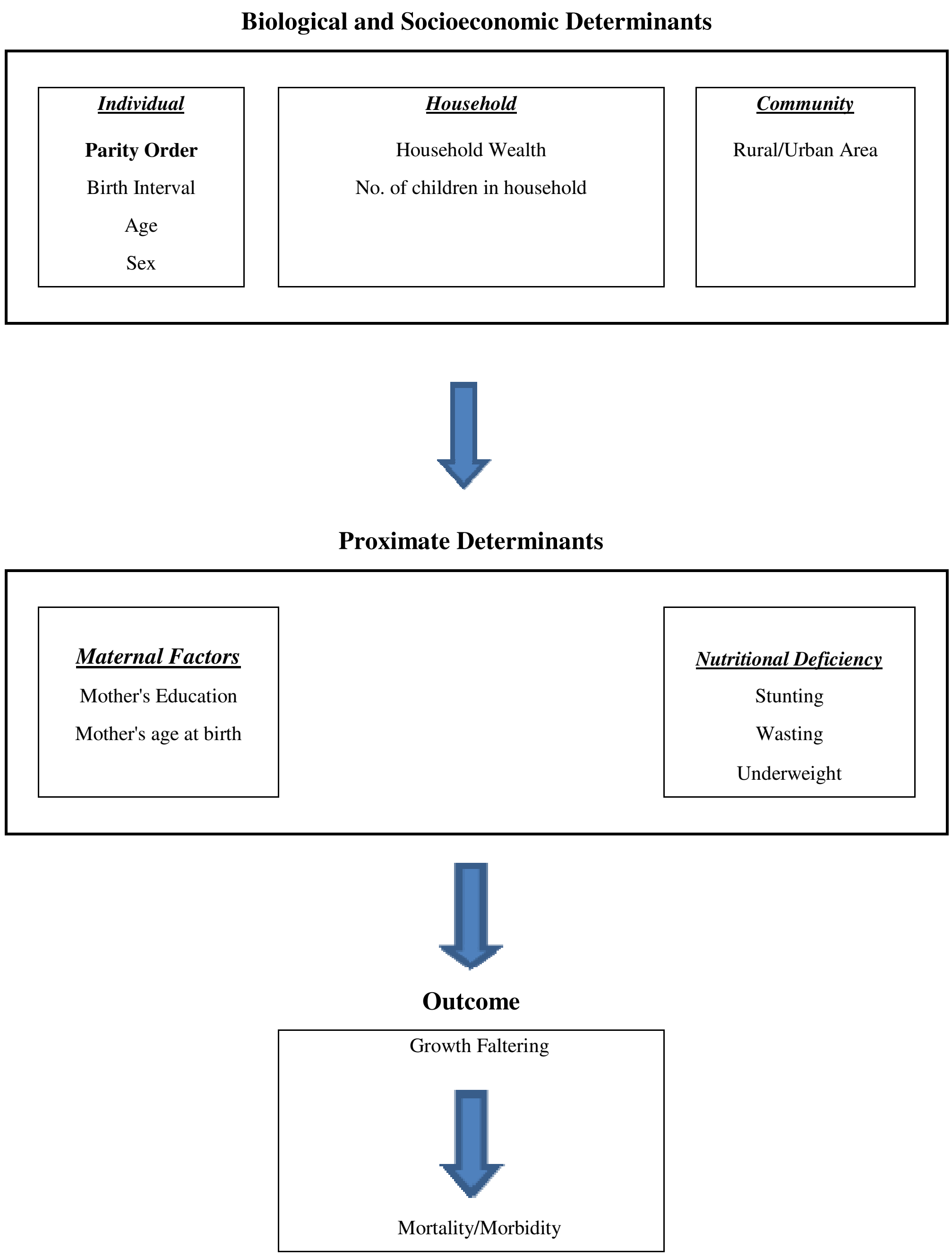

Figure 1: Adaptation of the Mosley and Chen Framework for an analysis of under-five nutritional status in Lesotho (Mosley and Chen 1984)

Socio-economic status and whether the child lives in an urban or rural area seem to have a more universally accepted outcome. For both of these variables, children born in poor households and those that live in rural areas show a disproportionate probability of being at a nutritional disadvantage. However, a gender preference in food allocation does not seem to be as evident as either socio-economic status or whether the child lives in an urban or rural area. Evidence for gender preferences is mixed according to geographical area.

The Mosley and Chen framework allows an understanding of how these variables may interact with one another to produce growth faltering or malnutrition. In investigating how the socio-economic and biological determinants interact and how they are then interlinked with the proximate determinants may provide a pathway in order to understand how malnutrition may occur.

Chapter 3: METHODOLOGY

3.1 Introduction

With the use of the 2004 Lesotho Demographic and Health Survey (LDHS) data it was the original intent to perform multinomial logistic regression to assess child malnutrition for each anthropometric measure. However, a logistic regression is performed for weight-for-age (underweight) and weight-for-height (wasting) due to the small number of cases in the malnourished and severely malnourished categories. However, for stunting, a large number of children were both either malnourished or severely malnourished, and thus a multinomial logistic regression is performed for height-for-age (stunting). The characteristics of the frequencies and relative frequencies of the participants in relation to the dependent and independent variables are explored. Once a univariate analysis is completed, a bivariate analysis with the use of contingency tables and chi-squared tests, as well as correlation tests, is used to investigate whether a relationship and correlation between the variables exists for children under the age of five years in Lesotho.

For stunting (height-for-age) malnourished children are classified as those children at a SD of -2, severely malnourished children are classified as those with a SD of -3 and less, and those considered nourished are all children above a SD of -2. For purposes of the multinomial logistic regression for stunting, nourished children act as a reference category, malnourished children are given a value of 1 and severely malnourished children a value of 2. On the other hand, for wasting (weight-for-height) and underweight (weight-for-age) malnourished children are classified as those children at a SD of -2 or less, and nourished children as those of a SD above -2. For purposes of each logistic regression (for wasting and underweight), nourished children act as the reference category, and malnourished children are given a value of 1.

Although parity order is the main explanatory variable under investigation, it has been established through a review of available literature that a number of other socio-economic and demographic variables may influence the affect that a child's parity order may have on their nutritional status. All children in the height and weight dataset, that have a corresponding parity order, are included in the sample for this study.

3.2 Source of Data and Study Design

3.2.1 The 2004 Lesotho Demographic and Health Survey

With the use of data from the 2004 Lesotho Demographic and Health Survey (LDHS) the children's, household and weight and height recode datasets were used to conduct an event history survival analysis. The anthropometric indicators, provided by the Height and Weight DHS dataset, as well as the household and women's recode data sets were merged. Together these indicators and the socio-demographic variables were included in a univariate and bivariate analysis, as well as in a multinomial logistic (for stunting) and logistic (for wasting and underweight) regression model in order to assess the probability of child malnutrition

The 2004 LDHS is the latest DHS conducted for this small country embedded in South Africa. The 2004 LDHS is part of a worldwide MEASURE DHS project funded by the Government of Lesotho, Development Cooperation Ireland (DCI), the World Bank, UNICEF, DFID, WHO and the USAID's regional HIV/AIDS Programme. The objective of the survey was to collect population-based data to inform health sector reform in Lesotho since 2000. The Lesotho Ministry of Health and Social Welfare, in collaboration with the Lesotho of Bureau of Statistics implemented the programme, with technical assistance provided by MEASURE DHS (Ministry of Health and Social Welfare 2005: 3).

3.2.2 Sample Size

The complete sample for the 2004 LDHS was conducted on a household population of 9000 households. Households were then systematically selected for participation in the survey. All women of reproductive age who were either permanent household residents in the 2004 LDHS sample or visitors present in the household on the night before the survey were eligible to be interviewed. Height and weight measurements were taken for eligible women and their children who were under five years of age (Ministry of Health and Social Welfare 2005: 3). This study included a sample of roughly 1700 cases.

3.2.3 Data Processing

In order to get all the required variables, three LDHS datasets were merged, namely the household, women's and weight and height recode datasets. Once the three datasets were merged into the *Lesotho under-five children's dataset* the variables that were not needed for the study were deleted and only the relevant dependant and independent variables were retained. The wealth index was calculated, and each independent variable was then placed in relevant intervals. The standard deviations in each anthropometric measure were used to create categorical values, for purposes of the logistic regressions (wasting and underweight) and for the multinomial logistic regression (stunting).

3.2.6 Study Population

For purposes of this study only those children reported in the sample by their mothers are included, and the following characteristics of the study population should be taken into account:

- All children under 60 months of age in the LDHS 2004 were included and a child file was created.
- As the DHS only includes the anthropometric measures of those children whose mothers are interviewed, as well as those children whose measures are considered correct and viable, the sample size includes fewer than 2000 children. Thus, all children in the Height and Weight DHS dataset were used. Children were identified through their *caseid* in the height and weight DHS dataset, and then merged both with the women recode dataset and household recode dataset in order to be able to investigate all the required variables for the study. Once all three datasets had been merged a total of 1763 children were included in the sample.
- Each index child in the dataset will be considered as an exposure case.

3.3 Variables in Data Analysis

A definition of each term is provided for each of the variables concerned.

3.3.1 Independent Variables

- Parity order - The numerical order of a live birth, recorded in relation to all previous live births of the mother, whether pregnancies were nuptial or extra-nuptial (OECD *undated*). For purposes of this study the lowest parity order found was 1 and the highest parity order of any child in the sample was 12. Intervals, however, were created for ease of interpretation. The first interval were those children born at parity 1 and 2, the second at parity 3 and 4, the third at parity 4 and 6, and the final interval were all those children born at parity 5 or higher as there were a low total number of children born at parity higher than 4.
- Birth interval between the index child and the sibling that preceded their birth - The DHS data shows this information in months, thus intervals in years were calculated. The first interval are all children born within 0-24 (or 0-2 years) months of their preceding sibling, the second between 3 and 7 years, and the final interval as all children born at more than 7 years after their preceding sibling.
- Mother's educational status - The DHS data provides an educational status of the mother variable divided into no education, primary, and secondary and higher than secondary.
- Number of children in the household – This independent variable is divided into those children living with no other children in the household, those living with 1 or 2 other children, those living with 3 or 4 other children, those living with 4 or 6 other children, and finally those living with more than 7 other children in the household.
- The mother's age at birth of the index child - A categorical and numerical variable, whereby the mother's age is shown in equal intervals of three years from the age of 18 (the youngest age in the LDHS) until 47 years (the oldest age in the LDHS).
- Whether the child lives in an urban or rural area - Whereby if the child lives in a rural area is assigned the value of 0, and for urban areas is assigned the value of 1.

- Household Wealth Indicator – An asset index is used with equal weighting of assets found in the household, such as a television, fridge, and so on. Each asset is given a value of one, and the total number of assets is added. The higher the number of total assets within the household, the higher the number of the wealth index allocated to the household. Thus, those with a wealth index of 0 are classified as "very poor", wealth index of 1 as "poor", a wealth index between 2 to 4 as "average", and a wealth index of 5 and more as "wealthy".
- The age of the index child is controlled for in the anthropometric indices

3.3.2 Dependent Variable

- Nutritional Status of the Child – Good nutrition incorporates macro- and micronutrients in sufficient and balanced quantities (Kibel et al. 2003: 153). For the study, nutritional status, and thus sufficiency of macro- and micronutrient intake, is assessed with the use of the World Health Organisation's (WHO) recommended score indicators of anthropometric measures, in which a standard deviation (SD) of -2 from the median identifies those who are malnourished, and a SD of -3 from the median identifies those who are severely malnourished (Som et al. 2004: 627), for those children that are stunted. Due to the low number total number of children found to be either nourished or malnourished according to the wasting and underweight anthropometric measures, these two categories are combined for the weight-for-height and weight-for-age indicators. As such, for wasting and underweight a SD of -2 and below from the median identifies those that are malnourished. For stunting, wasting and underweight, all those with a SD of over -2 from the median of the WHO reference population are classified as nourished. Nutritional status includes the investigation of the following three key anthropometric indicators:
  1. *Height-for-age* or the anthropometric measure for stunting. Height-for-age reflects the long-term consequences of malnutrition and is shown as deficits in linear growth.
  2. *Weight-for-height* and measures whether children under the age of five are wasted. Wasting occurs as a result of a recent but severe process of significant weight-loss.

3. *Weight-for-age*, which is a composite indicator of the first two anthropometric measures. Weight-for-age leads to children being underweight due to the influence of both the height and weight of the child, measured according to their chronological age.

In general there are three ways in which child anthropometric measures can by analysed; the reporting systems include z-scores, percentiles and percentage from the median (WHO Technical Report #854 1995: 7). However, to facilitate the analysis the z-scores will are the reporting system of choice with the use of the WHO standard reference population as the standard population to which the z-scores are compared. The WHO standard reference population was chosen as the standard as it is universally accepted and fulfills all the criteria stipulated by the WHO for a reference population. These include that the sample should include at least 200 individuals in each age and sex group; that the sample should be cross-sectional; that sampling measures should be defined and reproducible; that measurements should be carefully made and recorded by observers trained in anthropometric techniques, using equipment of well-tested design and calibrated at frequent intervals; and finally that measurement made on the sample must include all the anthropometric variables that will be used in the evaluation of child nutritional status (WHO Technical Report # 854 1995: 31-32).

There are also a number of DHS protocols in developing the anthropometric measures that one must be aware of when analysing these indices. For children of less than 60 months, their height/length is measured to the nearest 0.1 cm – a measuring board is used to measure the child's recumbent length (length when the child is lying down) for children less the 24 months and their standing length or stature for children over the age of 24 months (Zuguo & Grummer-Strawn 2007: 425). One caveat, however, that has been found in calculating the anthropometric measures is that there is a slight disjuncture with results, the prevalence of weight-for-height and height-for-age drops abruptly at 24 months (or from the transition of weight for length to weight for stature). This effect is seen more in a malnourished population since a larger proportion of children are found at the lower extreme of the distribution. (Dibley, Staehling et al. 1987: 752). These authors, however, do say that though this distortion may greatly exaggerate the impression of nutritional risk among children, the group in greatest need of an intervention will probably still be identified (Dibley, Staehling et al. 1987: 758). The second WHO protocol is that weight must be measured to the nearest 0.1 kg on a pediatric scale or other beam balance scale; and that then the 2 measurements of child's length and weight must agree within 0.1 cm and 0.1kg respectively (Zuguo & Grummer-Strawn 2007: 425).

Therefore, for purposes of this study the Height and Weight DHS dataset includes anthropometric indices computed on the basis of height, weight, age and sex of the index child. The standard deviations (SD) are computed according to the WHO recommendation of the use of z-score indicators of the National Center for Health Statistics (NCHS) reference population (Som et al. 2003: 627). Three indices are used to assess the nutritional status of the child, namely height-for-age (stunting), weight-for-height (wasting), and weight-for-age (underweight). Though the literature does suspect that weight-for-age (underweight) is a poor indicator for the growth in older children and adolescents (Kibel et al. 2003: 51), this indicator is still included and used as the age range in the study cuts across early and into later childhood.

3.4 Hypotheses

Null Hypothesis:

There is no difference in under-five children's nutritional status relative to their parity order.

Alternative Hypothesis 1:

Younger children of higher parity order have a disadvantaged nutritional status relative to older children of lower parity order.

Alternative Hypothesis 2:

Older children of lower parity order have a disadvantaged nutritional status relative to younger children of higher parity order.

3.5 Ethical Considerations

The study is a secondary analysis performed with the use of the 2004 LDHS, and thus no approval from an ethics review board was necessary.

3.6 Data Management

Three datasets were used in this study, the women's recode, the household recode and the weight and height datasets. It was important that all three datasets are used, as no one dataset includes all variables necessary for investigation, analysis, and conclusions for this study. Once the datasets were merged, using Stata version 9 a 2004 Lesotho Child dataset was created in order for all statistical sets to be conducted.

3.7 Data Analysis

The first part of the data analysis that is conducted is a univariate analysis of the characteristics of the study population according to the variables used in the study. The univariate analysis is presented in the form of frequency tables, together with their relative frequencies. The second part of the analysis of the data is a bivariate analysis in which the relationship between each variable, in turn, is investigated and relationships are defined. The third and final section includes multivariate logistic regressions (for wasting and underweight) and a multinomial logistic regression (for stunting).

3.7.1 Anthropometric Measures

The z-score is calculated by subtracting the median reference value from the actual anthropometric value, and then dividing the answer by the SD (please refer to Appendix 1)

(Dibley, Staehling et al. 1987: 752). However, z-scores have already been calculated by the DHS and are given in the Height and Weight dataset file.

To analyse stunting the commonly used cut-off point of -2 standard deviations (SD) from the median is used to identify those who are malnourished, and a SD of -3 from the median to identify those who are severely malnourished, and 0 for those who are nourished (Som et al. 2003: 627).

For wasting and underweight, due to the small number of children in the malnourished and severely malnourished categories all these children are put into one category and a cut-off point of -2 standard deviations (SD) from the median is used to identify those who are malnourished.

Once these indices are computed and analysed, a multinomial logistic regression model is used to estimate the odds and estimated probabilities of being malnourished and severely malnourished in stunted children. A multinomial logistic regression is the most appropriate statistical method to use here, as the dependent variable – children's nutritional status – is categorical and there are more than two categories (Som et al. 2003: 628; Walters et al. 2006: 591; and Rajaram et al. 2003: 339). For wasting and underweight, all children malnourished or severely malnourished are combined into one category (malnourished). In order to analyse whether parity order, and the other socio-demographic variables, increase the chances of whether a child in Lesotho is malnourished logistic regression is used. For all the regression models the base category is whether children are classified as nourished.

3.7.2 Independent Variables

Furthermore, for each of the regressions, the variables used for analysis are parity order, mother's age at birth of the index child, whether the child lived in a urban or rural area, the wealth index of the household in which the child lives, the birth interval between the index child and their preceding sibling, and mother's educational level. The age of the index child is controlled for in the anthropometric indices, as they are included during their computation (Dibley, Staehling, et al. 1987: 752), and thus does not need to be included in the logistic and multinomial logistic regression models.

3.7.3 Multivariate Regression Models

In the first model (for both multinomial and logistic regression) a regression with the dependent variable and parity order is performed.

The second model then includes all independent variables except for parity order, and finally the third model for each regression includes all independent variables.

With the use of the three models for the regressions, the effect of parity order, as it is the main independent variable of interest, can be analysed. These models are performed with the use of the STATA/SE version 9 software.

Chapter 4: UNIVARIATE AND BIVARIATE ANALYSIS OF CHILDREN'S CHARACTERISTICS

Results in this chapter are presented in two separate sections. The first section looks at the characteristics of the children in the study according to the dependent and independent variables, through the use of frequency tables. The second section looks at the bivariate analysis, and the interactions between all the variables through an investigation of the results of two-way contingency tables and chi-squared tests.

4.1 Characteristics of the Under-Five Children in Lesotho

Frequency distributions were used for the univariate analysis of the variables used in the study. It was attempted that intervals were made neither too large nor too small so that results were both relevant and that no information was lost (Pagano & Gauvreau 2000: 12). The frequency tables provide a good indication of the overall picture of what the data look like. Also included in the frequency tables is the percentage, or relative frequency, of all intervals for each variable. As some of the variables had missing values, the frequency of each interval is able to be compared as not all the variables had equal counts in their absolute values, and therefore the value of *n* was somewhat different (Pagano & Gauvreau: 13-14).

Table 1 shows both the total number as well as the percentage of each category in all independent variables included in the study. The first variable is parity order, which for ease of calculation and interpretation and due to the high maximum numbered birth order (12), intervals were calculated. Unsurprisingly, as parity order increases both the n-value and the percentage of children at each parity order decreases, with over fifty percent of all children in the LDHS sample at parity one and two. Only about six percent of children were born at higher parity orders - from parity order seven through to twelve.

Similarly, as the birth interval increases, the number of children represented at each birth interval decreases. However, over 75% of all children in the LDHS were born between 3 and 7 years after their preceding sibling. A further 12% of children were born eight to eleven years after their preceding sibling.

The frequency distribution and relative frequency of total number of living children in the household simply shows how many children are living with the index child at the time that the LDHS was conducted, whether they are genetic siblings or not. A higher number of children within the household compete for both the mother's care as well as the resources available to the index child. Over half of children share their households with between one and two other children (58%), and over a third of children live with more than 3 children in the household.

The wealth index for each household was computed by placing equal weighting to the presence of certain "modern" equipment in the household, such as the presence of a telephone or car. Simply, the lower the number in the wealth index the poorer the household in terms of the computed wealth index. When looking at the wealth index we see that the majority of the children live in households that are classified as "very poor" and "poor", with almost 85% of all children living in a household with a wealth index score of either 0 or one. Only 278 of the children, in a total sample of 1785, lived in households with a total wealth index score of above 2.

Fifty percent of children were born to mothers between the ages of 19 and 26 years of age, and a further 15%, or 265 of the 1764 children sampled, were born to mothers between the ages of 27 and 30 years of age. The mother's age at birth of the index child (Figure 2) shows a relatively normal pattern if we look at the frequency and percentage distribution of children in each age interval of the mother. A low percentage of children were born to mothers at ages 15 to 19, with a peak in the early and mid-twenties and then decreasing steadily thereafter. However, caution must be taken when interpreting these results as simply by looking at the total number and percentage of children, provides no indication of the parity order that the child in each age interval is assigned to, and thus children born to mothers at higher or lower parity orders are not necessarily first births.

***Table 1:** Number and percentage of Children in each Independent Variable in the LDHS 2004*

	Number of Children	Percentage of Children
Parity Order (n=1761)		
1-2	993	56.39
3-4	456	25.89
5-6	203	11.53
7-12	109	6.19
Birth Interval between Index child and Preceding Sibling – in years (n=1153)		
0-2	112	9.66
3-7	903	77.84
8-19	145	12.50
Number of Living Children in the Household (n=1764)		
No other children	50	2.83
1-2 other children	1 034	58.62
3-4 other children	425	24.09
5-6 other children	186	10.54
More than 7 other children	69	3.91
Wealth Index of Household (n=1758)		
Very Poor (0)	824	46.87
Poor (1)	662	37.53
Average (2-4)	214	12.13
Wealthy (5 and above)	64	3.63
Children Living in Rural and Urban Areas (n= 1764)		
Urban	408	23.13
Rural	1,356	76.87
Sex of Index Child (n= 1764)		
Male	907	51.42
Female	857	48.58
Educational Level of the Mother (n= 1764)		
No education	54	3.06
Primary	1,109	62.87
Secondary	581	32.94
Higher	20	1.13

The sex of the child did not show disparity in number or percentage, with both sexes representing roughly 50% of the children in the sample. The rural and urban disparity, on the other hand, does show a large difference, with under a quarter of all children living in urban areas. Finally, when we take into account the number of children born to mothers at each educational level (broken down into no education, primary, secondary and higher) we see that almost two thirds of the children were born to mothers with only a primary school education, and a further third of children born to mothers in the secondary education category.

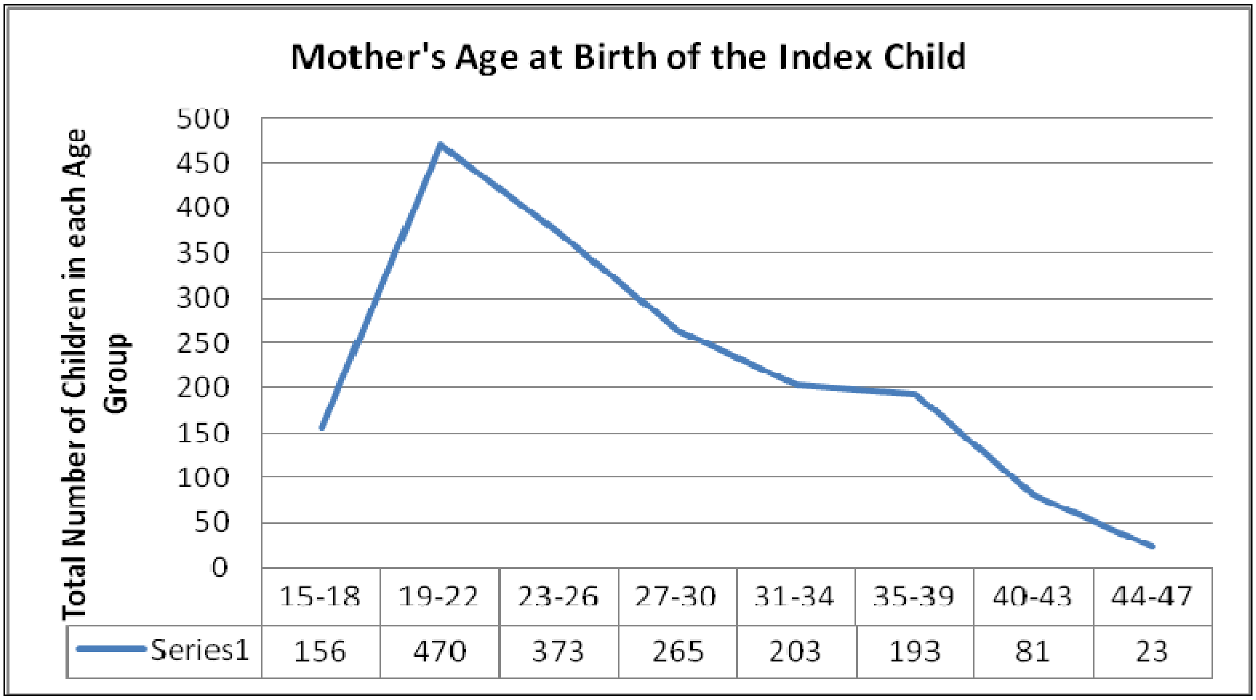

Figure 2: ***Total number of children born to mothers in each age group in the LDHS 2004 (n=1664)***

Table 2 presents the frequency of children represented in each of the dependent variables; namely weight-for-age (underweight), height-for-age (stunting) and weight-for-height (wasting).

Table 2: ***Number and percentage of Children in each Malnutrition Category in the LDHS 2004***

	Number of Children	Percentage of Children
Weight For Age - underweight (n=1758)		
Nourished	1,472	83.97
Malnourished	286	16.27
Height For Age - stunting (n=1758)		
Nourished	964	54.84
Malnourished	448	25.48
Severely Malnourished	346	19.68
Weight for Height - wasting (n=1764)		
Nourished	1,673	94.84
Malnourished	91	5.16

Figure 3, 4 and 5 visually portrays the three anthropometric measures divided into the three WHO recommended categories, simply to show the distribution of children at each nutritional category for underweight, stunting and wasting respectively. As can be seen in these three figures, a larger number of children are either stunted or severely stunted; but lower numbers are underweight and severely underweight, and even less are wasted and severely wasted. Due to the small number of children classified as malnourished and severly malnourished in the wasting and underweight measures, these two categories are combined in Table 2. Although the pattern is more visually evident when looking at Figure 3, both Table 2 and Figure 3 show a large proportion of children who are, according to the weight-for-age or underweight anthropometric measure, as being nourished (83.97%). Roughly 16%, however, are classified as being malnourished and severely malnourished according to the underweight category, a combination measure of wasting and stunting.

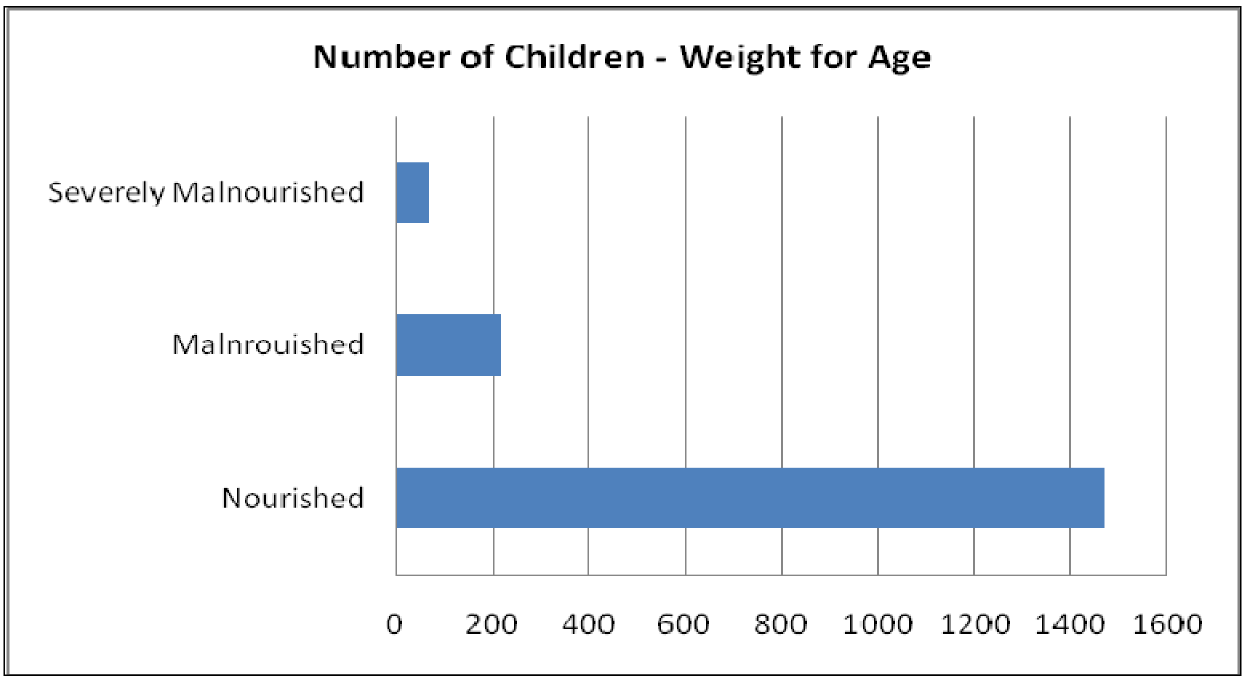

Figure 3: ***Total number of children in each nutritional status category for weight for age in the LDHS 2004(n=1758)***

Figure 4 (height-for-age) shows a different pattern to that which is shown in Figure 3. The number of children classified as malnourished and severely malnourished according to the stunting anthropometric measure is much greater than in the underweight category. Stunting measures the long-term effects of malnutrition, and thus the fact that a quarter of all children are stunted,and almost 20% are classified as severely stunted may be a reason for concern.

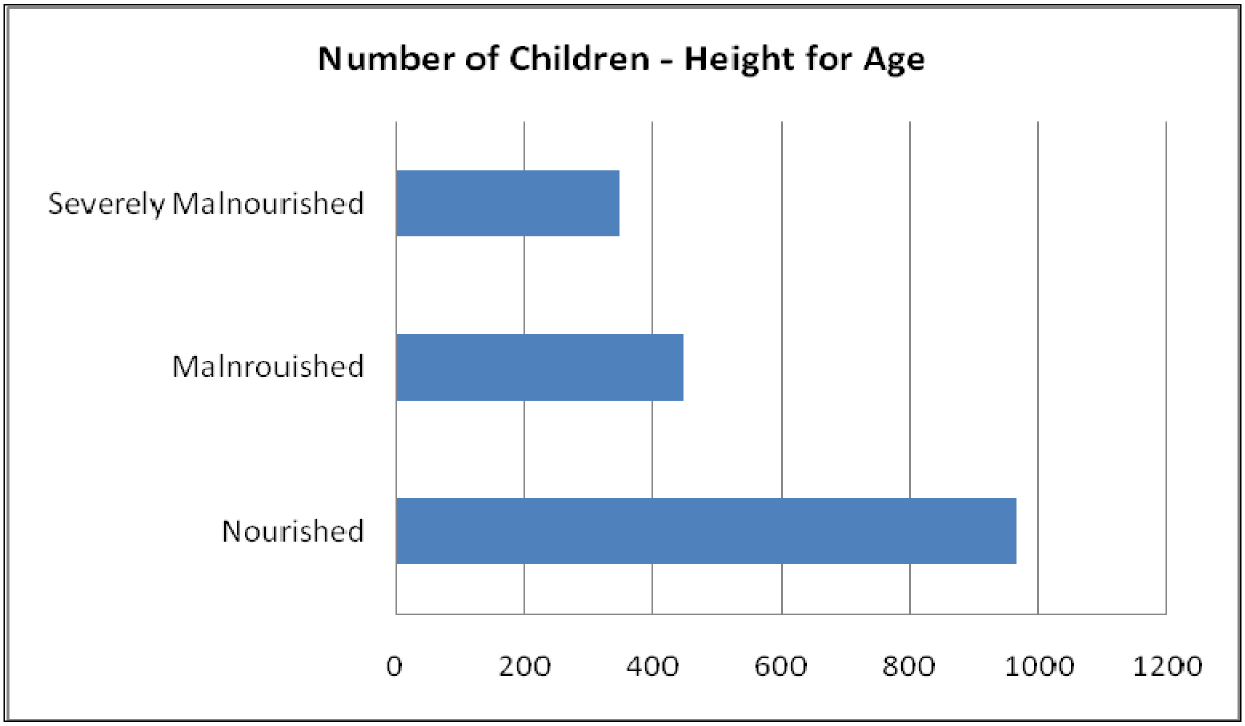

***Figure 4:* Total number of children in each nutritional status category for height for age in the LDHS 2004 (n=1758)**

Figure 5, at first glance, appears to show the same pattern as seen in the underweight (weight-for-age) category. However, Figure 5 shows the distribution of children in the weight-for-height, or the distribution of children who suffer from short-term malnutrition (wasting). Wasting appears to be far less common than stunting and underweight, with only a total of 5% of all children classified as either malnourished or severely malnourished according to the weight-for-height anthropometric measure.

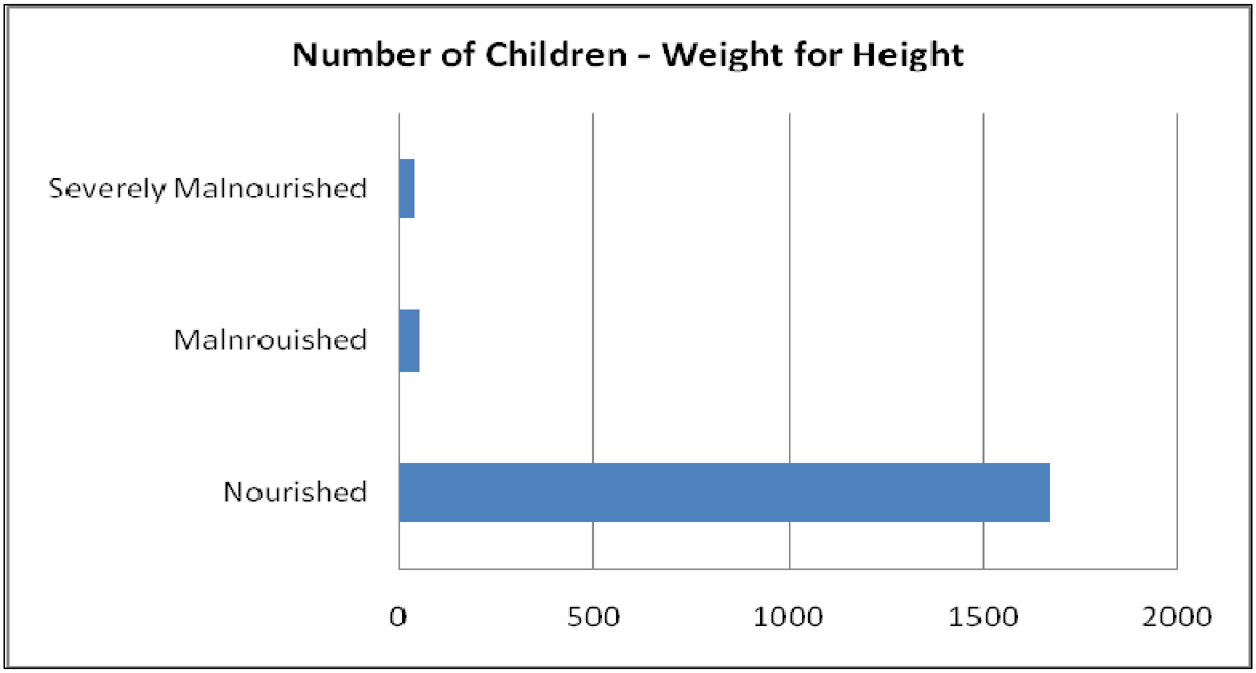

Figure 5: ***Total number of children in each nutritional status category for weight for height in the LDHS 2004(n=1764)***

However, it should be noted that for wasting and underweight, only in the above figures are these measures separated into the three nutritional categories (nourished, malnourished and severely malnourished). Due to the absolute number of children in the malnourished and severely malnourished categories for wasting and underweight being low, malnourished and severely malnourished children were combined into the "malnourished" category for all subsequent tests and results.

4.2 Bivariate Analysis

As part of the bivariate analysis, the correlation between the three anthropometric measures and the independent categorical variables was performed. At first a simple correlation with each anthropometric measure, with each independent categorical variable was performed as well as a correlation between the independent variables in turn. Once this had been done, a separate correlation analysis was run with each of the dependent variables and all the categorical independent variables together. The results did not differ between including each independent variable one by one, and placing them in the correlation all together. The only significant result was that parity order and the number of other children in the household had a correlation coefficient of 0.915. Thus, due to the high correlation between these two variables and the fact that parity order is the main independent variable of interest, the number of other children in the household was removed when the logistic and multinomial logistic regression models were performed.

The results of the correlation analysis run for each of the dependent variables, with all independent variables together, is shown in Table 3.

***Table 3:** Correlation of Independent Variables with the Anthropometric Measures in the LDHS 2004*

	Height For Age	Weight For Age	Weight For Height
Parity Order	-0.0355	-0.0618	-0.0159
Urban/Rural	-0.0330	0.0057	0.0173
Mother's age at Birth	0.0078	-0.0300	-0.0199
Number children in Household	-0.0207	-0.0592	-0.0153
Wealth Index	0.0161	0.0265	-0.0171

In Table 3, if we look at parity order, the relationship is negative with each. In other words, with all three anthropometric measures, as the birth order number of the child increases the standard deviation of the anthropometric measure increases. In other words, the higher the parity orders of the children, the worse their nutritional status.

Three surprising results, however, and which can be seen in Table 3 is whether the child lives in an urban or rural area (Urban/Rural), the mother's age at birth of the index child (Mother's age at birth), and the wealth index. One would assume that because the three anthropometric measures all measure the nutritional status of the child, that whether a relationship is negative or positive between the dependent and independent variables would be the same across all three anthropometric measures. However, for the independent variables "Rural/Urban", "Mother's age at birth" and "wealth index", this does not seem to be the case.

In the correlation between whether the child lives in an urban or rural area, and although the relationship is not linear with any of the three dependent variables, the relationship is positive only to the weight-for-age (underweight) and weight-for-height (wasting) measure but negative to the height-for-age (stunting) measure. In other words, if the child is stunted they predominantly live in a rural area, where the reverse is true for those children who are classified as wasted and underweight.

The opposite pattern is seen for the "Mother's age at birth" variable, whereby stunting probabilities of the child increases as the age of the mother at the birth of the index child increases, but wasting and underweight probabilities decrease as the age of the mother at birth of the index child increases. The wealth index follows the same pattern, thus as the wealth index increases stunting becomes a higher probability, yet once the wealth index increases wasting and underweight become less of a probability. However, much caution must be taken in interpretation of these results, as the correlation coefficient merely tells us whether the relationship between two variables is linear or not and the direction of the relationship, it does not specify whether the relationship is cause-and-effect (Pagano & Gauvreau: 402).

A number of contingency tables and chi-squared tests were performed in order to analyse the relationship between the independent and dependent variables in turn. The first few two-way contingency tables that were run measured the probability distributions between the dependent variables, and each of the independent variables in turn, to show the conditional probabilities of each category, whereby each distribution consists of the conditional probabilities of one variable, given the level of the other variable (Agresti 1996: 17).

As the main independent variable of interest, we first turn our attention to parity order, in relation to each of the dependent variables. Table 4 shows the results of the contingency table for parity order and each of the anthropometric measures, and column percentages are provided. Table 4 shows that at each parity order, over 50% of all children are nourished. However, in parity order 1 to 4, and parity orders over 7, more than a quarter of all children are malnourished. One in five children in parity orders 5 and 6 are also malnourished. In the severely malnourished category a more standard pattern is seen; except that those of parity orders 7 and over have a lower percentage of children who are severely malnourished than those of lower parity orders where roughly 1 in five children are found to be severely malnourished.

The majority of children, irrespective of their parity order are nourished according to the underweight measure. One pattern that is evident, however, is that the percentage of children who are malnourished decreases as parity order increases.

***Table 4:** Contingency Table and Chi-Squared test for Parity Order vs. the Anthropometric Measures in the LDHS 2004*

		Parity Order			
Height for Age		1-2	3-4	5-6	7-12
	Nourished				
	N	527	251	118	65
	%*	53.18	55.16	58.71	60.19
	Malnourished				
	N	266	116	40	26
	%*	26.84	25.49	19.9	24.07
	Severely Malnourished				
	N	198	88	43	17
	%*	19.98	19.34	21.39	15.74
Pearson chi2 (6) = 6.0914	Pr = 0.413				
Weight for Age					
	Nourished				
	N	814	382	175	99
	%*	82.22	84.14	86.63	90.83
	Malnourished				
	N	176	72	27	10
	%*	17.78	15.86	13.32	9.17
Pearson chi2 (3) = 6.9965	Pr = 0.072				
Weight For Height					
	Nourished				
	N	940	435	189	107
	%*	94.66	95.39	93.1	98.17
	Malnourished				
	N	53	21	14	2**
	%*	5.34	4.61	6.9	1.83
Pearson chi2 (10) = 20.9758	Pr = 0.021				

*=percentage of children nourished/malnourished at each parity order
**=number too small to be statistically significant

The contingency table results for parity order and weight-for-height (wasting), a similar pattern that was observed for underweight is evident. However, the difference is that for wasting although at parity orders 7 and above, far less children are malnourished, the same distinctive pattern where the percentage of children who are malnourished increases as parity order increases is not seen in wasting as is seen in the underweight children. Caution must be taken, however, in interpreting this as the absolute number of children who are classified as malnourished in the wasting measure is too small to be statistically significant.

Table 5: Contingency Table and Chi-Squared test for Weight for Age vs. Weight for Height in the LDHS 2004 (n=1758)

	Weight For Age	
Height For Age		
	Nourished	**Malnourished**
Nourished		
n	922	40
%*	62.89	13.99
Malnourished		
n	365	81
%*	24.90	28.32
Severely Malnourished		
n	179	165
%*	12.21	57.69

Pearson chi2 (2) = 357.4767 Pr = 0.000
*=percentage of children nourished/malnourished/severely malnourished at each weight for age category

Two-way contingency tables were also done for the three anthropometric measures and all other independent variables, and each of the dependent variables in turn. Weight-for-age (underweight) showed a statistically significant result with height-for-age (stunting) (Table 5), and weight-for-height (wasting) showed a statistically significant result with weight-for-age (underweight). In Table 5 we see over half of all children who are severely malnourished in the

Table 6: Contingency Table and Chi-Squared test for Weight for Height vs. Weight for Age in the LDHS 2004 (n=1758)

	Weight For Height	
Weight For Age		
	Nourished	**Malnourished**
Nourished		
n	1441	31
%*	86.39	34.44
Malnourished		
n	227	59
%*	13.61	65.56

Pearson chi2 (10) = 5.8929 Pr = 0.207

*=percentage of children nourished/malnourished/severely malnourished at each weight for height category

stunting measure, are also malnourished in the underweight measure. Similarly, 66% of children are classified both as malnourished in the underweight and wasting measures (Table 6).

Although unsurprising, nearly 80% of all children that were in the malnourished and severely malnourished categories for height-for-age (stunting) lived in rural areas, and roughly the same amount either scored 0 (very poor) or 1 (poor) in the wealth index.

Figure 6 shows the percentage of children in rural and urban areas, according to whether they are nourished, malnourished or severely malnourished according to the stunting measure. In Figure 6 it is evident that, surprisingly, a higher percentage of children in the urban areas are both malnourished and severely malnourished than their rural counterparts.

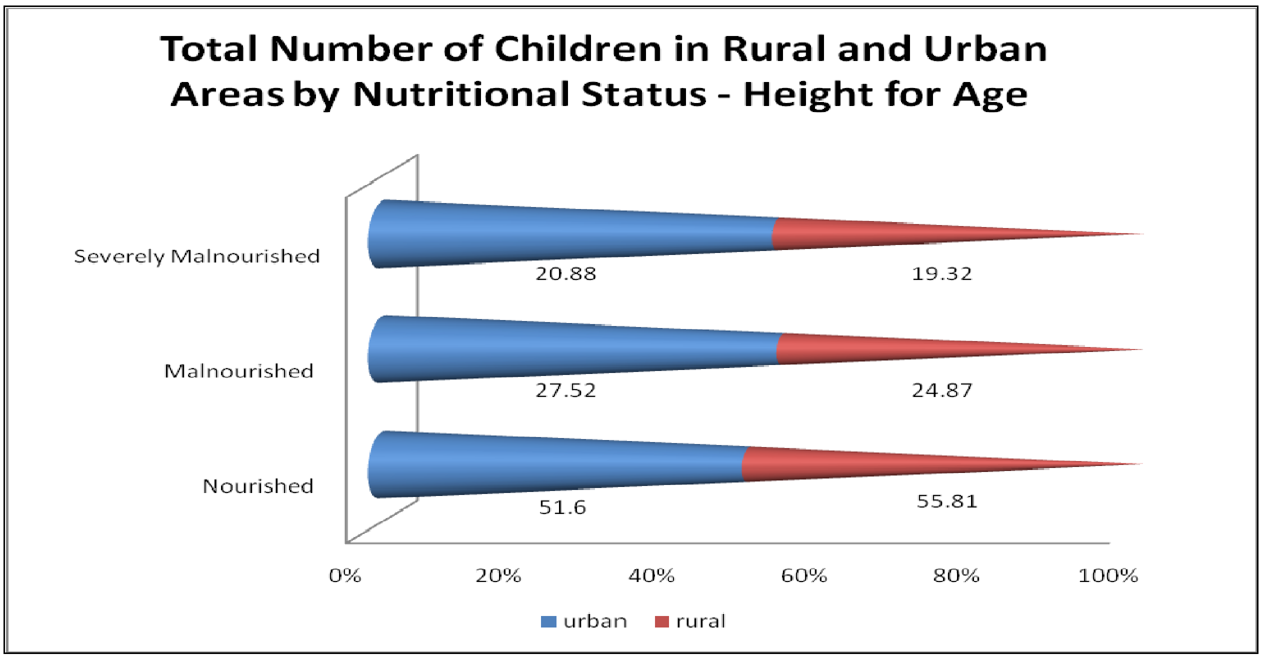

Figure 6: ***Total percentage of children in Rural and Urban Areas by Nutritional Status in the LDHS 2004 (Height for Age) (n=1758)***

A number of two-way tables were done for the dependent variables as well. In Figure 7 the total number of children by wealth index in urban areas is shown, and in Figure 8 the same results for rural areas can be seen. In comparing the two pie charts we notice that a much larger percentage of children in the lowest wealth index category are present in the rural areas, and a higher percentage of all other wealth index categories are present in the urban areas.

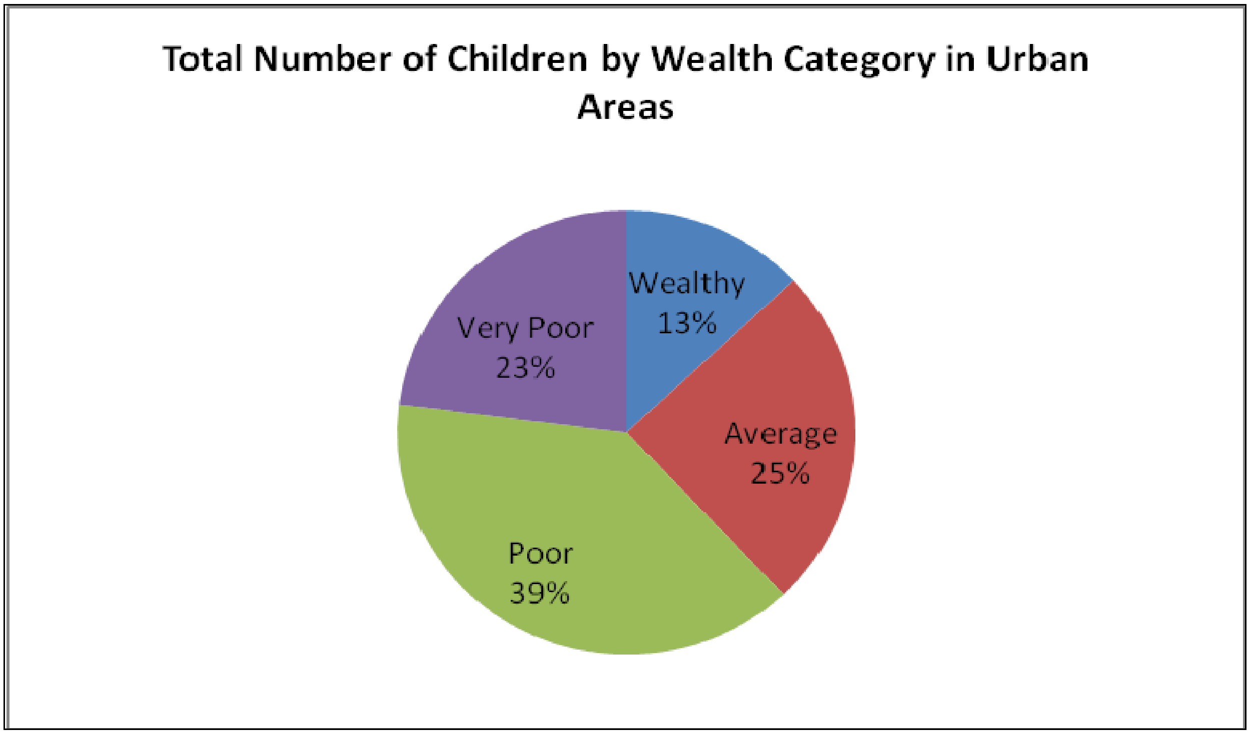

Figure 7: ***Total Number of Children at each Wealth Category in Urban Areas in the LDHS 2004 (n**=408)*

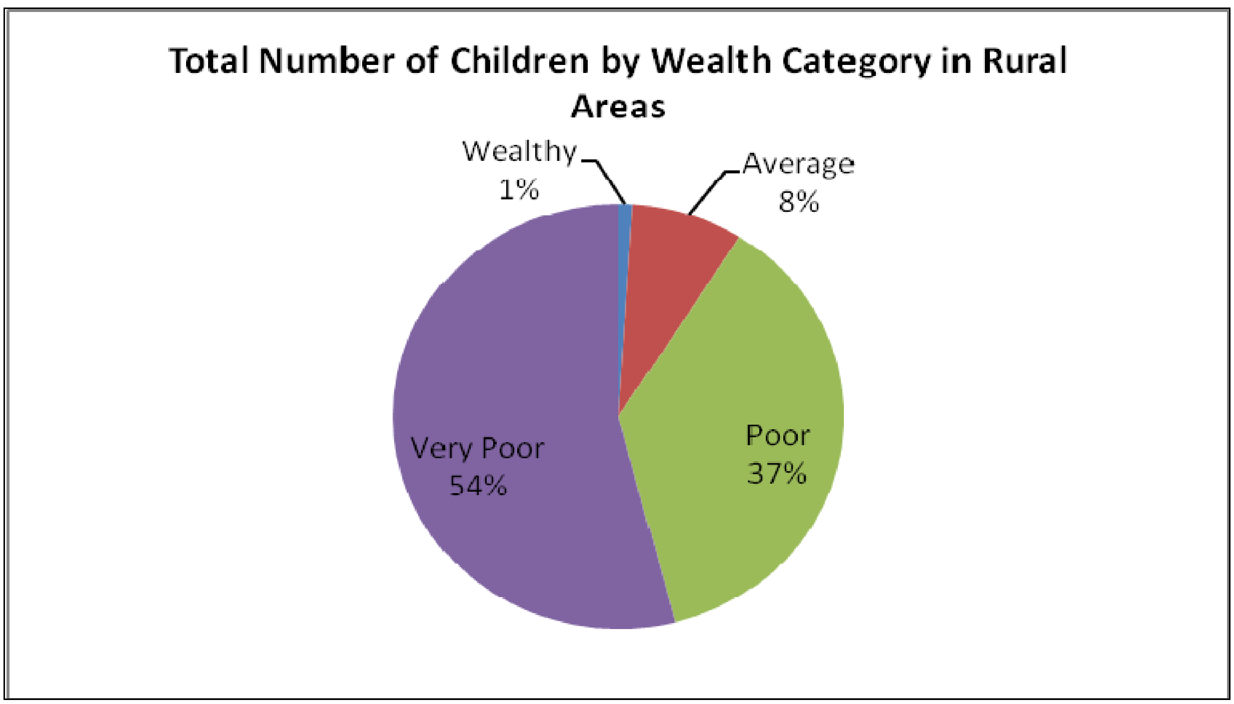

Figure 8: ***Total Number of Children at each Wealth Category in Rural Areas in the LDHS 2004 (n=1356)***

Figure 9 shows the number of children present in each wealth index category by their parity order. The highest numbers of children, at all parity orders are present in the 0 (very poor) and 1 (poor) wealth index category. However, at a wealth index of 0 (very poor), the parity order with the greatest number of children present is from parity orders 5 to 12; whereas at a wealth index of 1 (poor) parity orders 7-12 have the greatest number of children.

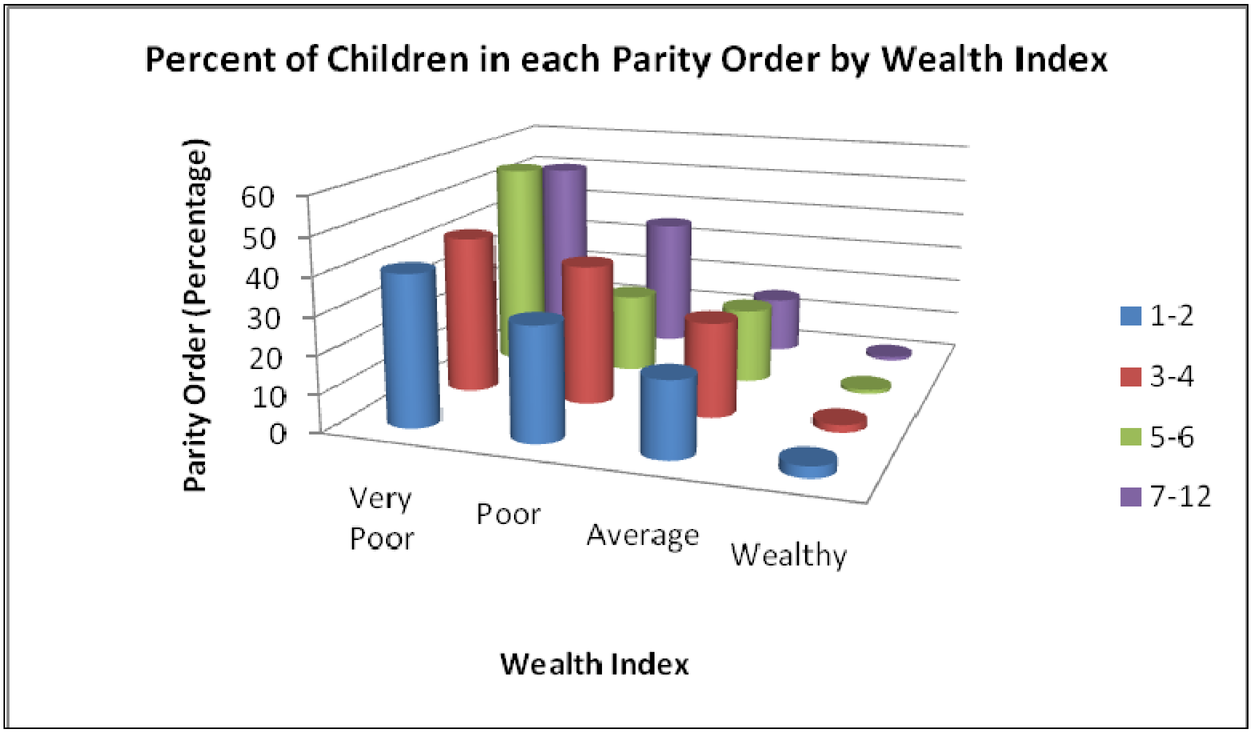

Figure 9: ***Percent of Children in each Parity Order by Wealth Index in the LDHS 2004 (n=1761)***

The bivariate analysis shows the same results as the literature, whereby the majority of children live in rural areas, belong to mothers of a lower educational status, and specifically that the majority of malnourished children live in rural areas.

<u>Chapter 5: MULTIVARIATE ANALYSIS OF CHILDREN'S NUTRITIONAL STATUS</u>

5.1 Introduction

This chapter is sub-divided into three separate sections. The first and second section explores the logistic regressions for weight-for-age (underweight) and weight-for-height (wasting). The third sub-section explores the multinomial logistic regression models for height-for-age (stunting). For the multinomial logistic and logistic regressions the base category for all anthropometric measures was whether children were classified as nourished, and were thus given the value of 0. For stunting the malnourished category, which is stipulated by the WHO standard as between a standard deviation (SD) of -1 and -2 of the reference population, were given a value of 1 and severely malnourished (SD of -3 and below) a value of 2. For wasting and underweight, and for purposes of the logistic regressions, due to the low number of cases that were malnourished and severely malnourished, those with a SD of -2 and below were classified as malnourished.

The multinomial logistic regression model estimate the probability of whether a child is classified to be in one of the nutritional categories for stunting, and as there are three categories (nourished, malnourished and severely malnourished) multinomial logistic regression was the most appropriate statistical method to measure these probabilities. On the other hand, as there were only two categories for wasting and underweight, logistic regression was more appropriate for these two anthropometric measures.

Furthermore, for each of the regressions, the variables used for analysis were parity order, mother's age at birth of the index child, whether the child lived in a urban or rural area, the wealth index of the household in which the child lives, the birth interval between the index child and their preceding sibling, and mother's educational level. Due to the high correlation between parity order and the number of children in the household, the latter independent variable was excluded from the multinomial logistic and logistic regressions. The age of the child is taken into account during the computation of the anthropometric measures and therefore did not have to be included in the regressions. In each regression (both multinomial logistic and logistic regressions) the first model included the dependent variable and parity order only. The second model for each regression then included all independent variables except for parity order, and the third and final model included all independent variables. This was done to measure the effect of parity order on the nutritional status of the child, both with and without the net effect of the other socio-demographic factors.

5.2 Logistic Regression for Weight-for-Age (underweight)

The parameter estimates of the logistic regressions for the first model for weight-for-age (underweight), in which only parity order is taken into account. No statistically significant results were found when looking at the p-value (not shown). However when looking at the odds ratio it was found that the probability of malnutrition according to the underweight measure is 47% in those children born at parity orders over 7, compared to those children of parity order 1 and 2.

Table 7 presents the parameter estimates of the second model in which all independent variables except for parity order are taken into account. According to the p-value, we again do not see any significant results. However, according to the odds ratio we find one result of significance. Surprisingly, those children born in households with a medium wealth index (a wealth index score of between 3 and 4 (average)) were found to have a 43% higher probability of being malnourished than those children born in the reference category where households are classified as “very poor”.

Finally, in Table 8, although the p-values do not show statistical significance at the 5% level, we do find that, again, those children born in households classified as “average” (wealth index score 3-4) according to the wealth index have a 41.4% higher probability of being malnourished than those children born in households that are very poor. Furthermore, when we turn our attention to parity order, according to the odds ratio, we also find a significant result in that both those children born at parity order 5-6 and those born at parity order over 7 have a higher probability of being malnourished compared to those children born at parity order 1-2 (48.3% and 28.4% respectively).

***Table 7:** Parameter Estimates for Model 2 of the Weight for Age Logistic Regression of Lesotho Children under the Age of 5 years*

	Odds Ratio	95%CI**	p-value
Mother's Age at Birth of Index Child			
15-18*	-	-	-
19-22	0.402	0.109 - 1.476	0.170
23-26	0.391	0.109 - 1.398	0.149
27-30	0.382	0.105 - 1.380	0.142
31-34	0.503	0.139 - 1.822	0.295
35-39	0.276	0.074 - 1.031	0.055
40-43	0.302	0.074 - 1.227	0.094
44-47	0.425	0.082 - 2.196	0.307
Wealth Index			
Very poor*	-	-	-
Poor	0.961	0.674 - 1.368	0.824
Average	0.427	0.209 - 0.874	0.020
Wealthy	0.656	0.209 - 2.061	0.471
Birth Interval between Index Child and Preceding Sibling			
0-2 years*	-	-	-
3-7 years	1.458	0.787 - 2.701	0.230
8-19 years	1.733	0.798 - 3.764	0.165
Whether Index Child Lives in a Rural or Urban Area			
Rural*	-	-	-
Urban	1.266	0.795 - 2.015	0.321
Educational Level of the Mother			
No education*	-	-	-
Primary	0.829	0.380 - 1.807	0.636
Secondary	0.844	0.366 - 1.945	0.690
Higher than secondary	0.651	0.067 - 6.311	0.711

*=reference category for the independent variables
**= CI means Confidence Interval
Nourished is the reference category
Significance at 5%

***Table 8:** Parameter Estimates for Model 3 of the Weight for Age Logistic Regression of Lesotho Children under the Age of 5 years*

	Odds Ratio	95%CI**	p-value
Parity Order			
1-2*	-	-	-
3-4	0.738	0.473 - 1.153	0.182
5-6	0.483	0.250 - 0.935	0.031
7-12	0.284	0.103 - 0.779	0.015
Mother's Age at Birth of Index Child			
15-18*	-	-	-
19-22	0.398	0.108 - 1.465	0.166
23-26	0.440	0.122 - 1.592	0.211
27-30	0.494	0.132 - 1.846	0.294
31-34	0.796	0.205 - 3.095	0.742
35-39	0.538	0.130 - 2.217	0.391
40-43	0.775	0.163 - 3.695	0.749
44-47	1.029	0.150 - 7.053	0.977
Wealth Index			
Very poor*	-	-	-
Poor	0.957	0.670 - 1.367	0.809
Average	0.414	0.202 - 0.848	0.016
Wealthy	0.625	0.199 - 1.963	0.421
Birth Interval between Index Child and Preceding Sibling			
0-2 years*	-	-	-
3-7 years	1.337	0.716 - 2.495	0.362
8-19 years	1.345	0.605 - 2.989	0.467
Whether Index Child Lives in a Rural or Urban Area			
Rural*	-	-	-
Urban	1.383	0.864 - 2.214	0.177
Educational Level of the Mother			
No education*	-	-	-
Primary	0.908	0.401 - 2.053	0.817
Secondary	0.848	0.354 - 2.032	0.712
Higher than secondary	0.609	0.062 - 6.018	0.672

*=reference category for the independent variables
**= CI means Confidence Interval
Nourished is the reference category

Significance at 5%

5.3 Logistic Regression for Weight-for-Height (wasting)

The parameter estimates of the logistic regression performed for the first model of the wasting anthropometric measure, in which only parity order is taken into account. Like the first model performed for the underweight measure, neither the p-value nor the odds ratio show a significant result (not shown).

In Table 9 the parameter estimates for model 2 are shown for the logistic regression for weight-for-height (wasting). Even though all the intervals for mother's age at birth of the index child show a significant p-value (p-value=0.000), the absolute values are too small to be statistically significant (not shown). Furthermore, not one of the odds ratios, together with their 95% confidence intervals shows any result which is significant.

***Table 9:** Parameter Estimates for Model 2 of the Weight for Height Logistic Regression of Lesotho Children under the Age of 5 years*

	Odds Ratio	95%CI**	p-value
Wealth Index			
Very poor*	-	-	-
Poor	0.906	0.500 - 1.642	0.744
Average	1.912	0.841 - 4.345	0.122
Wealthy	2.175	0.520 - 9.099	0.287
Birth Interval between Index Child and Preceding Sibling			
0-2 years*	-	-	-
3-7 years	4.001	0.952 - 16.812	0.058
8-19 years	1.340	0.210 - 8.535	0.757
Whether Index Child Lives in a Rural or Urban Area			
Rural*	-	-	-
Urban	1.625	0.751 - 3.514	0.217
Educational Level of the Mother			
No education*	-	-	-
Primary	0.543	0.179 - 1.647	0.281
Secondary	0.494	0.147 - 1.662	0.254
Higher than secondary	0.692	0.056 - 8.555	0.774

*=reference category for the independent variables

**= CI means Confidence Interval
***=numbers too small to be statistically significant
Nourished is the reference category
Significance at 5%

The same conclusion as in Table 9 can be found in Table 10, even when parity order is included in the multinomial regression. Neither of the parameter estimates shows a significant result and all cases in the mother's age at birth of the index child are too small to be significant (not shown).

Table 10: Parameter Estimates for Model 3 of the Weight for Height Logistic Regression of Lesotho Children under the Age of 5 years

	Odds Ratio	95%CI**	p-value
Parity Order			
1-2*	-	-	-
3-4	0.576	0.287 - 1.157	0.121
5-6	1.192	0.452 - 3.141	0.723
7-12	0.397	0.054 - 2.923	0.364
Wealth Index			
Very poor*	-	-	-
Poor	0.894	0.488 - 1.637	0.717
Average	1.901	0.835 - 4.329	0.126
Wealthy	2.026	0.481 - 8.536	0.336
Birth Interval between Index Child and Preceding Sibling			
0-2 years*	-	-	-
3-7 years	3.535	0.835 - 14.967	0.086
8-19 years	1.232	0.189 - 8.053	0.827
Whether Index Child Lives in a Rural or Urban Area			
Rural*	-	-	-
Urban	1.645	0.757 - 3.573	0.209
Educational Level of the Mother			
No education*	-	-	-
Primary	0.733	0.211 - 2.544	0.624
Secondary	0.638	0.166 - 2.452	0.513
Higher than secondary	0.906	0.067 - 12.249	0.941

*=reference category for the independent variables
**= CI means Confidence Interval
***=numbers too small to be statistically significant
Nourished is the reference category
Significance at 5%

5.4 Multinomial Logistics Regression for Height-for-Age (stunting)

Height-for-age, or stunting, measures the long-term consequences of a depletion of the essential micro- and macro-nutrients required in order for a child to remain healthy and well nourished. Table 11 shows the results of the parameter estimates of the multinomial logistic regression run for parity order (model 1). Table 12, on the other hand, shows the parameter estimates of the multinomial regression when all independent variables except for parity order are taken into account (model 2). Finally, Table 13 shows the final model in which the net effect of all independent variables in terms of their parameter estimates are shown.

In Table 11 the first result that is evident is that when parity order is the only independent variable, the results for any of the parity orders, according to the p-values, are not statistically significant for either those children who are malnourished or severely malnourished. The results from the relative risk ratio of whether a child of a certain parity order has a higher probability of being malnourished or severely malnourished relative to the reference category (parity order 1-2) gives the same result for all parity orders except for those children born at parity order 5-6, whom have a 67.2% higher probability of being malnourished than those children born at parity order 1-2.

<u>Table 11:</u> Parameter Estimates for the Multinomial Regression for the Height for Age of Lesotho Children under the Age of 5 years (Model 1)

	Malnourished			Severely Malnourished		
	Relative Risk	**p-value**	**95% CI****	**Relative Risk**	**p-value**	**95% CI****
Parity Order						
1-2*	-	-		-	-	
3-4	0.916	0.514	0.703 - 1.193	0.933	0.643	0.696 - 1.250
5-6	0.672	0.044	0.456 - 0.990	0.970	0.877	0.660 - 1.426
7-12	0.792	0.340	0.491 - 1.278	0.696	0.204	0.398 - 1.217

*=reference category for the independent variables

However, once all the other independent variables except for parity order are taken into account (model 2) as shown in Table 12, we find that even there is no statistical significance according to the p-value. However, mother's age at birth of the index child does show a significant result according to the odds ratio for five of the intervals, but only in the severely malnourished category. The probability of being severely malnourished increases by between 20.9% and 25.2% (ages 19 to 39) relative to the children born to mothers aged 15-18.

***Table 12:** Parameter Estimates for the Multinomial Regression for the Height for Age of Lesotho Children under the Age of 5 years (Model 2)*

	Malnourished			Severely Malnourished		
	Relative Risk	**p-value**	**95% CI****	**Relative Risk**	**p-value**	**95% CI****
Mother's Age at Birth of Index Child						
15-18*	-	-		-	-	
19-22	2.581	0.506	0.289 - 23.043	0.209	0.017	0.057 - 0.759
23-26	1.924	0.556	0.218 - 17.026	0.226	0.020	0.064 - 0.794
27-30	2.394	0.433	0.270 - 21.241	0.223	0.021	0.062 - 0.794
31-34	1.729	0.625	0.193 - 15.488	0.277	0.048	0.078 - 0.989
35-39	2.374	0.439	0.193 - 15.488	0.252	0.035	0.070 - 0.908
40-43	1.925	0.565	0.266 - 21.178	0.274	0.058	0.072 - 1.046
44-47	2.566	0.436	0.207 - 17.927	0.223	0.078	0.042 - 1.180
Wealth Index						
Very poor*	-	-		-	-	
Poor	0.927	0.640	0.674 - 1.275	1.335	0.110	0.939 - 1.853
Average	0.884	0.619	0.545 - 1.435	1.319	0.645	0.498 - 1.540
Wealthy	0.547	0.193	0.220 - 1.358	0.876	0.983	0.398 - 2.564
Birth Interval between Index Child and Preceding Sibling						
0-2 years*	-	-		-	-	
3-7 years	1.393	0.217	0.823 - 2.356	0.907	0.707	0.544 - 1.512
8-19 years	1.698	0.116	0.878 - 3.286	1.104	0.771	0.567 - 2.149
Whether Index Child Lives in a Rural or Urban Area						
Rural*	-	-		-	-	
Urban	1.024	0.982	0.705 - 1.487	1.271	0.266	0.833 - 1.941
Educational Level of the Mother						
No education*	-	-		-	-	
Primary	0.995	0.988	0.477 - 2.075	1.560	0.322	0.647 - 3.761
Secondary	1.309	0.496	0.603 - 2.844	1.521	0.374	0.603 - 3.835
Higher than secondary	5.338	0.030	1.178 - 24.201	5.444	0.053	0.976 - 30.381

*=reference category for the independent variables

Finally, in Table 13 (model 3) we find a different pattern to what is shown in both model 1 and 2, in that although the p-values still do not show any significant results, the relative risk ratios for some of the parity orders and intervals for mother's age at birth of the index child (severely malnourished only) do show a probability of increased malnourishment in children under the age of five years in Lesotho. Firstly, those children of parity order 5-6 have a 55.4% higher probability of being malnourished than their 1-2 parity order counterparts.

<u>Table 13:</u> Parameter Estimates for the Multinomial Regression for the Height for Age of Lesotho Children under the Age of 5 years (Model 3)

	Malnourished			**Severely Malnourished**		
	Relative Risk	**p-value**	**95% CI****	**Relative Risk**	**p-value**	**95% CI****
Parity Order						
1-2*	-	-		-	-	
3-4	0.875	0.506	0.591 - 1.296	0.798	0.306	0.517 - 1.230
5-6	0.554	0.049	0.308 - 0.997	0.653	0.172	0.354 - 1.204
7-12	0.582	0.189	0.259 - 1.305	0.307	0.010	0.125 - 0.755
Mother's Age at Birth of Index Child						
15-18*	-	-		-	-	
19-22	2.626	0.388	0.294 - 23.454	0.210	0.018	0.057 - 0.766
23-26	2.095	0.507	0.236 - 18.631	0.251	0.033	0.070 - 0.897
27-30	2.846	0.351	0.316 - 25.619	0.273	0.052	0.074 - 1.010
31-34	2.397	0.441	0.259 - 22.187	0.386	0.165	0.101 - 1.482
35-39	3.715	0.250	0.397 - 34.794	0.426	0.226	0.107 - 1.697
40-43	3.196	0.325	0.315 - 32.395	0.656	0.580	0.147 - 2.925
44-47	5.649	0.174	0.467 - 68.392	0.788	0.802	0.122 - 5.079
Wealth Index						
Very poor*	-	-		-	-	
Poor	0.931	0.663	0.676 - 1.283	1.347	0.088	0.957 - 1.896
Average	0.873	0.585	0.537 - 1.420	0.861	0.603	0.489 - 1.516
Wealthy	0.542	0.187	0.218 - 1.347	0.981	0.968	0.385 - 2.499
Birth Interval between Index Child and Preceding Sibling						
0-2 years*	-	-		-	-	
3-7 years	1.339	0.282	0.787 - 2.276	0.833	0.491	0.496 - 1.400
8-19 years	1.447	0.288	0.732 - 2.858	0.869	0.690	0.435 - 1.735

Whether Index Child Lives in a Rural or Urban Area						
Rural*	-	-		-	-	
Urban	1.089	0.659	0.746 - 1.590	1.364	0.156	0.888 - 2.095
Educational Level of the Mother						
No education*	-	-		-	-	
Primary	0.947	0.885	0.450 - 1.990	1.531	0.345	0.633 - 3.705
Secondary	1.182	0.677	0.539 - 2.594	1.392	0.486	0.548 - 3.534
Higher than secondary	4.607	0.049	1.005 - 21.119	4.906	0.072	0.870 - 27.679

*=reference category for the independent variables

On the other hand, those children of parity order over 7 have a 30.7% higher probability of being malnourished relative to those children born at parity order 1-2. When our attention is turned to the mother's age at birth of the index child, we find that when mothers are between 19-22 years and 23-26 years children have a higher probability of being malnourished (21% and 25.1% respectively) than those children born to mother's at ages 15-18.

However, the results of estimated probabilities are often not straight forward (Zulu & Chepngeno 2003: 257) and, thus, Table 14, 15 and 16 show the results of the estimated probabilities for the same multinomial logistic regressions as 11, 12 and 13 respectively. The probabilities are calculated for each covariate, while holding the remaining factors at their mean values. In Table 14 (model 1) we see that at each parity order more than 50% of children are nourished, according to the stunting anthropometric measure. However, as parity order increases both the probability of being severely malnourished increases while the probability of being malnourished decreases.

Table 14: ***Estimated Probabilities for the Multinomial Regression for the Height for Age of Lesotho Children under the Age of 5 years (Model 1)***

Independent Variable	**Dependent Variable**		
	Nourished	**Malnourished**	**Severely malnourished**
Parity Order			
1-2	0.531	0.268	0.201
3-4	0.556	0.249	0.196
5-6	0.580	0.230	0.190
7-12	0.604	0.212	0.184

*=reference category for the independent variables

As seen in Table 15 (model 2), mother's age at birth of the index child shows no evident pattern for those children who are malnourished. However, the opposite is true for children who are severely malnourished. For the severely malnourished category, as age of the mother increases, severe malnutrition increases as well, whereas for the malnourished category the probability of malnourishment increases steadily for children born to mothers between the ages of 15 to 39, and then decreases again thereafter.

The wealth index and whether children are born in rural or urban areas shows a surprising pattern. In the wealth index we find that, although children born in households classified as being poor or average have a higher probability of being severely malnourished than those in households that are very poor, they also have a higher probability of being malnourished compared to those children born in households that are wealthy. In the malnourished category, however, children born in households that are poor and wealthy have a higher probability of being malnourished compared to their very poor and average counterparts.

Children in rural areas have a higher chance of being malnourished (26.2%) compared to those children in urban areas (24.1%). However, children in urban areas (20.3%) have a higher chance of being severely malnourished than the children born in rural areas (17.1%).

Two further surprising results are shown in Table 15. The birth interval between the index child and their preceding sibling also shows an unexpected result, in that as the birth interval increases so does the probability of children being malnourished and severely malnourished. Educational level of the mother, in the severely malnourished category, corresponds to the results shown in the literature reviewed in that as educational level increases the chance that a child will be severely malnourished decreases. However, the opposite is true with the malnourished category, according to the stunting (height-for-age) anthropometric measure.

Table 15: ***Estimated Probabilities for the Multinomial Regression for the Height for Age of Lesotho Children under the Age of 5 years (Model 2)***

Independent Variable	Dependent Variable		
	Nourished	Malnourished	Severely malnourished
Mother's Age at Birth of Index Child			
15-18	0.580	0.235	0.185
19-22	0.576	0.237	0.187
23-26	0.563	0.245	0.192
27-30	0.556	0.249	0.195
31-34	0.551	0.251	0.197
35-39	0.547	0.251	0.201
40-43	0.551	0.242	0.207
44-47	0.562	0.226	0.212
Wealth Index			
Very poor	0.560	0.247	0.193
Poor	0.558	0.244	0.198
Average	0.553	0.248	0.199
Wealthy	0.563	0.245	0.192
Birth Interval between Index Child and Preceding Sibling			
0-2 years	0.604	0.202	0.194
3-7 years	0.559	0.245	0.196
8-19 years	0.517	0.286	0.197
Whether Index Child Lives in a Rural or Urban Area			
Rural	0.568	0.262	0.171
Urban	0.556	0.241	0.203
Educational Level of the Mother			
No education	0.618	0.189	0.193
Primary	0.571	0.233	0.196
Secondary	0.525	0.280	0.195
Higher than secondary	0.484	0.325	0.190

*=reference category for the independent variables

Table 16 (model 3) shows the net effect of the independent variables when all of them are included into the multinomial logistic regression for stunting. For parity order, the same effect is seen as when parity order is the only independent factor taken into account. In other words, as parity order increases, the chances of being either malnourished or severely malnourished decrease as well. Likewise, mother's age at birth of the index child is not affected by whether

Table 16: ***Estimated Probabilities for the Multinomial Regression for the Height for Age of Lesotho Children under the Age of 5 years (Model 3)***

Independent Variable	Dependent Variable		
	Nourished	**Malnourished**	**Severely malnourished**
Parity Order			
1-2	0.538	0.261	0.201
3-4	0.555	0.248	0.196
5-6	0.579	0.231	0.191
7-12	0.600	0.213	0.187
Mother's Age at Birth of Index Child			
15-18	0.607	0.222	0.171
19-22	0.580	0.235	0.185
23-26	0.564	0.244	0.192
27-30	0.551	0.251	0.198
31-34	0.549	0.252	0.199
35-39	0.544	0.253	0.203
40-43	0.553	0.242	0.206
44-47	0.541	0.237	0.222
Wealth Index			
Very poor	0.558	0.248	0.194
Poor	0.558	0.244	0.198
Average	0.551	0.249	0.200
Wealthy	0.558	0.247	0.194
Birth Interval between Index Child and Preceding Sibling			
0-2 years	0.596	0.206	0.198
3-7 years	0.560	0.245	0.195
8-19 years	0.513	0.288	0.199
Whether Index Child Lives in a Rural or Urban Area			
Rural	0.568	0.262	0.171
Urban	0.554	0.242	0.203
Educational Level of the Mother			
No education	0.607	0.194	0.199
Primary	0.570	0.234	0.196
Secondary	0.525	0.280	0.195
Higher than secondary	0.484	0.326	0.190

*=reference category for the independent variables

parity order is taken into account or not. Again, as in model 2, for the severely malnourished category, as age of the mother increases, severe malnutrition increases, whereas for the malnourished category the probability of malnourishment increases steadily for children born to mothers between the ages of 15 to 39, and then decreases again thereafter.

Furthermore, none of the other independent variables' probabilities of malnutrition or severe malnutrition change when parity order is taken into account. For all the remaining independent variables, the exact same pattern as was seen in model 2 is shown.

In the multivariate analysis, only stunting was found to have a significant result when parity order, and the other socio-demographic factors, were taken into account.

Chapter 6: DISCUSSION AND CONCLUSION

This study has investigated the relationship between under-five children in Lesotho's nutritional status and whether parity order and other socio-demographic variables do in fact increase the chance of these children being stunted, wasted or underweight. Various studies of nutritional status and various socio-demographic variables were reviewed. However none showed results of how parity order, in particular, has been shown to influence nutritional status of children under the age of five years in Lesotho or in any sub-Saharan African country. Birth order, and its influence on nutritional status has been extensively explored in India and other Asian countries, although due to the different contextual milieus they did not provide an exact indication of what would be found in Lesotho.

The study found that 50% of children in Lesotho are of parity order 1 and 2, and only a small percentage (17%) is of higher parity orders (seven and above). However, this seems to be consistent with the findings of the Lesotho Ministry of Health and Social Welfare in 2005, in that it was reported that Lesotho has the lowest Total Fertility Rate (TFR) in sub-Saharan Africa (Ministry of Health and Social Welfare: 9-10). One could argue that a disproportionate number of young mothers could have participated in the LDHS in 2005. The fact that the mother's age at birth of the index child is concentrated in the ages of 19 and 30 years (65%) and then steadily decreases thereafter, that the majority of children live with only between 0 and 3 other children in the household, and that the greatest number of children had between four and seven years between themselves and their preceding sibling makes this scenario highly unlikely.

Another finding that is consistent with what was found by the Lesotho Ministry of Health and Social Welfare is that, although Lesotho shows a low overall number of births at higher parity orders, there is a large rural-urban disparity in the TFR. In this study it was found that only a quarter of all children who participated in the 2004 LDHS lived in urban areas, whereas the remaining 75% of children were all concentrated in the rural areas of Lesotho. A further finding is that, according to the computed wealth index, 80% of all households are classified as extremely poor (with a wealth index score of 0 or 1); only 27 of the children lived in households where the wealth index score was above 5 (wealthy).

Educational level of the mother also showed a large disparity, whereby mothers with a primary educational attainment had two-thirds of all children surveyed, and mothers with a secondary educational attainment had a further one-third. The proportion of mothers that had no education or above secondary education was minimal. Therefore, although mothers are not uneducated, it is unknown whether primary education in Lesotho is sufficient to have a positive and beneficial effect on their children's nutritional well-being.

The anthropometric measures showed great disparity in terms of total number and percentage of children in each nutritional level. Weight-for-height, or wasting, showed that only 3.01% of children in Lesotho are classified as wasted and a further 2.10% are classified as severely wasted. However, once we turn our attention to stunting, which measures the short-term effects of a lack of essential micro- and macronutrients in children, the numbers become slightly more alarming. Just over a quarter of all children are classified as stunted, and a further one in five children as severely stunted – these are very similar results to those found by El Tahir in a study he conducted in 2004 (*undated*: 1).

Although not as alarming, but still reason for concern, 12.3% of children under the age of five are underweight, and 3.65% are severely underweight. However, as this is a composite indicator, combining both stunting and wasting, much of the effect seen in weight-for-age in under-five children could largely be the effect of the large proportion of children who are stunted and severely stunted, which together constitute 40% of all children. The only anthropometric measure, however, that showed any significant results with the independent variables was height-for-age, or stunting.

Kauffman and Cleland (1994) established that each extra year of maternal education decreases the risk of under-five mortality and morbidity by between 2% and 9%. However, most women in Lesotho were found only to have a primary-school level of education, and one would think that this could account for the high number of children found to be stunted and severely stunted. In both the second and third model of the multinomial logistic regression, however, the mother's educational attainment did not show this pattern. In fact, and in general, malnourished and severe malnourishment had a higher probability of occurring amongst those children whose mothers had a higher educational level. Jain (1994) and Cleland and van Ginneken (1989) found that educational status of the mother often facilitates or inhibits changes in health-seeking behaviour in terms of preventive care and precautions, which both sets of authors found to be directly associated to the higher probability of malnutrition (Jain 1994: 201; and Cleland and van Ginneken 1989: 86).

The fact that Basotho women have historically been known to control household resources and allocation of food due to the long periods of absenteeism of partners who work in other places, rules out the possibility that a higher control of household resources for Basotho women is a pre-determinant to whether their children's nutritional status and well-being is good.

The findings of this study, however, may be due to the fact that either mother's with a lower educational level have more time to care and support their children and that the public health system may have been effective in disseminating key child health messages to the point that educational attainment may no longer be a determinant of child's nutritional status. This result, and the fact that a higher probability of severe malnourishment (stunting) was found amongst those children in urban areas, than those in rural areas would corroborate with the conclusions of Jain (1994) and Brockerhoff & de Rose (1994) that effective health messages from the health system may cancel out the effects of educational levels of the mother as a determinant of nutritional status of the child (Jain 1994: 199; and Brockerhoff & de Rose 1994:194).

The birth interval between the index child and the sibling that preceded their birth was found not to have results that have been previously found in studies conducted in Africa. Loaiza (1997) found that, in Africa, birth intervals of less than two years had the highest risk of child mortality and malnutrition (Loaiza 1997: 17). In this study, unlike the results found by Loaiza in the 38 DHS country comparative study, children born at higher birth intervals had a higher chance of being stunted compared to those of lower birth intervals. This may be due to the fact that children born at larger birth intervals, may be born to older mothers who may have less time to care and support children, and also may have not been beneficiaries of gains in improvements in the health system and media health messages of more recent times.

The mother's age at birth of the index child was also found to be a statistically significant predictor of children's nutritional status in a number of previous studies, where it was found that children born to mothers between the ages of 20 and 29 years were more likely to have children that suffered from negative nutritional outcomes than those children born to older mothers (Som et al 2006: 632; Rajaram et al 2003: 343). However, in Uganda, Kikafunda et al (1998) found that older and less educated mothers were classified as a risk factor to their children's nutritional status (Kikafunda et al. 1998: E45). In this study, the results seem to conform with those found in the Asian studies by Kikafunda et al (1998), whereby children born to mothers between the ages of 19 and 39 years compared to those of 15 to 18 years, and those older than 40, have a higher likelihood of being stunted – although the same result was not found for weight-for-age (underweight) and the total number of cases present in weight-for-height (wasting) was too small to be statistically significant.

The wealth index, as a proxy for socio-economic status of the household, showed a surprising result in that those children, in general, in households that have a low wealth index (0 and 1) score were less likely to suffer from stunting than children in households with a higher wealth index score. Hong (2007) found that, in Uganda, the poorest 20% of households were also twice as likely to have children who were stunted (Hong 2007: 377). In Lesotho, however, the majority of those that had a wealth index of 0 and 1 were also living predominantly in rural areas. In nutritional status this disparity is also evident. Children under the age of five years who live in rural households were less likely to be stunted than their urban counterparts, yet the opposite was found for severe malnutrition.

Finally, no previous studies were found to have investigated the effect that a child's birth order may have on their nutritional status in Lesotho or sub-Saharan Africa. However, studies in India (Som et al. 2006) and in the Philippines (Horton 1988) found that children of later birth orders and those with shorter birth intervals had a higher likelihood of being malnourished. A different result, however, seems to be evident in Lesotho, whereby it was found that even when all independent variables were taken into account, children of lower birth orders were more likely to be stunted or severely stunted than those children born at higher birth orders; although the same results were not found for severe stunting, wasting or underweight measures.

One now needs to understand how all these factors may come into play in order to explain how stunting may occur in children under the age of five years in Lesotho. The Mosley and Chen framework, adapted for an analysis of under-five nutritional status in Lesotho, provides a foundation in which this relationship can be better understood (refer to figure 1).

The first part is the intermediate, or socio-economic and biological, determinants which are sub-divided into three sections or levels. At the individual level we find that lower order parity births and higher birth intervals between the index child and the sibling that preceded their birth have significant negative results to the child's nutritional status according to the results of this study. Thus, children of lower parity orders and children born at higher birth intervals have a higher probability of being stunted. This may be due, according to Loaiza (1997), to the fact that mothers of higher parity order are more biologically depleted and therefore more tired and less able to look after children at older ages. Another reason may be that children at higher parity orders have siblings and other children living in the household that are able to look after and care for them, or that mothers with higher parity order births are more experienced than younger mothers of lower parity.

At the household level, both the household wealth index, and the total number of living children in the household both have a negative and significant effect on the child's nutritional status. In other words, as the wealth index score decreases and the number of children in the household decreases, the likelihood of the index child being stunted increases. This may be due to the fact that older children in the household are able to help with the care and support given to younger children living in the household.

The final proximate determinant in this study is placed in the community level. Urban and rural disparities in Lesotho are clearly relevant, and those children who live in rural areas have a much higher chance of being severely stunted than those children who live in urban areas, although the opposite can be said for those children found to be stunted.

The second part of the framework, the proximate determinants, includes both maternal factors as well as nutritional deficiency factors. Mother's educational level as well as mother's age at birth of the index child also has significant effects to whether the child will experience growth faltering and ultimately morbidity or mortality consequences. In this study it has been shown, however, that although children born to mother at younger ages have a higher chance of being stunted, those born to mothers at lower educational levels have a lower chance of being stunted. The second sub-category for the proximate determinants, nutritional deficiency, shows slightly different results than expected. In the Mosley and Chen framework all three of the anthropometric measures are included in the nutritional deficiency sub-category. However, in this study, due to the fact that only stunting showed any significant results, wasting and underweight cannot be included as the results remain inconclusive at this stage.

Chapter 7: RECOMMENDATIONS AND LIMITATIONS OF THE STUDY

7.1 Recommendations

This section is divided into two parts, the first part are recommendations proposed to researchers as an outcome of this study. The second section deals with recommendations as to how development organisations, and the Lesotho government would be able to decrease the number of under-five children who are stunted with specific consideration of the factors found to increase the likelihood that children of this age will be stunted.

Few studies have been found to deal specifically with how parity order and stunting may or may not have a relationship. Most studies that have investigated this relationship have been based in Asia; whose cultural, social, economic and demographic scenario differs greatly to that found in Lesotho and sub-Saharan Africa. Thus the first recommendation proposed is that further research be conducted on the relationship that exists between stunting and parity order, and the factors that exacerbate this relationship in both Lesotho and the region.

Furthermore, although this study did not find any likelihood that the factors investigated would lead to a child under the age of five to be wasted or underweight, there are a number of other factors that could in fact be found to increase this likelihood. Examples of such factors, that were found in other studies conducted:

- Father's occupation;
- Whether the mother and father of the child are married;
- Whether the child lives with a relative or with their parents; and
- A closer investigation to whether the sex of the preceding sibling could in fact increase or decrease the likelihood of malnutrition in the index child if they are of the opposite or same sex, and finally the relation to the child employment status of the household head.

A second recommendation to researchers would be to narrow down the dependent variables to specific nutrients and vitamins in order to investigate exactly which of these may or may not be present in the diet. One can assume that stunting in children under the age of five in Lesotho could be due to a lack of certain vitamins and minerals; for instance, if children's diets contain too much protein or too many carbohydrates, or if dairy in take is too low. In narrowing down which micro- and macro-nutrients may be deficient in the children's diets, then initiatives may be able to begin interventions that could take immediate effect. This would compliment certain recommendations that are listed below as the factors included in this study are more socio-demographic in nature, and thus interventions will only see their effects in the long-term, once new practices and behaviours are learned and socialised into Lesotho society.

The third recommendation to researchers is that a closer and more refined study on the link between mother's education and the passive reception of information from the health system be conducted to investigate the effects on child malnutrition in Lesotho. This study found that, unlike other studies whether the maternal education-child nutritional status was researched, children born to mothers of higher educational attainment were more likely to be malnourished and severely malnourished according to the stunting anthropometric measure. The final recommendation to researchers is that a more purposive survey, in order to reach mother's whose children are wasted, be conducted. This study had a low number of children who were wasted according to their mother's age at birth and thus a sample whereby a higher number of wasted children, according to the age of their mother at the child's birth is required to investigate whether or not this is a risk factor in children's malnutrition (stunting).

The government of Lesotho, and any stakeholders that so wishes to ameliorate the nutritional status of children under the age of five years in Lesotho would need to take account that immediate measures need to be taken, such as the second recommendation given to researchers mentioned above. However, for a sustainable intervention to have positive and beneficial long-term effects, such initiatives must take into account certain socio-demographic and economic factors that will not be remedied in the short-run as well. As such, the first recommendation given to these stakeholders is an educational campaign, with simplified communication media that will teach mothers the foods and the type of diets that will benefit their children in the long-run. It is suggested that communication media be simple, as most mothers have been found to have primary educational level as their highest level attained. The manner in which this factor was structured for the study simply classified all those with a primary educational attainment, and hides what grade attainment mothers have received. Therefore, literacy of the mothers could be a limiting factor when attempting to communicate the complexities of a healthy diet and what that would entail.

Furthermore, it is imperative that initiatives to ameliorate the nutritional status of under-five children, be synchronized with poverty reduction and development strategies in order to up-lift these families to an economic situation in which they would be able to afford critical food with high levels of required micro- and macro-nutrients. Lesotho is also known to have an extremely mountainous terrain, and most rural areas are situated in the highlands. The health care system, and the government of Lesotho, must provide educational and supportive centers for mothers in all health centers, including those in far-to-reach areas. Key to such an initiative will be to train a certain number of people from each village, and enroll them into a programme whereby regular and systematic training on issues of nutrition and health are provided. These people will then be able to be community health care members that are able to provide information, care and support for their community and the children.

Another factor that was found to strengthen the likelihood of stunting in children under the age of five years is children born to mothers at older ages as well as children born with larger birth intervals between themselves and their preceding sibling. Although Lesotho was found to have a low proportion of children who related to this factor, it may be a contributing factor. Both scholastic education, as well as the mass media, should make a continuous effort to encourage women to have children in safe reproductive ages, and to have their children with shorter but moderate (not within two years) birth intervals between them. If women so wishes to bear children at older ages not only should she be monitored very closely by health professionals but she should have access to information that communicates preventive care for children, such as the correct nutritional requirements.

Finally, the parity order of the child and the number of living children that are within the household were also found to be important factors to whether children are stunted. Although the absolute number of children of high parity order and children that share the household with more than two children is very low, the probability of children who live in households with more children and who are born at higher parity orders is less than children of lower parity order and those children living in households with a lower number of children. However, over and above the immediate measures that are required but need to be researched more thoroughly, these families who do decide to have a higher number of children or who may have taken in other children other than their own need to be supported both financially and nutritionally, with supplements and food packages.

7.2 Limitations of the Study

As many of the children may still be breastfeeding (either partially or exclusively), the effects of breastfeeding were not completely controlled for, and as such much of the nutritional status of these children may be confounded by the nutritional status of the mother. This is especially true for children up to the age of 24 months.

Much of the literature found on nutritional status and parity order, as well as nutritional status and birth spacing is found for Asia – few studies have concentrated on this topic in Africa. As such this study wishes to additionally inform differences between differentials in African children's nutritional status, relative to their parity order and socio-demographic characteristics, if they so exist.

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APPENDICES

Appendix 1: Mathematical and Statistical Formulas

a. Z-score/Standard Deviation Score

The formula used to calculate the z-score is:

$$\text{Z- or SD-score} = \frac{\text{(observed value)} - \text{(median reference value)}}{\text{Standard deviation of reference population}}$$

(WHO Technical Report Series # 854 1995: 7; & Dibley, Staehling et al. 1987: 752)

b. Statistical Formula for Multinomial Logistic Regression

The basic multinomial logistic regression formula is shown below:

For the predictor variable:
P_1=estimated probability of being nourished
P_2=estimated probability of being malnourished
P_3=estimated probability of being severely malnourished

For the response variable, e.g. where the response variable is education and ethnicity represented in this example as:
M= 1 if parity order 1, 0 if otherwise
H=1 if female, 0 if otherwise
I=1 if urban, 0 if otherwise

Then the formula is:

$$\log \frac{P_1}{P_3} = a_1+b_1M+c_1H+d_1I$$

$$\log \frac{P_2}{P_3} = a_2+b_2M+c_2H+d_2I$$

$$P_1+ P_2+ P_3=1$$

Where: we assume that the mathematical form of the model is correct, and we choose the values of a_1, b_1, c_1, d_1, a_2, b_2, c_2 and d_2 to maximise the likelihood function.

(adapted from Retherford & Kim Choe 1993: 151-152)