THE DETERMINANTS AND IMPACT OF LONG-TERM CHILD UNDERNUTRITION: EVIDENCE FROM RURAL TANZANIA

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All errors are my own.

Abstract

A large proportion of the population in developing countries leads a disadvantaged life, often being unable to move out of poverty. The causes of poverty are varied and complex, working through many channels; ranging from macroeconomic crises and isolation from jobs to political instability, discrimination, poor health and nutrition. The last factor is one that is often cited as a cause and effect of a life of poverty, with far reaching effects on individuals' stock and accumulation of human capital. This leads to losses in productivity with adverse consequences for the economic growth of a country.

Children are the most vulnerable to poor nutrition and its consequences owing to poorly developed immune systems and weaker decision-making power. Using longitudinal individual and household level data from the Kagera district in Tanzania, we aim to investigate the determinants of poor childhood undernutrition and whether it affects later schooling achievements.

One, which socio-economic factors are associated with under the age of 5 in the short and long-term periods? Results suggest that household wealth, food security and caregiving practices and the status of women are significantly associated with children's nutrition. This thesis uses Kagera Health and Development Survey (KHDS) data to answer this question. In doing so, it highlights the limitations of using household survey data to investigate health and nutrition outcomes of individuals, due to shortcomings in survey methodology.

Two, does poor nutrition in early childhood affect the attendance and grade achievement of primary school-going children? Results indicate that poor early childhood nutrition, current nutritional status and long-term illnesses of children are associated with children's school attendance and grade achievement. However, the indicators used to measure school quality are at best, proxies and this raises the issue of the appropriateness of instruments used to measure school quality in specific contexts.

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1. Introduction

A large proportion of the population in developing countries leads a disadvantaged life, often being unable to move out of poverty. The causes of poverty are varied and complex and work through many channels; they range from macroeconomic crises, trade slumps, isolation from jobs to political instability, discrimination and poor health. This last factor is one that we would like to explore through this study. Hunger and poor nourishment are often cited as a cause and effect of a life of poverty. The reasoning for this is simple – people go hungry if they do not have the means to acquire food. Lower food intake implies lower levels of energy, poor health as well as developmental problems. This, in turn, means that individuals spend less time at school and work due to illness leading to losses in productivity with adverse consequences for the economic growth of a country. This motivates the analysis of the determinants and impact of child malnutrition.

The importance of good nutrition cannot be disputed. Proper nutrition is necessary for the physical well-being of an individual as it helps the human body to grow and provides energy to do work. Without adequate and proper nutrition, individuals are susceptible to diseases such as scurvy, beriberi, metabolic syndrome as well as cardiovascular disease and diabetes. This harms their overall quality of life. The problem is more acute for children. Children are more susceptible to disease owing to relatively poorly developed immune systems and the fact that they rely on adults to make decisions for them. But there is more to this– it points to the fact that a child's fundamental right to adequate food and a healthy life is being violated.

In 1990, the World Summit for Children took up the task to reduce child undernutrition and improve child health, among several other goals that aimed at improving the lives of children, especially those in developing countries. Two decades later, life for a large number of African children, in particular, remains difficult, dangerous and tragically short. Chronic undernutrition remains widespread in Africa and the achievement of the Millennium Development Goal (MDG) of a 50% reduction of undernutrition in children under the age of five is far from reach. Nutritional interventions have received little attention in this continent during the 1990s, especially in Tanzania, where child malnourishment rates are one of the highest in the world. UNICEF figures indicate that by 2000, almost 43% of children were stunted and 31% were underweight in Tanzania. Many children suffer from severe micronutrient deficiency. The deficiency of vitamin A alone accounted for one in seven deaths of children under the age of five years. The situation has not improved since then. In 2010, Tanzania's national demographic and health survey indicated that 42% of children under the age of five were stunted, 16% were underweight and 5% were wasted in the country (NBS and ICF Macro, 2011).

Using data from the Kagera Health and Development Survey (KHDS), this study makes a modest attempt to answer two questions that will help in the achievement of the MDG of a 50% reduction of undernutrition among children. The first, which socio-economic factors are associated with children's nutritional outcomes? Using a cross-section of the KHDS data, we will look into which social and economic characteristics at the individual and household levels are associated with children's nutrition in the immediate and distant future. We use the framework put forward by Smith and Haddad (2000) to answer this question. To our knowledge, this is one of the few studies that includes the quality of food intake as an explanatory variable in this framework, others only consider the quantity of food intake. Our initial research into calorie and food consumption patterns in Tanzania and Kagera using data from different quantitative and qualitative sources, revealed an alarmingly high level of carbohydrate intake and extremely low levels of intakes of other food groups, hinting at micro-nutrient deficiencies among Tanzanians, driving our motivation for the inclusion of this variable in the framework. In addition, unlike other studies that investigate the determinants of child undernutrition, we take into account the interactions between some of the explanatory factors and their association with nutrition. For example, the interaction between the level of mother's education and employment; whether this affects children's nutrition and how it does so.

The limitation of this study is that while we are able to account for interactions between some of these determinants of undernutrition among children, we are unable to account for dynamic and seasonal changes that affect children's nutrition. This is a potential source of endogeneity that will bias our results and we do attempt to overcome via the use of instrumental variables. We find that there are several pathways and channels through which these factors affect children's nutrition in the short- and long-term and owing to this it is not always possible to single-out individual determinants of child undernutrition.

The second question is whether poor early childhood nutrition and health are negatively associated with children's schooling outcomes, taking into account children's socio-economic circumstances and school characteristics. The outcomes that we investigate are children's school attendance and grade achievement. The focus of other studies in economics, public health and education is more on factors that affect school enrolment or achievement. This study also focuses specifically on what drives school attendance of children who are enrolled in school. Other studies have, of course, investigated the determinants of school attendance but have excluded the role of children's nutrition and health from their analysis (for example, Burke and Beegle (2004)).

However, there is a lack of data on some key aspects such as children's intrinsic motivation, ability, the value that parent's place on education, and the aspirations that they have for their children. As a result, we are missing information on some key aspects that drive school achievement and attendance. To some extent, we are to control for this using community, household and school fixed effects, although this is not a fool proof method as it may not control for the endogeneity caused by some variables, for example, children's nutrition. Owing to this, we cannot claim that we can establish direct causality between early childhood nutrition and health and children's school attendance and grade achievement. Further, we must bear in mind the fact that there is some degree of reverse causality between children's health and nutrition. Thus, our results may only be indicative of the relationship between children's nutrition and health and their schooling outcomes

Secondary data from sources such as household budget surveys, Living Standards Measurement Survey (LSMS), and indeed the KHDS are a source of rich and detailed information that can facilitate the investigation of issues related to well-being and poverty. However, using such data can also be limiting as the motivation for collecting this data tends to be different from that of researchers other than the principal investigators. Despite the longitudinal nature of the KHDS that allows us to track individuals and households over time and the breadth of information that it offers, we are still missing vital pieces of information. As a result, we are, at best, able to make associations rather than establish causality in our analyses. This study shall also look into whether household surveys such as the KHDS collect adequate information to answer the kinds of questions about the causes and effects of poor nutrition that are similar to the ones we ask.

This study is organised as follows: Chapter 2 is a review of relevant literature that explores concepts pertaining to the measurement of undernutrition, its determinants and impacts on children's educational outcomes – grade achievement, cognitive development and school attendance. Chapter 3 is an overview of Tanzania; its economic and social history of health and education policies and a presentation of trends in national consumption expenditure, nutrition and education. In Chapter 4, we discuss the sampling strategy and features of the KHDS. This is followed by Chapter 5, where we present a descriptive analysis of the KHDS and discuss how various individual and household level factors are associated with children's nutritional outcomes. In Chapter 6, we model these relationships and discuss the results of the regression analysis. We then move on to investigating the impact of poor childhood nutrition on children's school-related outcomes ie their school attendance and grade achievement. In Chapter 7, we present descriptive statistics trends and models for the relationship between children's stock of health and nutrition and their school attendance and grade achievement. Chapter 8 concludes.

2. Review of Literature

Malnutrition is a general term that refers to a medical condition that is the result of an inadequate or unbalanced diet, in which certain nutrients are lacking or being consumed in incorrect proportions. Malnutrition can manifest itself in two forms – overnutrition and undernutrition. Overnutrition, often leading to obesity is a result of consuming the wrong kind of food that is rich in calories but lacking correct nutrients. Undernutrition, which can result in emaciation, is a result of a diet that is deficient in calories as well as nutrients. Both forms of malnutrition are seen all over the developed and developing world, across all age groups. However, special attention is to be paid to undernutrition because it signals that there is something fundamental that is taking away from an individual's well-being.

To be able to tackle the problem of undernutrition, a good starting point is to find the answers to three very important questions. One, how many people are undernourished? Two, where are they located or concentrated geographically? Three, why are they undernourished (Svedberg, 1999)? This chapter will review the literature that aims to answer these questions. In addition, it will review the literature that investigates the impact that undernutrition and malnutrition can have on an individual's educational and cognitive development outcomes. First, we explore the various measures of undernutrition, their advantages and shortcomings.

2.1 Measuring Undernutrition

This section discusses the way in which undernutrition is measured by international development organisations such as the Food and Agricultural Organisation (FAO), Bank for Reconstruction and Development (IBRD), World Health Organisation (WHO) and by individual researchers in different populations. It draws the merits and disadvantages of these approaches from existing literature to be able to come to some consensus about the most appropriate way in which undernutrition can be measured.

2.1.1 Different Methodologies

The most aggregate estimates are derived by the FAO and the World Bank. Based on these estimates of availability of calories in various countries and how they are distributed across households, the IBRD and FAO estimate the proportion of population that is undernourished. Several studies have been able to estimate food consumption at the individual and household level. The WHO and another set of studies use anthropometry to assess the nutritional status of individuals.

Calorie availability estimates

The FAO defines undernutrition as "*the extent to which people have dietary intakes below certain minimum requirement levels,…ie that level of energy intake that will balance energy expenditure when the individual has a body size and composition and level of physical activity consistent with long-term good health, and which will allow for the maintenance of economically necessary and socially desirable physical activity*" (Svedberg, 2000, pp. 21). Simply, this is a measure of the "energy input" of an individual.

Here, the supply of food available during the period of study is denoted by adding the total quantity of foodstuffs produced in a country to the total quantity imported and adjusted for any change in stocks that may have occurred since the beginning of the reference period. On the utilisation side, there is a distinction made between the quantity that is used as seed, fed to livestock, exported, put to non-food use, lost in storage or during transportation and that available for human consumption. The per caput supply of each food item available for human consumption is then obtained by dividing the food supply available for human consumption by the related data on the population that actually takes part of it. The data on per caput food supplied are expressed in terms of quantity as well as by applying appropriate food consumption factors in terms of nutrients such as calories, proteins etc. The data on calorie availability are supplied by national governments based on replies to FAO questionnaires that are administered annually. In the event that official (or semi-official) estimates are not available from the countries, FAO makes their own estimates (Svedberg, 1999).

Dietary intake

This may be done in several ways. One, by collecting qualitative information by asking people how much of specific foods they have consumed over a specific period though interviews (recall) or by having individuals record their consumption and intake (food diary). Two, by measuring purchases and changes in the food stocks and converting these into consumption flows. Three, by weighing the food actually observed to have been consumed by the individual or the household. The nutritional content of the food can be estimated from standardized conversion tables (Stromborg and Olsen, 2004). Again, this measures the calorie or energy input of individuals.

As research tools, diaries have been used in several fields of research; the most common areas where they are used are nutrition and sleep. There has been a growing interest in using diaries to collect information on consumption and expenditure. The World Bank does have examples of consumption and expenditure diaries for several low- and middle-income countries that enable a measurement of total food consumption that can help gauge living standards. Dietary, nutrition or food diaries are typically used to monitor the dietary intake of particular groups such as infants, school-going children and pregnant women or focus on specific medical conditions such as obesity, diabetes and bulimia nervosa (Grosh and Glewwe, 2000).

Prevalence of undernutrition

The process of estimation of the prevalence of undernutrition used by the FAO and IBRD consists of three main parameters. The first is the number of calories available for human consumption, the national per capita availability of calories. The second is the distribution of calories across households. This distribution is assumed to be log normal and is measured by the coefficient of variance. The third is the lowest acceptable per capita availability (intake) of calories. Very simply, households that have a per capita availability that does not meet the per capita minimum norm (or the calorie cut off point) are classified as undernourished. It follows that the share of the population that is classified as undernourished depends on where the calorie cut off point is fixed. A lower cut off point at a given national per capita availability of calories and calorie distribution implies a lower prevalence of undernutrition. Further, if the national per capita availability of calories is smaller for a given calorie distribution and cut off point, it means that the proportion of undernourished individuals is larger. Similarly, as the distribution of calories across households changes, the prevalence of undernutrition will also be lower or higher (Svedberg, 1999).

The FAO and IBRD work with the same aggregate database of the FAO's estimates of per capita availability of calories. However, the norm for lowest acceptable per capita availability of calories is different. The FAO uses two cut off points. Assuming that an individual has a given energy requirement for internal body functions ie a constant basal metabolic rate (BMR), the FAO sets the cut-off point at 1.4 times the BMR. This norm accounts for the minimum amount of energy that an individual needs for the most basic personal undertakings and to maintain muscular and cardiovascular fitness but no other physical activity. The second cut off point is at 1.2 times the BMR. This accounts for the same activities mentioned above but also makes provision for the fact that the human body has an in-built mechanism that ensures that energy is more efficiently metabolised and utilised when the intake is very low (for example, when food is scarce).

The IBRD uses alternative cut off points that are based on the recommended dietary allowance (RDA). The IBRD does not do this on the basis of different assumptions of the energy requirements of individuals but does so in order to be able to distinguish between those who are "moderately" and "severely" undernourished. The cut off points are set at 90 and 80% of the RDA, respectively. These cut off points are higher than the FAO's cut off points. Both organisations assume that the distribution of available calories across households is determined by income. Two things are worth mentioning: one, while the IBRD method of estimation is fairly accessible, the FAO undertakes its own estimations, which it does not publish; and two, The IBRD works with discrete income groups while the FAO uses a continuous scale (Svedberg, 1990).

Anthropometry

Anthropometry is based on the presumption that it is not imperative to estimate individuals' calorie intake and expenditure to be able to assess their nutritional status. Imbalances, if any, between intake and desired calorie expenditure will manifest themselves in the human body in the form of reduced body weight or retarded growth stature. This means than an individual could be thin for her age, short for her age or thin for her height. There are three anthropometric indices that can be used to assess an individual's nutritional status: weight-for-age (underweight), height-for-age (stunting) and weight-for-height (wasting). Anthropometry, therefore, looks at the "energy output" of an individual and today, is one of the most commonly used indicators of undernutrition.

The most commonly used and most comfortable indicator to work with is the Z-score. According to recommendations from a World Health Organization Expert Committee (de Onis and Habicht, 1996) for each individual i, the Z-score is defined as:

$$Z_i = \frac{AI_i - MAI}{\sigma}$$

Where *AI* is the individual's anthropometric indicator, *MAI* is the median of the reference population and σ is the standard deviation of the reference population.[1] Conventionally, it is assumed that Z follows a standard normal distribution. If the Z-score of an individual is 2 standard deviations below the median weight (or height) of the median of the reference population, the child suffers from moderate undernutrition while if the Z-score of the individual is 3 standard deviations below the median weight (or height) of the median of the reference population, the individual is severely undernourished. It follows that the larger the Z-score of an individual is, the better nourished she is.

2.1.2 Conflicting Evidence

Svedberg (1999) presents different sets of estimates of the prevalence of undernutrition arrived at by the FAO and IBRD at the aggregate country level for sub-Saharan Africa (SSA), anthropometric studies of sample populations, FAO estimates of availability of calories and actual calorie intake in 85 different sample populations in order to determine whether different measures of undernutrition present different pictures and the extent of the difference. He finds that for the period of study, there is hardly any discrepancy between the FAO estimates based upon supply side aggregate data and the average of the sample estimates derived from

[1] The reference population is usually a well-nourished and healthy population that may belong to the same country or region or a different country or region.

demand side disaggregated consumption survey data. The FAO claims that the calorie availability data may be overestimated because some of the food available to households is wasted. The little difference that there is between FAO's estimates and Svedberg's sample estimates is positive but small, suggesting that waste of food at the household level is negligible.

According to Svedberg, if the current nutritional status is judged by weight-for-height, it seems that the average person in SSA countries is at least somewhat above the level that is conventionally thought to imply that she is undernourished. This is not readily compatible with the FAO or dietary sample estimates that the food available or actually consumed corresponds only to about 80% of the RDA ie if the average person has a weight-for-height that is above the "safe level" then food consumed is above what is needed to avoid undernutrition. Finally, he makes a third comparison of the prevalence of undernutrition and anthropometrics. According to the IBRD estimates, in the early 1980s, 44% of the SSA population was at least moderately undernourished and that there was no great improvement since the 1970s. Further, there are several other studies that suggest that only 5 to 10% of children were moderately undernourished. It was only in a few cases that the wasting among children was greater.

It is clear from Svedberg's results that different measures of undernutrition present a different picture. In order to be able to choose an appropriate measure, it is necessary to be aware of the shortcomings and merits of the different measures.

2.1.3 Which Measure is More Appropriate?

In 1996, the FAO asserted that there were 841 million people in the world are chronically undernourished and the prevalence of undernourishment (POU) was the highest in SSA. FAO attributed this to the insufficient availability of food (Svedberg, 1999). In his analysis of FAO's claims, Svedberg (1999) finds that the FAO method of estimation is very sensitive to relatively small "errors" in the parameters. He also notes that the data that the FAO collects for SSA countries is of very poor quality.

The data on calorie or food availability is not very accurate. Lipton (1986) argues that as there is no concrete idea about the levels or trends in output or consumption of that main staples for four of the largest SSA countries; output can only be estimated within a range of (plus/minus) 15-40% of the FAO estimates. An OECD study (Blades, 1980) finds that for SSA countries, the margin of error in agricultural production is in the range of 25-60% (plus/minus). The study also finds that when production estimates of a particular crop of an African country are available from two or more sources, the estimates are considerably different in trends over time, the sign of annual deviations and in absolute terms for single years. Food trade estimates are also not reliable.

There are two reasons for the large margins of error. One, the agricultural system in most SSA countries is very complex. Production is mainly for subsistence and mixed cropping is very common, the number of minor crops usually being large. Two, the estimation methods used are outdated. There are often instances when parts of a country are left out and when no consistent estimation method is used.

The FAO estimates of how calories are distributed across households are based on two household expenditure surveys that were conducted by the International Food Policy Research Institute (IFPRI) in Kenya and Zambia. Though these surveys rely on repeated survey rounds that reduce measurement errors and the effects of random variations and provide trustworthy results for the samples that they represent, the problem arises from the fact that they are not representative of the SSA population.

As far as the cut off points are concerned, Svedberg (1999) argues that the FAO has erroneously assumed that all races have the same BMR. Until the late 1980s, it was believed that this was true. However, further investigations showed that individuals from "tropical" countries had a lower BMR than Caucasians and that their BMR was about 10% lower. If the FAO were to revise this norm and make it 10% lower for SSA countries, their estimates of POU for these countries would fall considerably. Another concern with the FAO's norm for minimum acceptable level for calorie/energy intake is that it does not account for the fact that poor, thin people in developing countries often undertake physical activity as work.

Gabbert and Weikard (2001) find similar problems with the FAO's average and minimum energy requirement norms. They observe that under the assumption that the distributions of food energy requirement and food energy consumption are independent, a fixed cut off point for a group may overestimate or underestimate the

POU. They argue that for individuals, it is possible to determine a range of energy for individuals based on age, height, sex and activity levels. The two cut off points of average and minimum dietary energy requirement that the FAO proposes have been derived from average and minimum desirable weight for specific age-sex groups and for moderate and light activities. It may happen that individuals with energy requirements smaller (larger) than the calorie cut off point are misclassified as undernourished (well nourished) if their energy intake is less (more) than the cut-off point but adequate (inadequate) for their individual requirements. Such errors have been mentioned in undernutrition literature but their impact has not been explored for a larger number of countries.

In their study of 86 developing countries, the authors analyse the size and the frequency of under and overestimation effects that may arise from the abovementioned problems with the cut off norms. Their main finding indicates that the POU is underestimated for at least 30 countries if average energy requirements are considered and for at least 59 countries if minimum energy requirements are considered. As far as overestimation is concerned, POU is overestimated in countries with the lowest dietary energy supply, the majority of which are located in SSA.

These issues are also brought up by Nube (2001), who studies the POU at the individual country level rather than at the regional level using anthropometry and food energy inadequacy. In his investigation of POU for 23 countries, he finds that there is a poor relationship between (a) food energy inadequacy and anthropometric indicators for children and women; and (b) mean levels of calorie availability and mean body weight in adults. He suggests that if both these measures show similar patterns of undernutrition, it is worthwhile to think of them as supplementary methods. This pool of information could contribute to policy debates on food and nutrition. However, if these patterns differ greatly it is necessary to weigh the merits and demerits of the two approaches and what can be done to improve the current methodology. He explicitly addresses the question of which approach is the most suitable for assessing nutritional conditions and the POU rates. On the one hand, food availability data provide comprehensive information on the flow of agricultural commodities and can be used to identify any changes and vulnerabilities in the food supply system. On the other hand, anthropometric indicators may be a more reliable source of information in if one wants to compare the nutritional situation in different countries or regions and identify vulnerable people or populations.

According to Svedberg (2000), a good measure of undernutrition should be able to characterize what undernutrition is. The FAO's measure does not take into account the fact that the minimum energy requirement differs across individuals depending on their gender, age, weight, height and the amount of the work that they do. He also suggests that a measure of undernutrition should be able to explain why people are undernourished. The food supply based measure's answer to this question is that the food availability is too low. This measure, however, underestimates the per capita availability of food, especially in countries where the production technology used is outdated. In addition, often much of the food that is produced is for subsistence and tends to be under-recorded. As a result, these estimates of undernutrition tend to be overstated.

What makes the case for anthropometry as an indicator of undernourishment is the fact that obtaining anthropometric measurements is uncomplicated, relatively inexpensive and the estimates contain relatively smaller measurement errors and biases (Marks *et al*, 1989). However, the simplicity of taking measurements is deceptive. Measurement errors may appear due to improper techniques or inadequate supervision of field workers. Anecdotal evidence from a household survey in Mumbai, India also reveals that some respondents are "too shy" to be measured for height or weight- they are embarrassed if they feel that they are short or overweight.

Further, little thought is given to the time required for subsequent calculations and interpretations, which is substantially more than the time required to collect the measurement data, as well as the time and effort wasted if the original measurement is inaccurate. As a result, it is necessary that the techniques that are employed such as weighing, must be carefully carried out, standardised and thoroughly understood by all fieldworkers. This is especially important when assessing growth by the measurement of small increments in small children. Measuring instruments need to be accurate, simple to use, inexpensive and portable. They also must be checked and calibrated frequently. The effects of inaccurate measurements are unfortunate, since the erroneous results are expressed numerically and are too often viewed as precise and objective data (Jelliffe, 1966).

The anthropometric method also has shortcomings in explaining what undernutrition is. In anthropometry, height or weight is in relation to the height- or weight-for-age below which there are measurable impairments in terms of increased morbidity, physical disabilities and mortality. However, it should be noted that an individual could be underweight or short for his or her age but still not have any impairments. Anthropometric methods cannot capture this. Further problems may arise if the wrong anthropometric indicator is used. For example, the short-term impact of undernutrition is loss of body weight. The height-for-age indicator, if used in this situation will not pick this up. The long-term effect of undernutrition is the slowing down of growth. The weight-for-age indicator, if used here will be unable to pick up this effect.

As mentioned earlier, if the Z-score of an individual is 2 (3) standard deviations below the median weight (or height) of the median of the reference population, the child suffers from moderate (severe) undernutrition. There is a considerable amount of debate surrounding the issue of the appropriateness of the reference population used. This stems from the observation that body proportions appear to vary among different groups of people. This is could be partly genetic, possibly related to climatic adaptation - for example, the build of Arctic dwelling Eskimos widely differs from that of the Dinka of equatorial Africa. Due to the fact that different ethnicities have different patterns of growth, it is not appropriate to use a standard reference population for all communities. Jelliffe (1966) explains this by citing an extreme example: height standards for the pygmies of Rwanda are inappropriate for their neighbours, the tall nilo-hamitic Tutsi.

The issue of choosing a reference population becomes more complicated when assessing the POU or nutritional status of children. In some cases, it may not be possible to identify a reference population, especially in local settings in developing countries because only a small proportion of children may be well fed, healthy with their ages known exactly, owing to inadequate birth registration. The group that is measured as the reference population has to be ethnically homogeneous because children belonging to different ethnic groups have different potentials for growth (*ibid*). However, there is no concrete evidence to support this. Some studies (Falkner, 1986) show that ethnic differences only establish themselves at puberty rather than in early childhood, which is the age group for which most anthropometric data is collected. Another study by Habicht *et al* (1974) found that nutrition had a greater effect on growth than ethnic background in their study well-nourished children from different ethnic backgrounds. The effect of ethnicity, they found, much smaller than that of nutrition and environment, that they felt that it was not unreasonable to use height and weight standards of well-nourished Caucasian children as the reference population for comparison with samples of children from other populations. Gopalan (1992) finds that children from well-to-do urban households in India have the same average height- and weight-for-age as the reference population norms used by the WHO (Caucasian children). One study finds that children of Indian stock living in the UK have norm-consistent heights on an average (Svedberg, 2002).

It is worth looking into the specific issues that need to be dealt with when using food diaries as a means to measure undernutrition. As diaries allow analysis of an event over time, they may offer a more accurate behavioural analysis than a simple "snap shot". They also help place events in a broader social, economic and political context. For example, when using diaries to collect information on consumption and expenditure, it is important to look at the effect seasonality has on expenditure, particularly in poor rural communities (Wiseman *et al*, 2005). In cases where food availability and/or anthropometric data are unable to give a clear indication of nutritional status, food diaries may help us better understand the factors such as input of energy, its manifestation, changes in the input and output and why they have occurred.

It has been argued that households may enjoy the novelty of filling out diaries, while others argue that households may only answer questions when it suits them most. In a sense, diaries are retrospective in that events and behaviours are recalled and reconstructed with their help but they can also be prospective as events are recorded as they occur or close to that time. As diaries rely heavily on short-term memory, it is possible that diaries are less likely to suffer from problems of recall bias than other data collection tools.

Using diaries as research tools can also be challenging. An important issue is fatigue. As the diary period becomes longer, respondents may tire of keeping records and may become less thorough in their reporting. There is also an issue of missing or unclear data, which comes up when respondents are left to their own devices in terms of completing the diary. This is difficult to resolve. Verbrugge (1980) finds that if researchers have to revert to the respondent to clarify entries, the data becomes retrospective and is subject to recall bias that other methods such as questionnaires are also subject to.

Diaries are not feasible in situations where the information being gathered could incriminate respondents. For example, expenditure and income diaries collect information on the use of illicit drugs, income not declared to tax authorities, which respondents may be reluctant to provide. Self-reporting of dietary intake is even more problematic as respondents may not accurately report this. Reasons include a sense of shame stemming from the poor access to and availability of food to a household, inaccurate perception of portion size, personal preferences, serving sizes and comparison of personal servings with those of others. Women tend to underreport their intake, especially those who feel that they are overweight.

Diaries are less appropriate in areas where literacy levels are low (Bowling, 2002) as is not uncommon in developing countries. This may be overcome by using pictoral diaries or by nominating a school-going child from the household to act as a scribe (Grosh and Glewwe, 2000). However, the problem with using a scribe is that she could compromise the quality of data, especially if the information is of a private nature.

There is also an issue of cost involved owing to the large volume of data that needs to be collected and analysed, the time required to train diary keepers and to maintain their support (Verbrugge, 1980). However, Stromborg and Olsen (2004) argue that since fewer research personnel are required to collect data, food diaries are associated with lower costs.

The commonly used period for the time period of a diary study is one week, although for consumption and expenditure surveys the norm is a maximum of 4 weeks. However, if issues such as seasonal variation, migration, shocks to the economy in consumption and expenditure are likely to be significant, then collecting diary data for a week or a month is meaningless. Wiseman *et al* (2005) suggest that there is a trade-off between the length of time a dairy is maintained and the burden that is placed on the respondents. They say that there is no point in pushing participants to maintain a diary for lengthy periods of time, simply to generate poor data.

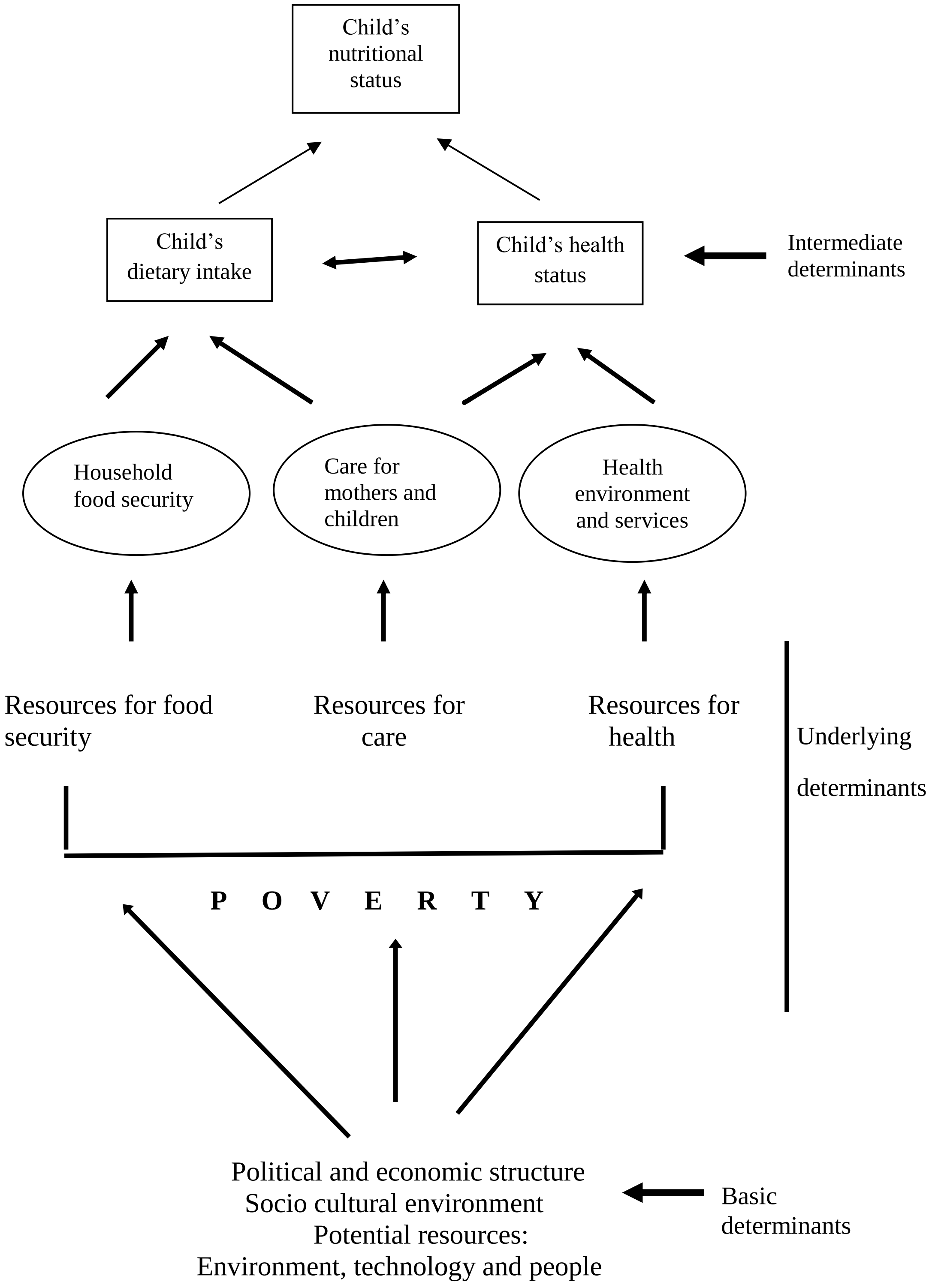
Wiseman *et al* (2005) recommend regular interviews with diary keepers as well as the use of aide memoirs and other prompts. Those planning studies based on dairies need to budget for this training. Finally, they emphasise that the success of diaries depends on there being a very trusting relationship between the fieldworker and diary keeper.

2.2 Causes of Malnutrition and Undernutrition

The most often cited conceptual framework that delves into what causes child malnutrition is the one constructed by the United Nations Children's Fund's (UNICEF 1990, 1998). This framework has also been used by Smith and Haddad (2000) in a research report on child malnutrition across developing countries for the IFPRI. We will focus on the framework used by these international organisations as they have been widely adopted by other research studies and projects for their research analyses and dissemination of findings. However, we recognise that there is a large and growing body of nutritional, bio-medical and public health theory that postulates other frameworks to explain the determinants of poor nutrition among populations (a few examples are studies by Vorster, 2010; Loechl *et al*, 2008; Black *et al*, 2008, Nandy *et al*, 2005; Haddad *et al*, 1999; Ruel *et al*, 1998; Igbedioh, 1993; Thaver *et al*, 1990; de Onis *et al*, 1993; Beaton and Ghassemi, 1982; Pellet; 1989). The framework is extremely comprehensive and it incorporates biological and socio-economic causes of malnutrition at the micro and macro levels. It recognises three levels of causality corresponding to immediate, underlying and basic determinants or channels that affect a child's nutritional status.

The immediate determinants of a child's nutritional status manifest themselves at the level of the individual and include dietary intake and health status. These factors are not independent of each other - a child with an inadequate dietary intake is susceptible to disease. Disease suppresses the appetite, slows down the absorption of nutrients in food and reduces a child's energy level.

Figure 2.1: Conceptual framework of the determinants of child undernutrition



Source: Smith and Haddad (2000)

The immediate determinants of a child's nutritional status are in turn affected by underlying determinants that act at the household level. The first of these is food security, which is achieved when an individual has enough access to food to lead an active and healthy life (FAO, 1996). The resources that provide access to food are food production, income for food purchases or in-kind transfers of food. Care is the second underlying determinant. Irrespective of the quantity of food that is available, no child can grow without nurturing from other human beings. This aspect of child nutrition is captured by care for children and their mothers, who are the main caretakers in a household. Health environment and services is the third underlying determinant, which depends on the availability of safe drinking water, sanitation, health care facilities, housing and other such factors.

Poverty plays an important role in this mechanism as it affects the underlying determinants - poor households and individuals are unable to achieve food security, have adequate sources of care and are unable to use health resources on a sustainable basis.

The underlying determinants and poverty are affected by the basic determinants. These include the resources available to a country that are subject to the natural environment, access to technology and quality of human resources. Prevalent political, economic, cultural and social factors and norms affect how these potential resources are utilised and how they are translated into resources for food security, health environment and services and care.

These determinants may have direct or indirect impacts on children’s nutrition. They may act singly or in combination with each other. For example, if a household is poor, it is likely that they are food insecure and this has detrimental effects on children’s nutrition. Here, poverty and inadequate access to food act in combination. It may also occur that a child in a well-off household that is food secure and provides a healthy and caring home environment is poorly nourished as she is born with a weak immune system, that impinges on her health and nutritional statuses. Here, the child’s health status alone has a detrimental effect on her nutrition. The questions we need to ask, therefore, is: what are the different determinants that have an impact on children’s nutrition?

2.2.1 Key Determinants of Good Health

During the 1970s and the 1990s, the Basic Needs Agenda and the Physical Quality of Life Index promoted a focus on non-income indicators of development. Since the

1990s, the United Nations Development Programme has advocated a similar multi-dimensional approach to development as captured by the Human Development Index (HDI). The Millennium Development Goals have adopted various social goals such as reduction of infant and child mortality as poverty reduction targets. This has sparked a debate about whether agreeing to incorporate social indicators of development is the same as agreeing that achieving development requires looking beyond a growth development strategy (Hamner, Lensink and White, 2003). On the one hand, there is the view that there is a relationship between income per capita and social indicators, though this relationship is imperfect (Ravallion, 1997). Hence, a sustainable improvement in welfare may be brought about by increases in income. On the other hand, various issues of the *Human Development Report* indicate that countries with comparable levels of per capita income can have considerable variation in their HDIs and as such, poor performers may be able to improve their social welfare without waiting for growth (Hamner, Lensink and White, 2003).

It cannot be denied that good health contributes to productivity and well-being, which contribute to the development process. This section of the literature review briefly discusses existing studies that examine the determinants of good (or ill) health. This is done so that we have a background against which we can set up the child undernutrition problem and also because there exists a reverse causality between nutrition and health. Several of the key variables used for analysis in this literature such as poverty, education and health environments including the ease of access to health facilities are often used in analyses of determinants of child undernutrition. Reviewing studies of the determinants of good (or ill) health will thus ensure that we do not miss any crucial variables that will help in our analysis of child undernutrition.

Anand and Ravallion (1993) look into how health is affected by the level of per capital national income, poverty and public provision of social services. They use gross domestic product (GDP) per capita to measure national income and the proportion of the country's population that consumes less than one dollar a day as a measure of poverty. The public provision of social services is measured by per capita public health spending. Using data for 86 developing countries for the year 1985, the authors find a simple but strong correlation between national income and life expectancy. They run an ordinary least square (OLS) regression for a sub-sample of

22 countries for which they have comparable data and add poverty incidence and public health spending per person as explanatory variables. They find that there exists a significant and positive relationship between life expectancy and national income. However, the statistical significance disappears when poverty and public health spending are controlled for – poverty has a significant negative effect on life expectancy while public spending has a significant positive effect. The result for infant mortality is similar. They conclude that average income does matter but only insofar as it reduces poverty and is able to finance key social services. One-third of national incomes' effect on life expectancy is through poverty reduction and two-thirds is through increased public spending.

Using data from 72 developing countries and data over the period 1970-95, Subbarao and Raney (1995) focus on the role of women's education. They regress infant mortality rates (IMR) in 1985 on female and male gross secondary enrolment rates lagged five and 10 years, purchasing power parity adjusted GDP per capita, rates of urbanisation, a family planning services score and proxy variable for health service availability, population per physician. They find that women's education has a strong influence on IMR. While the other explanatory variables are also statistically significant, their influence on IMR is not as strong as that of women's education. For a typical country, the authors estimate that doubling women's education in 1975 would have reduced IMR in 1985 from 105 to 78. Halving the number of people per physician would have only reduced IMR by four points, from 85 to 81 and doubling national income would have lowered IMR by three points from 99 to 102.

Neither of these two studies tests for the possibility that country's income itself may be affected by the health of its citizens. As they both use OLS in their analyses, they do not take into account any omitted country specific effects that may influence health outcomes and be correlated with the explanatory variables included. As a result, it is likely that they identify an associative relationship rather than a causative one between the national income and indicators of health used.

Using data from 1960 to 1985 for between 58 and 111 countries, Pritchett and Summers (1996) examine the impact of GDP per capita and education levels on infant mortality, child mortality and life expectancy. They control for country specific and time invariant factors using a first difference approach and for possible reverse causation between income and the outcome variables by employing instrument variables techniques, using several instruments for income such as countries' terms of trade, investment etc. The authors find a significant and negative impact of income on infant mortality. The results for the other dependent variables such as child mortality are similar but are much weaker for life expectancy. The authors conclude that increases in a country's income may tend to raise the health status but only in the short run. Education was also found to have a significant impact in improving health status.

Hamner, Lensink and White (2003) estimate over 42,000 equations for infant and child mortality. Their results indicate that income per capita is a robust determinant of both these variables, but so are indicators of education, health and gender inequality. Contrary to some World Bank led research (Ravallion, 1997), their results show that improvements in child mortality rates can be brought about independent of income growth. Further, they argue that it is important to support social policy such as increasing health expenditure if poverty goals are to be achieved, while recognising that further work is required to identify effective interventions.

2.2.2 What Affects Child Undernutrition?

In this section, we review studies that are able to identify, to some degree, socio-economic factors that are associated with child undernutrition. We limit our review to studies in economics but include those from public health and epidemiology nutrition if their modelling framework is similar to that of Smith and Haddad (2000) to allow us to investigate the channels that the authors propose. These studies either use individual level data from primary or secondary household surveys or use macro data collected at country level. Documented support for each of these determinants is discussed further below based on the framework depicted in Figure 2.1.

Evidence from micro-level studies

The first set of determinants that influence children's nutrition status are the immediate determinants i.e. a child's dietary intake and health status.

Several studies have used the number of meals consumed daily as a proxy for dietary intake in examining the determinants of undernutrition. However, the evidence pertaining to the impact of the number of meals consumed daily on children's nutrition is mixed. On the one hand, in a study of the nutritional status of children aged between one and one and a half years in Nicaragua, Lamontagne *et al* (1998) find that the number of meals eaten daily by children are positively associated with weight-for-age and weight-for-height Z-scores. On the other hand, Caputo *et al* (2003) also use the number of meals eaten daily as a proxy for food intake in their investigation into the causes of child malnutrition in Benin but find that this has no significant impact on children's nutrition outcomes. Smith and Subbandoro (2007) suggest that it is not only the quantity of food that matters for an individual's nutrition but also the quality of food. Literature on investigations into the effect of quality of diet on nutritional status in microeconomics is very sparse. However, findings from clinical and epidemiological studies have bolstered the concept that nutritional deficiencies resulting from either poor intake of macro or micro nutrients are likely to make individuals susceptible to diseases and infection and adversely impair how immune system responds to these threats to health (Chandra-Babu and Andersen, 1994). Our review did not find any studies in economics that used the stock of child's health or recent illness as an explanatory variable.

Campbell (1991) suggests that food insecurity can affect health either directly or indirectly through a physiological mechanism related to nutritional status and can often lead to undernutrition. However, the impact of food security on the nutritional status of children is mixed. Kracht and Schultz (1999) in the introduction to their book *Food Security and Nutrition: The Global Challenge* called food security a pre-condition to development as food insecurity has a negative impact on nutritional outcomes. In turn, poor nutrition negatively impacts child and adult health which affects adult productivity. Studies such as those by Cook *et al* (2004), Olson (1999) and Casey *et al* (2001) find that children who live in food insecure households, who do not have enough to eat or eat food that lacks essential nutrients, tend to be malnourished or undernourished. Bairagi (1986) examines the determinants of the nutritional status of children in rural Bangladesh for a sample of 1400 children between the ages of one and four years. He uses food availability as one of the explanatory variables and compares the availability of food to households during famine and non-famine periods. The results of his regression analysis show that a famine (associated with little or no food availability) has a significant and negative effect on a child’s nutritional status. In another study, Borooah (2002) finds that the size of a household's stock of foodgrains and its access to a fair price shop were inversely related to the likelihood of a child from that household being stunted.

However, Kaiser *et al* (2002) find that among Mexican- American pre-school children, household food insecurity was not correlated to either their weight or height. The nature of the impact of food security on nutrition is often not very direct but acts in combination with higher levels of income, access to health facilities and the education of women in the household (Chandra- Babu and Andersen, 1994; Campbell, 1991).

Next, we look at the evidence for the impact of the underlying determinants of child undernutrition, aside from food security, which has been discussed above. Often used to proxy for care for children and mothers as explanatory variables are women’s education and the status of women in the household. Borooah (2002) uses data at the individual level for a sample of 50,000 children in rural India and examines the role of maternal literacy in reducing the risk of child malnutrition in India. He finds that the likelihood of a child being malnourished is higher when the mother is illiterate than when she is literate. A contributing factor to this result is that literate mothers make more effective use of health-care institutions than illiterate mothers. Behrman and Wolfe (1987) also find that mother’s schooling has a positive and significant effect on children’s nutritional status in a study conducted in Nicaragua for 1699 mothers who had children under the age of five. Similar results are found by Horton (1986) for a study investigating family size and children’s nutritional status in the Philippines and by Alderman *et al* (2005) for a study that evaluates the impact of nutritional interventions in Tanzania. This is a result that is also supported by Thomas *et al* (1991) who find that for their sample of 1346 children aged five or less in Brazil, mother’s education has a positive impact on children’s health and the pathway through which this acts is better access to information and income. Smith *et al* (2003) argue that the decision-making power of women (relative to that of men) improves with an improvement in their nutritional status. As a result, women’s nutritional status may act as a pathway through which any improvement in women’s status could lead to an improvement in their children’s nutritional status. However, Martorell *et al* (1984) found that for children under the age of 10 in rural Nepal, mother’s education was not associated with children’s nutritional status.

There is also evidence that suggests that the father’s education levels also have a positive impact on children’s nutrition (Cesar *et al*, 1996; Cochrane *et al*, 1982; Kassouf and Senauer, 1996). The magnitude of this impact was found to differ. Cesar *et al* (1996), Kassouf and Senauer (1996) and Alderman *et al* (2005) find that the magnitude of the impact of father’s education on children’s nutrition was greater than that of mother’s education, while Cochrane *et al* (1982), find that the impact of father’s education is only half that of the mother’s.

The contribution of income to a household’s budget is seen as a source of increased decision making power of women relative to that of the men in the household. This is because it may increase a woman’s perceived contribution to her household’s economic status. It may give women a sense of economic independence from men, especially if women are employed outside their households as it increases her fall-back position and gives her more bargaining power. Of course, this would still depend on the decision making mode in the household (Smith *et al*, 2003). Women who work outside their homes not only have an enhanced capability but they also have more social contact with people who are not family members (Sen, 1990). As discussed above, this means that they are exposed to new knowledge and have a clearer perception of well-being and individuality, which may enhance their power, relative to that of men in the household (Kishor, 2000).

While the employment of women could improve their status within the household, there is a trade-off between the benefits for children of mother’s income via female employment and the costs of reduced time of the mother in child care. The benefit of increased income would actually depend who controls income and has decision making power in the household as this would affect how resources are allocated within the household. This is confounded by the differences between working and non-working women in their marital status, poverty, education etc. Employment of women outside the household, especially those women who are mothers or primary caregivers, can also result in a loss of childcare time as the mother may be less available to breastfeed, cook meals etc. However, it is possible that non-working mothers spend less time on childcare activities if there are alternate arrangements for childcare (Lamontagne *et al,* 1998).

Empirical evidence on the relationship between children's health and nutrition and female employment is inconsistent. On the one hand, some studies show that mothers who contribute more to total household income are less likely to have undernourished children and that the majority of mothers' incomes are used to provide for their children (Mechner, 1988; Engle, 1993). On the other hand, others found that among poor women who worked as daily wage labourers, maternal employment significantly increased the risks of child mortality and malnutrition (Lamontagne *et al*, 1998; Abbi *et al*, 1991).

We have seen the various ways in which parental education and employment have an impact on caregiving behaviour and, in turn, on children's nutrition. However, it is also likely that the death of either or both parents and thus, changes in care are likely to affect the nutrition, health and overall well-being of children. This is corroborated by evidence from several studies on the impact of orphanhood, which find that the death of one or both parents can have a negative impact on children's health and nutrition (Ainsworth and Semali, 2000; Beegle *et al*, 2005; Lindblade *et al*, 2003; Alderman *et al*, 2005). However, some studies have also found that the nutrition status of orphans is not worse than that of non-orphans (Panpanich *et al*, 1999; He and Ji, 2007). It is possible that orphanhood can influence health through multiple pathways. The first is via income of the household since parental deaths are associated with income losses or costs incurred because of chronic illnesses. Another reason is that when one or both parents die, there is a change in the caregiver. In this case, there may be a bias against orphans and favouritism towards biological children for children who have lost both parents or among children who have lost one parents and are living with foster parents (Beegle *et al*, 2005). A change in caregiver may also take place when a parent moves out of the household, for example, out migration for employment and again, children may face discrimination in favour of biological children.

Several studies attempt to investigate the links between health and sanitation and children's undernutrition and use variables such as availability of drinking water, safe toilets and distance to the nearest health facility as indictors for good health environments. Hoddinott (1997) showed that improvements in water quantity and quality have reduced the incidence of various illnesses, including diarrhoea, roundworms, guinea worms, trachoma etc. that may in turn lead to undernutrition among children and adults. Horton (1986) uses data collected from 1903 households in the Philippines to examine the impact of home characteristics on children's nutrition. She finds that having an improved source of water i.e. water that is piped into the household or yard has a significant and positive impact on the nutritional status of children. Moreover, the use of modern toilet facilities by the household also has a positive effect on children's health. In a study set in Vietnam that looks into the impact of health programmes on child nutrition, Glewwe *et al* (2002) find that distance to the nearest provincial hospital and private pharmacy have a significant impact on children's nutrition. Being closer to these facilities is likely to have a positive impact on children's nutrition.

Next, we look at the evidence on income and how it affects children's nutrition. At the household level, variables that capture information on household resources are used. Duflo (2000) finds that children aged between 6-60 months in 9000 households in South Africa that benefited from a pension expansion programme that gave a boost to available household resources improved children's nutrition. In an evaluation of a conditional cash transfer programme in Colombia, Atanasio *et al* (2005) find that children who lived in households that benefited from the programme had better nutritional outcomes. Martorell *et al* (1984) find a household's landholdings and income are positively and significantly associated with almost all measures of nutritional status. Bairagi (1987) also finds that increases in income can bring about improvements in children's nutritional status. The size of this effect of income on nutrition however, is seen to be stronger for more literate mothers. This effect of income is also seen in a study conducted by Alderman *et al* (2005) in Tanzania. The authors evaluate nutrition interventions and income growth to see how both these can contribute to reducing malnutrition among children. Using data from the 1991-1994 short panel data set from Kagera in north western Tanzania, they estimate the determinants of a child's nutritional status in the short-term and long-term, including household income and the presence of two particular nutrition interventions in the community. Their results show that better nutrition is associated with higher income, and that nutrition interventions have a substantial beneficial effect.

Finally, we turn to socio-cultural factors such as religion of the household and ethnicity that are among the basic determinants of undernutrition (Smith and Haddad, 2000). Belonging to certain religious or ethnic minority groups often dictates access to infrastructure, education, labour markets of households that have an impact on the underlying determinants of undernutrition (Boo, 2009).

Including religion as a determinant of undernutrition would capture differences in food intake and care practices owing to the peculiarities of each group but empirical evidence to this extent is mixed. Caputo *et al* (2003) find that in Benin, children who followed Christian and traditional religions were less likely to be undernourished than children who did not follow any religion. They suggest that these differences may actually arise from the regional location of these groups as Christians (and Muslims) tended to be concentrated in urban areas while traditional religious groups and other lived in rural areas. However, these differences in nutritional status among religious groups disappear as children grow older. In another study in India, Belitz *et al* (2010) find that children who are of Islamic and Sikh faiths are poorly nourished compared to children who are of Hindu and Christian faiths. Here, however, the authors suggest that the differences in nutritional status among these groups are due to differences in care giving practices of each group. Jha and Gaiha (2003) also find that belonging to certain religious groups can have a positive impact on child and adult nutrition. In Tanzania, Abdulai and Aubert (2002) find significant variations between caloric demand between religious groups. However, Martorell *et al* (1984) find that belonging to a particular caste had no significant impact on children's nutrition.

The bulk of the literature reviewed is able to identify poverty and mother's education as having significant relationships with children's undernutrition. The literature shows that these relationships may be straightforward in some cases, while they are more complicated in others. For children in very poor households, it may be that even if they are able to obtain enough food, this is inadequately allocated to children or that it is of poor quality. Some households may have highly educated women, who despite their greater knowledge do not have physical access to health facilities such as hospitals or clinics. Policy responses are to address these deficits where they exist. However, providing these missing inputs, whether at a national level or at lower levels on an experimental basis may not have the desired behavioural change and this may not have an impact on undernutrition in the way that academics, practitioners and policy makers anticipate (Du Pas, 2011).

Evidence from macro-level studies

We now turn to the macro level evidence available for factors that have been shown to be associated with child undernutrition. At the country level, Smith and Haddad (2000), use secondary data from many sources for 63 developing countries over 1970-1996 in order to examine which factors may it as a proxy for food security. Their estimates for DES are statistically significant and positive, indicating that increases in DES help reduce child malnutrition. However, this is a declining marginal effect.

Smith and Haddad (2000) find that their overall estimates of women’s education as a determinant of child malnutrition are statistically insignificant and small. However, their estimates for each country indicate that mother’s education is highly significant and has a much stronger effect on a child’s nutritional status than seen in the first case. Haddad *et al* (2003) show that at the macro level, for a dataset of 70 developing countries, women’s education is significant only in one third of the countries. Thus, it is not necessary that an increase in the average level of women’s education would always improve undernutrition among children. However, in SSA, the higher status of women relative to that of men has a positive influence on children’s nutritional status.

At the macro level, the effects of health environments and health services are often captured by using variables population per physician, per capita health expenditure for country level studies. For a dataset that consists of 66 developing countries, Osmani (1997) finds that the coefficient on population per physician is positive and highly significant as a determinant of stunting. Hence, if there are a large number of well-trained and highly skilled physicians in a country, it is likely that fewer children will be undernourished (i.e. be short for their age). However, it is not just the number of physicians that matter. What should also be taken into account is whether individuals have access to health amenities such as sanitation and clean drinking water in order to account for a more complete analysis of the health environment. Gillespie, Mason and Martorell (1996) find that the levels of public health expenditures are significant determinants of changes in underweight prevalence, implying that the more that state spends on improving health facilities, the less likely individuals are to be undernourished. This indicator, however, does not capture people's access to these improved health services. If people do not have access to the improved health facilities, they will not benefit from them and their nutritional outcomes will not improve. Smith and Haddad (2000) find that the access to clean drinking water has a positive impact on health and nutrition. This indicator captures the state's efforts to provide a good health environment to its citizens as well as whether people have access to this clean water or not.

At the country level, per capita income is used as an explanatory variable in order to capture the economic resources that are available to households. It demonstrates the ability of individuals to purchase essential market and non-market good and services such as food, access to health and educational facilities. There are two views on how per capita income can influence undernutrition. One view is that increases in per capita income improve the nutritional status of children. A United Nations Administrative Committee on Coordination's Sub-Committee on Nutrition study (ACC/SCN 1993) examines the role of per capita income growth in determining annual changes in underweight prevalence in 42 developing countries. It finds a statistically significant relationship between GDP per capita growth and changes in underweight prevalence. Smith and Haddad (2000) find that their estimates for GDP per capita are statistically significant and positive, indicating that increases in GDP work towards reducing child malnutrition.

The other view is that increases in per capita income do not have any positive effect on the nutritional status of children. Some studies suggest that as poor households become less poor they spend the additional income on more expensive foods, which do not necessarily yield more calories. That explains why the elasticity of food expenditure is high and yet the elasticity of calorie intake is so low (Behrman and Deolalikar 1989; Subramanian, 2001). However, these estimates are biased upwards and have led to incorrect inferences. Also, these do not take into account the quality of food, which is just as important as the quantity - two people could have the same calorie intake but one of them could suffer from a deficiency disease such as anaemia or rickets because the quality of her food intake is poor. Haddad *et al* (2003) conclude that malnutrition and undernutrition would persist despite growth in per capita income, especially if additional measures to combat malnutrition are absent.

There is an intermediate view of the effect of per capita income on undernutrition. Haddad *et al* (2003) assume that household expenditure per capita is an indicator of the household long-term income potential. They use household consumption to proxy for per capita income. The authors find that at the micro level for 12 developing countries the logarithm on per capita household expenditure has a positive and significant effect on nutrition. The same study shows that for a dataset consisting of 70 countries the logarithm of GDP per capita has a negative and significant effect on the percentage of undernourished children at the macro level. The authors conclude that income that grows at a moderate pace cannot improve undernutrition. They suggest that if income is to help in successfully combating undernutrition, it should be complemented with investments in health, educational and other infrastructure.

While some of the macro literature can identify clear and statistically significant relationships between socio-economic characteristics of a household and child malnutrition, these links are not always unambiguous as seen in the case of the micro-level studies. For example, as discussed above, simple increases in GDP per capita are not enough to improve undernutrition; it needs to be accompanied by an increase in public health expenditure

2.3 Impact of Child Malnutrition and Undernutrition

In 2000, the United Nations estimated that one out of every three pre-school going children in developing countries (ie 180 million children under the age of five) exhibits undernourishment in the form of stunting. In their own right, improving child health and nutrition are seen to be important development objectives. As such, international organisations such as the World Bank and WHO prioritise improvements in this sector. It is widely recognised that ill health and poor nutrition can affect mental development in infancy and early childhood. As a result, children may enter school at a disadvantage. This holds true for developed and developing countries but more so for the latter owing to lower income levels and poor access to health and education facilities. These organisations that work towards improving children's health also emphasise increasing schooling attainments and are committed to the MDG of achieving universal primary education by 2015 (Alderman *et al*, 2002).

This section will first link nutrition and cognitive development and educational attainment in a general context. It will then discuss how a child's nutritional status can affect her educational outcomes in the context of existing economic literature.

2.3.1 Linking Nutrition to Cognitive Development and Educational Attainment

Health and nutrition can have long-term effects on cognitive abilities and their development though multiple pathways (Jukes, 2005). A state of disease can directly affect the brain through a reduction in the supply of nutrients or infectious agents that release neurotoxins or precipitate an immune response that affects the brain. This may lead to damage to the structure of the brain. In the event that this damage is irreversible, long-term effects on cognitive functions may appear.

With time, it is possible that secondary behavioural consequences may emerge in addition to the direct effects of illness. In particular, there is a high interdependency in early childhood between physical and mental development. For example, Lozoff *et al* (1987) find that iron-deficient children are more often fearful and more likely to cling to their mothers. A secondary consequence is that undernourished children do not explore and interact with their environment to the same extent as those children who are healthy. This, in turn, reduces the level of stimulation to the brain and stunts cognitive as well as social development. Indirect effects may also be mediated through caregivers. For example, it has been observed that parents of severely malnourished children interact with them less frequently. This lack of stimulation may in turn affect children's development further, compounding the symptoms of undernutrition (Grantham -McGregor *et al*, 1989).

It is therefore plausible that blows to cognitive development in early childhood that affect mental and social development can become worse over time. It is also plausible that once children are free from infection or their nutrition status has improved their cognitive functions too may recover.

2.3.2 Impact of Nutrition on Education

From historical studies, it can be seen that in pre-industrial societies, children with few years of formal schooling perform better than their unschooled peers in a wide range of cognitive tests. This is because formal education leads to the formation of learning skills and helps children to use information effectively. Pollitt (1990) states that this is also true in an environment of extreme economic poverty and in situations where physical facilities of the classroom are inadequate, books are scarce, teachers are poorly trained and underpaid. He argues that iron and protein energy deficiencies and even infections caused by hookworm, ascariasis and trichuriasis can have negative impacts on the school performance of a child. He goes on to say that this can affect the trajectory of the child's formal education.

We divide this section of the literature review into two broad parts. The first part will review studies that investigate the impact of nutrition on educational achievement either measured by performance on school exams, tests or other tests of cognitive development such as the PPVT and Raven's test. The second part will review literature on the effect of undernutrition on school attendance.

Educational Achievement

A body of literature, some of it outside economics, has explored the relationship between preschool nutritional status and the education of school-age children and adolescents in the context of developing countries. Results indicate that malnourished children score lower on tests of cognitive functioning, have lower activity levels, have lower enrolment rates, have poorer psychomotor development and fine motor skills, fail to acquire skills at normal rates, complete fewer grades of schooling and interact with other children and adults less frequently. It is believed that these reflect, in part, the biological pathways in which malnutrition can affect neurological development as discussed above. The adverse effect of malnutrition on fine motor control suggests that physical tasks associated with attending school, such as learning to hold a pencil, are more difficult for those who have suffered from malnutrition (Yaqub, 2002).

Maluccio *et al* (2006) advance beyond previous literature on the effect of early childhood nutrition on education in developing countries by using unique longitudinal data begun during a nutritional experiment during early childhood (from zero to 36 months of age) with educational outcomes measured in adulthood. They link information collected in the 1970s on individuals (and their families) exposed to a nutritional intervention when they were 0–15 years of age, with new data on these same individuals collected in 2002–04. They look into the effect of the intervention on several different education-related measures over the life cycle: grades of schooling attained; the rate at which individuals progressed through school; a test of cognitive ability; and an educational achievement test of literacy, vocabulary, and comprehension.

Their results indicate significantly positive and fairly substantial effects of the randomised nutrition intervention a quarter century after it ended. These included increased grade attainment (1.2 grades) by women through the increased likelihood of completing primary school and some level of secondary school as well as quicker grade progression by women. There was a one-quarter standard deviation increase in a test of reading comprehension with positive effects found for both women and men and a one-quarter standard deviation increase on nonverbal cognitive tests scores. There is little evidence of heterogeneous impacts with the exception being that exposure to the intervention had a larger effect on grade attainment and reading comprehension scores for females in wealthier households. This paper is perhaps the first of its kind from a prospective survey of the important role played by preschool nutrition in subsequent educational attainments and thus, underscore the value of a lifecycle approach to education that includes the preschool period. This suggests that programmes that provide nutritional supplements to very young children or improve their nutritional intake in some way may have substantial, long-term educational consequences.

Alderman *et al* (2002) link literature on shocks to the literature on pre-school nutrition. Their paper explores the long-term consequences of shocks on children's health and education in rural Zimbabwe. Using longitudinal data, they link the exposure to war preceding Zimbabwe's independence and the 1982-84 drought to the health status of the children. This, in turn, is linked to their educational and health attainments measured in 2000. They find a statistically significant relationship between the height-for-age of children under the age of 5 and the age at which a child starts school. Exposure to the 1982-84 drought resulted in a loss of height of 2.3 centimetres, 0.4 grades of schooling and a delay in starting school of 3.7 months. The authors go on to say that if the median pre-school child in the sample had the stature of a median child in a developed country, as an adolescent, she would be 4.6 centimetres taller, would have completed an additional 0.7 grades and would have started going to school seven months earlier. Their findings also indicate that these poor attainments adversely impact a loss of lifetime earnings of seven – 12% (and that such estimates are likely to be lower bounds of the true losses). Further, the effects of preschool child nutrition on school enrolments are larger for girls than for boys.

Even more recently, several studies have used longitudinal data have explored the relationship between early childhood nutrition and later cognitive development and skill acquisition. Le Thuc (2009) uses a pro-poor longitudinal dataset to study the childhood poverty–cognitive achievement nexus among children in Vietnam. He finds that, controlling for standard socio-economic circumstances of the household, increases in the standard deviation of children's height-for-age Z-scores at the age of one leads to an increase by one fourth of a standard deviation in the log score on test of language ability at the age of five. This improvement in the height-for-age Z-score also produces an increase of 0.20 points in the score on the administered mathematics test.

Sanchez (2009) uses longitudinal data for children in Peru. Controlling for lagged child and household characteristics and taking into account community characteristics, he finds a positive and statistically significant impact of early nutrition on cognitive achievement (measured by the Peabody Picture Vocabulary Test) four years later. In another study based on longitudinal data from India, Helmers and Patnam (2009) look into the formation and evolution of cognitive and non-cognitive skill formation for children in India. They look into the relationship between child health at age one and cognitive skills at age five. They find that child health at age one is positively correlated with cognitive skills at age five, though not with non-cognitive skills. They also found that child health at age one has a positive significant impact on cognitive skills at age five, though again, not on non-cognitive skills.

In a study based in rural Tanzania, Alderman *et al* (2009) investigate the impact of pre-school nutrition on schooling attainment and age of school entry. Their objective is to understand how an improvement in nutritional status of children can affect children and future adults. Specifically, they focus on the relationship between children's malnutrition and the ultimate achievement of grades and whether these grades are received later on (relative to well-nourished children) as a result of delayed entry into school. Using a longitudinal dataset from the Kagera region in Tanzania, they use panel data that tracks households and individuals over time and thus, link children's observed nutritional status with their subsequent (observed) school outcomes.

In their regression analysis, they use two ordered probit models, to estimate the determinants of schooling attainment and delayed years of school entry, controlling for right censoring of the years of schooling. This is done to account for the fact that the years of schooling completed do not always indicate the total schooling attainment to be achieved if the children are still going to school. The authors recognise that the endogeneity of childhood nutritional status could generate a correlation between nutritional status and the error components of their models. To correct for this endogeneity, they use household reported crop loss and community reported weather shocks, flood and drought, specifically, interacted with gender and age at the time of the survey.

The estimates of their probit models show that poor childhood nutritional status negatively affects school entry and schooling attainment. The authors also show that children who are severely malnourished are at greater risk of never attending school – they are twice as unlikely to go to school as well-nourished children. However, the effects of better nutritional status on schooling attainment decline as nutritional status improves. In addition to nutritional status, the authors also find that other significant determinants are the education levels within the family and household wealth. It is worth mentioning at the outset that the subsequent analysis our study has similar scope and uses the same data as the Alderman *et al* (2009) study. How the two analyses compare with each other will be discussed later on in this document (see Chapter 7).

Alderman *et al*'s findings from the study discussed above are corroborated by evidence presented by Glewwe and Jacoby (1995) and Glewwe, Jacoby and King (2001). Both analyses investigate the relationship between poor childhood nutrition and a delay in school entry and grade attainment. Both analyses, the former set in Ghana and the latter in the Philippines find that early childhood undernutrition does result in a delay in school enrolment even when standard socio-economic and school quality characteristics are controlled for. Glewwe and Jacoby (1995) find that in Ghana, the relationship between undernutrition during childhood and schooling achievement is inconclusive, while Glewwe, Jacoby and King (2001) find that there is a positive relationship between undernutrition and schooling achievement. However, what these studies do not include as explanatory variables are behavioural choices and preferences. For example, they do not include children's ability relative to siblings or classmates, children's motivation, parents' aspirations for children, time parents spend helping children with homework, etc. Owing to the lack of data on these variables that do have an impact on schooling achievement, these studies are unable to clearly establish causality between nutrition and education.

While these studies that have been discussed above use children's overall nutritional status as an explanatory variable, there are a few studies (mostly experimental) that suggest that a child suffering micronutrient undernutrition or deficiency, primarily iron deficiency, is also likely to have poor schooling and cognitive development outcomes. These studies are experimental and date as far back as the one conducted by Pollit et al (1978; 1983) and Deinard *et al* (1986) in the USA, Politt *et al* (1986) in Guatemala, Soewondo *et al* (1989) in Indonesia and Seshadri and Gopaldas (1989) in India. More recent studies include those conducted by Hall *et al* (2001) in Mali and Whaley *et al* (2003) in Kenya. Their findings show that interventions that provide iron supplements to those children who suffer anaemia result in improvements in their attention spans as well as their cognition. These studies are better able to explain causality owing to fact that interventions or trials are designed to study the impact of a "treatment" given to a group controlling for a scenario where the treatment is not given to another group.

Another set of experimental studies examine the impact of parasitic and worm infections on cognitive development and schooling achievements. Kvalsvig, Cooppan, and Connolly conduct two studies to (1991) investigate the impact of parasitic and whipworm infections on cognitive achievement in Natal, South Africa. For a sample of 210 children, in the first study, they find that parasitic infections combine with nutritional deficiencies and harm cognitive development. In the second study, they use a more comprehensive drug treatment and find no significant impact of the improved treatment on cognitive progress or educational attainment. These results do not conclusively establish a positive link between good nutrition and better schooling achievement or cognitive development.

More recently, Miguel and Kremer (2004) conducted an experimental study in 75 primary schools in rural Kenya and examine the impact of a programme that phased deworming treatment into these schools in a randomised order. They find that the deworming programme, which is a means to improve children's health and nutrition, brought about a reduction in school absenteeism by approximately 25% and that among the participation gains for the youngest children were the largest. Owing to the communicable nature of ringworm and hookworm infections, the authors also investigate the impact of deworming on children who attended schools that were near the "treatment" schools. They found that the positive effect of deworming seen among the children at the targeted schools spilled over to children who attended nearby primary schools. The authors also investigate the impact that the deworming programme, had on academic test scores and found that the programme has only a weak impact on scores.

A third set of experimental studies explores the impact of better diets as achieved by food supplementation intervention programmes. Behrman (1996) in his review argues that these appear to have been even less successful in establishing a link between nutrition and education than other studies. Chavez *et al* (1987) followed a sample of children in rural Mexico from birth until the age of 9. Of these children, half received supplementary food. The authors find that the children who received the supplementary food were more active in the classroom, had better interactions with classmates and significantly higher test scores on school tests than the children who were in the control group, showing that nutrition has a positive effect on children's schooling achievement.

A similar study was conducted in Guatemala where a sample of individuals was provided with a supplement drink (as against a control that received a placebo drink) and surveyed from 1969-1977. These individuals were followed up twenty years later (Martorell, 1995). The results show that those children who received the supplements performed better on motor development tests at the age of two, perceptual organisation tests at the age of five and was positively associated with knowledge, numeracy, reading and vocabulary and, to a lesser extent, to information processing result that is consistent with the evidence that early childhood nutrition has important long-run effects on cognitive achievement.

School Attendance

The impact of poor health and nutrition on school attendance is the primary research question for very few economics studies as most tend to concentrate on the impact on educational or cognitive achievement. A handful of studies in economics have looked into factors that have an impact on children's school attendance and our review found that it is the link between poor health and school attendance rather than nutrition and school attendance that is explored. Existing literature reveals that the effects of early childhood stunting on the future health of an individual can be quite severe. In terms of physical manifestations, children who are stunted in early childhood are likely to never reach their potential height or gain the corresponding weight. Further, women who are undernourished are likely to have children with low birthweight, perpetuating the prevalence of undernutrition and poor health (Victoria *et al,* 2008). Further, stunting can prevent the immune system and vital organs from fully developing, leading to a diminished stock of health (Cogill, 2003; Svedberg, 2000). Victoria *et al* (2008) find that birthweight is positively associated with lung function and the incidence of some cancers. The authors also suggest that stunting could be associated with mental illness with lower human capital. Much of the literature that examines the impact of the damage suffered in early life due to undernutrition links it to individuals' permanent physical and cognitive impairment, which in turn affects future productivity and income earning potential (Maluccio *et al* 2006; Jukes 2005; Grantham -McGregor *et al*, 1989; Yaqub, 2002; Appleton *et al*, 1996; Boisserie *et al*, 1985).

Neuzil *et al* (2002) find that among 313 students across pre-primary, primary and secondary schools in Seattle, Washington, children with influenza had high rates of absenteeism. In developing country settings, in a study undertaken to determine the prevalence of disease, the choice of treatment and the use of health services for a group of preschool children in rural, costal Tanzania, Neuvians *et al* (1988) found that cough, difficulty breathing, common cold and ear ache caused about 50% of all episodes of illness. However, this study is based on information available from village health workers' service records and obviously, does not capture any information about those children who may not have access to health services, physically or economically. The study also does not offer information on older children and adolescents.

While stunting provides information about early childhood undernutrition, it is likely that children's current nutritional statuses prevent them from regularly attending school. As children grow older, their nutritional status may not improve if their higher energy demands (needed for chores, walking to school etc.) are not met. Thus, irrespective of their early childhood nutritional status, if children are undernourished and/or hungry in 2004, they may not regularly attending school. However, the evidence on this is mixed. Powell *et al* (1998) suggest that hunger during school may prevent children from benefiting from education. In their evaluation of a school breakfast programme in rural Jamaica, they find that children who were provided with breakfast had better heights, weights, school attendance and small improvements on administered tests than those who were not given breakfast at school. Similar results were found by Meyers *et al* (1989). However, Weinreb *et al* (2002) find that among homeless and low-income housed mothers and their children (180 preschool-aged children and 228 school-aged children) in Massachusetts, there is no relationship between hunger and school attendance or school achievement.

It would be also be simplistic to assume that children do not attend school solely as a result of being undernourished or unwell. In developing countries, often, a reason for not sending children to school even though they may be enrolled in school is the cost associated with schooling, whether direct or indirect. Household wealth can play an important role in determining whether children attend school. Households incur direct and indirect costs when they send children to school, some of which can be extremely prohibitive for poor households. These costs include tuition fees, school supplies such as textbooks and other stationery, clothing such as school uniforms and shoes, transport costs to get to school, etc. Poor households may also have to bear additional opportunity costs of sending children to school in the sense that sending children to school results in the lost value of child labour, whether for activities within the household such as chores, caring for younger siblings, working on household farms/ business or outside the household on paid work activities (Burke and Beegle, 2004; Krutikova, 2009). Evidence suggests that better off households bear lower schooling costs and are more able to purchase goods and make resource allocations that will promote children's productivity in school and in turn, in the labour market (Leibowitz, 1977). Further in studies conducted in Ethiopia and India, children may be kept home from school as they are required to take care of younger siblings, older or sick family members; being engaged in paid or unpaid work activities within or outside the household; as an ex-post coping mechanism, etc (Krutikova, 2009; Bhalotra, 2007).

It is also believed that the gender of the child can determine school attendance, especially in patriarchal societies. Parents prefer to send boys to school as they feel that the returns to their education are higher than that of girls. The evidence on this, however, is mixed – this may be true for primary education but the reverse is true for secondary and tertiary levels of education (Deolalikar, 1993; Brown and Park, 2002; Burke and Beegle, 2004). The gap could also be driven by the fact as that girls grow older, parents feel that it is less safe for them to go to school, for fear of risks they may face on the way to school or abuse or bullying at the hands of teachers and male students (Tafere and Camfield, 2009).

Parental education can have a bearing on the education of children via several mechanisms. One view is that parental education is correlated with their children's education because of certain genetic abilities that children inherit from their parents (Leibowitz, 1977). Another view is that educated parents, who are likely to be wealthier parents, attach more importance to the education of their children and are more likely to provide their children with better quality and quantity of inputs that facilitate better educational outcomes (Stafford and Hill, 1974). Related to the better provision of inputs is the view that educated parents tend to have lower fertility rates than less educated parents and as a result, are better able to allocate household resources between their children. More educated parents, especially mothers, are also believed to be more socially mobile and are more likely to seek out knowledge that will improve caregiving practices and the well-being of children over a range of outcomes including education and health (*ibid*, Smith *et al*, 2003). Children of more educated parents may be more effective in developing their child's educational outcomes as well (Leibowitz, 1977). Children who have more educated parents are more likely to be attending school regularly. To summarise, this happens as Black *et al*, (2004) suggest either because of selection – more educated parents are likely to have skilled jobs, higher incomes, and this is likely to result in their children having adequate opportunities and inputs for higher educational attainments. Another reason is one of causality- more educated parents become better parents as education increases their mobility and their tendency to assimilate better caregiving knowledge, create better home environments and provide adequate inputs that result in better educational outcomes of their children.

There is also the view that even if households have the physical and economic means to access schooling, they may experience disadvantages in education. Very few of children who belong to these groups are likely to enter into school. If they are able to do so, they are likely to experience delayed enrolment, incomplete cycles of education and low levels of schooling (UNESCO, 2010). For example, Cueto (2009) found that in Peru, belonging to a family that spoke an indigenous language was an important predictor of poor educational outcomes for children compared to belonging to a Spanish speaking family. In Ethiopia, children who are Somalian in ethnic origin tend to complete fewer years of schooling than children of other ethnic origins (UNESCO, 2010).

2.4 Concluding Remarks: Literature Review

In this chapter, we have discussed different methods used to measure undernutrition as well as the advantages and limitations of each of these. There is a consensus that the POU measure as used by the FAO tends to give incorrect estimates of undernutrition for several reasons including inappropriate cut-offs for energy norms and poor quality of data on food availability of nations and energy requirements and consumption of individuals. While food diaries provide a detailed account of individual food and energy consumption, they are a tiresome method to collect data, especially for respondents. They suffer from the problem recall bias as do other survey questionnaire methods used to collect data. Additionally, respondents may over-report or under-report consumption of food because of a sense of shame as discussed in Section 2.1.3. Perhaps the most appropriate method to measure nutritional statuses of individuals would be anthropometry. While this method too has its shortcomings, such as measurement errors and the choice of appropriate reference populations, anthropometry gives a more accurate picture of the nutritional status of an individual.

We have also discussed the various socio-economic factors acting at the individual, household and national level that can determine the health and nutritional status of young children. While these studies suffer from some methodological limitations, they point to the importance of key variables as determinants of child malnutrition. They are per capita national income, women's education, variables related to health service and the health environment and national food availability. They present conflicting results, however, with respect to the impact that women's education, health environment and food availability have on health and nutrition. Anand and Ravallion (1993) suggest that in addition, poverty and variables affecting birth weight, such as women's status may be key. The studies also point to the importance of accounting for potential differences across regions.

From a conceptual standpoint, most studies have not taken into account the differing pathways through which various determinants of child malnutrition influence it. Past studies that have mixed basic underlying and immediate determinants in the same regression equation for child malnutrition have probably underestimated the strength of the impact and statistical significance of determinants lying at broader levels of causality. The studies reviewed here (except Pritchett and Summers 1996) do not address the problem of endogeneity, which arises from a number of different sources. For example, they omit cultural factors influencing caring behaviour that are difficult to measure and are typically unobserved but are important to nutritional outcomes. As a result, they are inferential and establish causality via the use of instruments or proxy variables. The exclusion of some variable (for which there are no proxies or instuments) can cause a large omitted variable bias because they may be correlated to included explanatory variables such as women's education. A final source of endogeneity is measurement error in the explanatory variables.

Finally, we reviewed the findings of studies that look into the relationship between poor early childhood nutrition and cognitive development of individuals at a later stage. While these studies exploit the advantages of longitudinal data that allow following up of individual outcomes, they are unable to establish a direct causative relationship between poor childhood nutrition and poor cognitive development or educational attainment, perhaps because of lack of data on some factors, for behavioural characteristics or responses of children and their parents such as their motivation, agency, efficacy and aspirations. While this is true for a few cases, there are some non-experimental studies, such as those by Alderman *et al (*2009) and Glewwe and Jacoby (1995) that are able to tackle this endogeneity using an instrumental approach. Further, these studies only explore the effects on cognitive outcomes of children who are very young and unlikely to be enrolled in school. Thus, they overlooking the impact that other factors such as school attendance, school quality and stimulation received at school can also have on cognitive development or the educational attainment of children.

We also review a set of experimental studies that examine the impact that poor nutrition acting via nutritional deficiencies, parasitic infections have on schooling achievements and cognitive development. Another set of studies explores the impact of food and nutritional supplements on educational achievement. The evidence on their impact on educational attainment is inconclusive and some of these studies suffer from problems related to inadequate randomisation and do not account for some confounding (explanatory) factors.

This literature review brings to mind several questions about the determinants and impact of malnutrition and undernutrition that still need to be explored:

1. How can we best analyse the different determinants of child undernutrition given that they tend to interact with each other? Which factors increase the likelihood of children being undernourished in the short- and long-term?

2. Given the mixed evidence on the impact of household food security on child undernutrition, does this factor (especially, the quality of food) indeed play a role in the determination of children's nutrition status as suggested? Does this role differ across the short- and long-term?

3. How do different indicators of status of women have an impact on children's nutritional status?

4. Does household wealth have a positive impact on children's nutrition? Is this a direct link or could it work through various other pathways?

5. How are poor early childhood nutrition and health and educational outcomes such as school attendance and cognitive development associated with each other?

6. Is this relationship still as strong when we take into consideration children's socio-economic circumstances?

7. Does the use of secondary data help us answer these questions in a satisfactory manner?

8. Do currently available sources of data need to make the use of better or more contextual instruments?

Through this study, we identify questions 1, 2, 4, 5 and 6 as the primary questions that need to be answered to help identify and help vulnerable populations as well as aid the achievement of the stipulated MDGs. Questions 3, 7 and 8 are secondary questions that are also crucial to the development process and can help us find better ways to find answers.

The next chapter provides an overview of social and economic policy in Tanzania, paying special attention to the national food and nutrition policy. This is followed by a discussion of some characteristics of Tanzanian households and child undernutrition and education in Tanzania.

3. Tanzania: Policy, Consumption, Nutrition and Education

How has economic and social policy developed in Tanzania? This chapter provides an overview of social and economic developments in Tanzania beginning in the pre-independence period until recently. This will give us the context in which we can study human development indicators of Tanzania as well as set up the background against which we can set up our analysis of the Kagera region.

3.1 Brief History of Policy

Tanzania has a long colonial history that dates back to the 1890s. In 1891, the German government declared a protectorate over its sphere of influence in Tanganyika and over the coastal strip of Zanzibar, where the German East Africa Company had bought out the sultan's rights. The German government recognised the administrative inability of the Company and was anxious to take advantage of the resources of its new dependency. However, a lack of communication at first restricted development to the coastal Zanzibar. In 1982, the introduction of sisal from Mexico in 1892 marked the beginning of the territory's most valuable industry. By 1912, coffee-growing activities on the slopes of Kilimanjaro and wild rubber tapped by Africans, together with plantation-grown rubber, helped swell the country's economy. The government also supplied good-quality cottonseed free to African growers and sold it cheaply to European planters. The administration tried to make good the lack of clerks and minor craftsmen by encouraging the development of schools, an activity in which various missionary societies were already engaged.[2]

Owing to the outbreak of World War I and being blockaded by the British navy, the country could neither export produce nor get help from Germany. The British advance into German territory continued steadily from 1916 until the whole country was eventually occupied. The war disrupted the German-led administration and economy and their return to traditional social systems of subsistence farming. Under

[2] Tanzania National Website: http://www.tanzania.go.tz/history.html#Colonial%20Period

the 1919 Treaty of Versailles, Britain received a League of Nations mandate to administer the territory.

In Tanganyika territory, the objective of the British government was to build up local government on the basis of traditional authorities. However, the economic depression in 1929 resulted in the curtailment of many of the British development proposals for Tanganyika. At the outbreak of World War II, Tanganyika's main task was to become as independent as possible of imported goods. Inevitably the retrenchment evident in the 1930s became more severe and while prices for primary products soared, the value of money depreciated proportionately. Tanganyika's main objective after the war was to ensure that its programme for economic recovery and development should go ahead (Penna, 1993). The continuing demand for primary produce strengthened the country's financial position. In 1947, Tanganyika was placed under UN trusteeship. Under the terms of this trusteeship agreement, Britain was called upon to develop the political life of the territory, which gradually began to take shape in the 1950s with the growth of the Tanganyika African National Union (TANU) (*ibid*).

After gaining independence in 1961, Tanganyika, has enjoyed peace and stability. She acquired the name Tanzania after Tanganyika united with the island sultanate of Zanzibar in 1964. Since then, Tanzania has passed through different political and development periods, each driven by different political ambitions and developmental directions and each having consequences in terms of the people’s health.

Four main development periods have characterised Tanzania since her independence. The first period begins in 1961 with independence and ends in early 1967. This marks the beginning of Tanzania’s phase of socialist policies for development. The nature of politics that dominated Tanzania during the period until 1967 did not, however, differ from what was inherited from the colonial government. Although racial discrimination was abolished in the provision of education and health services, private sector, particular religious organisations, continued to dominate in the provision of health and education. Emphasis on health provision continued to be curative rather than preventive (Heggenhougen and Lugalla, 2005).

In 1967, the TANU, the only official party at that time, redefined its political ideology and developmental direction. Juluis Nyerere the then president of the Republic of Tanzania and Chairman of TANU introduced the Arusha Declaration, which became the country's development blueprint for socialist construction. It rejected the capitalist path to development and vowed to build a socialist society based on the principle of "Ujamaa (familyhood) and Self-Reliance". The Ujamaa policy, the focus of which was on rural development and self-reliance, also introduced policies of nationalisation. In addition to banks, insurance firms and other companies, the nationalisation process also included schools and health institutions. This marked the beginning of the provision of free education and medical care. As far as health care was concerned, the emphasis shifted from curative to preventive and from huge investments in few big hospitals to the construction of primary rural health care centres and rural dispensaries. What was advocated was the importance of a holistic preventive community approach to health rather than a curative one. During this period, emphasis was placed on raising consciousness about Ujamaa's philosophy and policy by the government throughout the country. In addition, the Arusha Declaration sought to marshal the commitment of Tanzania to building a nation based on the principles of socialism, equality and self-reliance. These principles for social change were expected to improve the health and welfare of Tanzanians (*ibid*).

The Ujamaa policy of Tanzania introduced human oriented policies that emphasized the redistribution of economic resources to the rural poor. Although there is some evidence that the policy was coercive and violated human rights of a few, it created conditions that allowed the majority of people to easily access the basic necessities of life such as land, good education and health care. In the health sector, as a result of the Ujamaa policy, Tanzania managed to create an extensive network of health facilities. For example, a study carried out in six of the country's 20 regions found that in 1979, 92% of the population was within 10 kilometres and 70% were within five kilometres of a health facility and 45% had such a health facility in their local community (Heggenhougen *et al*, 1987)

The third development phase began in the early 1980s and extended into the mid-1990s. This phase was mainly characterised by a growing conviction on the part of many politicians and other leaders that the country had a number of policy and development problems. It became clear that Tanzania was in a serious social and economic crisis, which began in the mid-1970s and manifested itself in extensive and persistent internal and external macroeconomic imbalances. These were manifest in insufficient and declining GDP growth; poor performance of the agricultural sector, which led to food deficits and a decrease in the volumes of traditional crops exported; overvaluation of currency and balance of payments; accelerating rate of inflation; budget deficits; and deteriorating social and physical infrastructure. These problems are believed to have stemmed from exogenous factors that were affecting the economy such as drought, increase in petroleum prices, the war with Uganda under Idi Amin and terms of trade volatility (Lugalla, 1997; Green, 2001; World Bank, 2002). While Tanzania's long term foreign debt was US$ 188 million in 1920, by 1994, this had risen to US$ 6.2 billion (Heggenhougen and Lugalla, 2005). These problems resulted in acute shortages of basic commodities such as clothing, sugar, soap, cooking oil etc. Data also indicates that real agricultural output declined during this period. The only sector that continued to expand in real terms was public administration. The fundamental political economy problem of the country at this time was that material production was decreasing but public administration was expanding. The crisis had serious consequences for the government's ability to provide basic social services such as education and health care. As far as health was concerned, its quality began to deteriorate tremendously. Shortages in medicine and essential equipment in hospitals, rural health centres and dispensaries became apparent. Lack of incentives such as good living wages and a good working environment demoralised the health personnel and bred inefficiency and corruption (*ibid*).

In the mid-1980s, in order to deal with the crisis, the government, at the urging of the International Monetary Fund and World Bank, adopted structural adjustment policies, which, besides other measures, advocated the reduction of government expenditure on health and education. These policies also introduced user fees so that costs were shared between the providers and consumers. This brought about mixed outcomes for different socio-economic groups. Several rural areas were served by government facilities and not always well stocked. Often, villagers needed to travel long distances to the district or regional headquarters where most health (and education) facilities are located. Further, the inability to pay for these services is of concern as not all people were able to pay (World Bank, 2002).

Since the late 1990s, despite the adoption of a decentralised governance structure, the Tanzanian government is still centralised in operation and has weak capacity as far as public service delivery is concerned. In order to effectively implement market-based economic policies, the government has left most economic activities in the hands of the private sector and focuses on the "core functions of the government", i.e., providing infrastructure law and order, defence and security, etc. This move to institutionalise market-oriented economic systems after nearly 40 years of a socialist approach to economic and social development has led to the recent public service reforms mentioned above. It is believed that these reforms will target changes in attitudes and enhance efficiency in the delivery of public services (*ibid*). However, supportive institutions and changes in the legal provisions are needed to buttress the development of the private sector in the economy. What continues to remain a challenge is enabling the economy to move to a higher level of supply response and growth while persistently working towards poverty reduction.

The Government of Tanzania has articulated the long-term development perspective of the country in Development Vision 2025. This takes into account lessons learnt from past and on-going economic reforms and charts the future outlook of the country to set goals and targets to be met by 2025 that will improve growth and development. To realise these goals, it will be necessary take steps that will minimise price distortions, ensure price stability, and manage balances so that Tanzania does not "live beyond its means". It also means that higher levels of domestic savings and investment would have to be mobilised and that human resource development and sustainable economic growth would have to be ensured (*ibid*).

3.1.1 The National Tanzania Food and Nutrition Policy

The first major government initiative to address the malnutrition problem in Tanzania was taken in 1937 by the British colonial government. Mwaluko and Kilama (1991) stipulate that it was driven by the underlying belief of the British government that improved nutrition of the African population would result in better health and resistance to disease, which meant greater capacity for work and output. This led to the preparation of a nutrition programme, which could not be implemented due to World War II breaking out; after the war, the programme was shelved. In 1947, the Ministry of Health established a Nutrition Unit and appointed a full-time Nutrition Officer. This was followed by several nutrition surveys done in specific areas mainly in the Mlalo and Makonde Highlands. The first attempts towards systematic pursuits of national nutrition objectives were made in the 1960s (Mwaluko and Kilama, 1991).

Following the Arusha Declaration, the need for a systematic pursuit of national food and nutrition objectives through a national food and nutrition policy became more apparent. The need for a national food and nutrition policy stemmed from the fact that there was an array of sectors, institutions and agencies, both governmental and non-governmental involved in nutrition work. All these required guidelines to harmonise their activities and it was believed that a national food and nutrition policy would bring about this harmony, conceptually and practically (Msuya, 1999).

Eventually through the support of the Swedish International Development Authority a field-oriented coordinating centre called the Tanzania Food and Nutrition Centre (TFNC) was created. The main challenge that the TFNC faced was moving nutrition into the mainstream of development planning discussions. As these discussions went on in the country, the understanding of causal factors due to malnutrition increased. Progressively, the analysis was moved from malnutrition as the final concern to include child deaths as a manifestation of the various nutritional and health problems. The organisation of the various ideas in the early 1980s saw the development of a conceptual framework that has guided subsequent work in nutrition (Jonsson, 1988). Thus, establishing a national food and nutrition policy in Tanzania was not an easy task. It took four years (1976-1980) to formulate a draft policy and another 11 (1980-1991) for the policy to be amended and declared. The process was politically initiated in 1976 by TANU. This was also in response to the food crisis brought on by the 1974-1975 country-wide drought. The first draft was completed by the TFNC and submitted to the government for scrutiny in 1981. Several revisions have been made since then following inputs from various sectors and institutions that were involved such as lessons learnt from an intervention programme in the Iringa region and goals from the World Summit for Children (Mwaluko and Kilama, 1991).

The food and nutrition policy in Tanzania addresses five key areas: (i) food security; (ii) care for special groups; (iii) essential human services; (iv) food and nutrition committees; and (v) the role of various sectors in the implementation of the policy. Besides the national food and nutrition policy, several large scale successful food and nutrition programmes have been initiated in mainland Tanzania and Zanzibar, largely under UNICEF field support. There are also a number of other programmes that have been set up that have affected the nutrition of the people, though this was not their main aim. These included programmes that aim to improve and develop agriculture; school and adult education programmes; health improvement programmes; (for example, provision of primary health services to people in rural areas); programmes to create food sufficiency' to provide people with safe drinking water; general income improvement, etc. (Msyua, 1999).

The rest of this chapter aims to provide a descriptive summary of some demographic and socio-economic characteristics of the population in the households sampled in the 2004-05 Tanzanian Demographic and Health Survey (TDHS). It will also examine national trends pertaining to nutrition and education. This is done to explore these areas and determine national patterns, which would enable us to contextualise the situation in the Kagera region.

3.2 Household Consumption and Food

3.2.1 A Typical Tanzanian Household[3]

Owing to high levels of fertility in the past, Tanzania has a larger proportion of its population in the younger age groups than in the older age groups. According to the 2004-05 Tanzania Demographic and Health Survey (TDHS), about 47% of the population is under age 15 and about 49% of the population is aged between 15 to 64 years with the remaining 4% being aged 65 and above. As a result the age

[3] For the purpose of the 2004-05 TDHS, a household was defined as a person or a group of persons, related or unrelated, who live together and share a common source of food.

dependency ratio in the country is very high (104). This pattern is similar to that found in the 1996 TDHS.

Table 3.1: Distribution of households by sex of the head of the household, household size, 2004-05

	Residence				
	Mainland				
	Urban	Rural	Total	Zanzibar	Total
Sex of the head of the household					
Male	77.2	74.9	75.5	77.1	75.5
Female	22.8	25.1	24.5	22.9	24.5
Number of usual members					
1	13.9	7.2	8.9	4.6	8.8
2	13.2	10.7	11.4	8.6	11.3
3	16.8	15	15.5	13.1	15.4
4	15.3	15.6	15.5	13.1	15.5
5	12.8	15	14.5	13.p	14.4
6	9.4	12.2	11.5	12.1	11.5
7	6.5	8.3	7.9	12.3	8
8	5	5.5	5.4	8.4	5.5
9 or more	7	10.3	9.4	13.9	9.5

Note: Figures are in percentages.
Figures are based on de jure members
Source: TDHS (2004-05)

The composition of households by sex of the head of the household and size of the household is presented in Table 3.1. As these characteristics are associated with aspects of household welfare, it is important to include them in our discussion. For example, typically, households that are headed by women are poorer than those that are headed by men. Larger households are associated with more crowding in dwelling, poverty and poor health and sanitation. Table 3.1 shows that women head one-fourth of Tanzanian households. On an average, the size of a household size is 4.9 persons, with the average number of members lower on the mainland (4.8) than in Zanzibar (5.6). Households with nine or more members account for 7% of mainland urban households, compared with 10% of mainland rural households and 14% of households in Zanzibar. Conversely, the proportion of single-person households is higher in mainland urban households (14%) than in mainland rural households (7%) or Zanzibar (5%).

As it is an agrarian economy, the agriculture sector in Tanzania is the main employer. Figures from the 2004-05 TDHS indicate that 78% of women and 71% of men were engaged in agricultural occupations. Unskilled manual labour is an emerging sector, constituting 11 and 9% respectively, of total employment for women and men. Professional, technical, and managerial occupations engaged only 2% of women and 4% of men. The occupation that individuals are engaged in varies with the area of residence. In rural areas, most women and men were engaged in agriculture, and urban dwellers in other occupations. Residents of mainland Tanzania were found to be engaged in various occupations while residents of Zanzibar, with limited land, were more likely to be engaged in skilled and unskilled occupations, compared to the mainland. Unsurprisingly, the proportion of individuals in professional, technical, and managerial occupations is higher in Zanzibar (14% of men and 10% of women) than on the mainland (3% of men and 2% of women).

The TDHS 2004-05 suggests that there is little association with age and occupational categories, barring professional, technical, and managerial occupations, the proportions of which generally increase with age. Men and women with at least some secondary education are most likely to be employed in professional, technical, or managerial jobs.

The availability of durable consumer goods is a good indicator of a household’s socioeconomic status. Of the items listed in the TDHS 2004-05, nationally, the most commonly owned items were radios (58%), paraffin lamps (39%), and bicycles (38%). Only 9% of Tanzanian households owned a telephone, 6% a television, and just 4% a refrigerator. On mainland, urban households are more likely than rural households to own each of these items with the exception of a bicycle. The vast majority of households in Zanzibar own a radio (80%) and more than half own a bicycle.

Ownership of agricultural land is common in Tanzania. The TDHS 2004-05 find that nearly eight in 10 households possessed land. Not surprisingly, rural households on the mainland were much more likely than urban households to own agricultural land (93% and 42%, respectively). In Zanzibar, 48% of households reported ownership of agricultural land.

The next section looks into the consumption expenditure patterns of households in Tanzania. We look at what proportion of their consumption expenditure is on food items and how this has changed over time. This leads into a discussion on food security – the quantity and quality of food that they consume.

The Tanzanian Household Budget Survey (HBS) collects information on income, consumption and expenditure at the national level. This information will help put into context key issues that will help explain the poverty- nutrition nexus and consequently, enable a more comprehensive analysis of our research questions. The key issues that we aim at looking into are (i) sources of household income; (ii) consumption and expenditure patterns of households; and (iii) food security of households given income and expenditure.

3.2.2 Sources of Household Income

The HBS collects information on household income in two ways. Households were asked to keep a dairy and to record details of income coming into the household for the duration of the survey month. This included the amount, its source and the household member who received it. This was supplemented by recording the annual household income at the end of the survey month (HBS, 2007). Households receive income from a variety of sources that include formal and informal sector employment, self-employment as well as in-kind transfers from institutions or other individuals. The HBS distinguishes between these various sources and includes the value of household consumption of items that were produced by the household as well as transfers.[4] Table 3.2 presents the mean per capita monthly income in 2007 for each household. [5]

In 2007, Dar es Salaam has the highest per capita income, while it is lowest in rural areas. Agriculture had the highest share in income in Tanzania, followed by transfer and receipts and employment (cash). However, when we disaggregate this data by region, we see that different sources contribute to income in different proportions. For example, agriculture and related activities have the highest share in income in rural areas but in Dar es Salaam and other urban areas, the highest share in income comes from non-farm self-employment.

[4] As the information was collected in the form of gross revenue for some sources, it is possible that the average per capita receipts may seem to be larger than per capita expenditure, though this is not the typical case.

[5] The information presented in this section is based on the figures obtained from the monthly diaries. It is felt that this method may provide more comprehensive information on the range of sources in the population as a whole (HBS, 2007)

Table 3.2: Mean per capita monthly income for households, Tanzania, 2007

Source	Mainland Tanzania	Rural	Dar es Salaam	Other urban
Employment (cash)	6,787	2,812	28,898	12,727
Employment (in-kind)	104	53	84	309
Self-employment (non-farm)	17,166	10,241	38,826	34,654
Agriculture and related activities	9,426	11,324	1,036	5,673
Producers co-operatives	82	73	39	135
Imputed rent	23	10	56	60
Interest and dividends	22	9	71	49
Rent received	338	118	724	1,023
Transfers and other receipts	5,413	3,777	10,410	9,599
Total income	39,362	28,418	80,144	64,231

Note: Figures are reported in TShs
Source: HBS (2007)

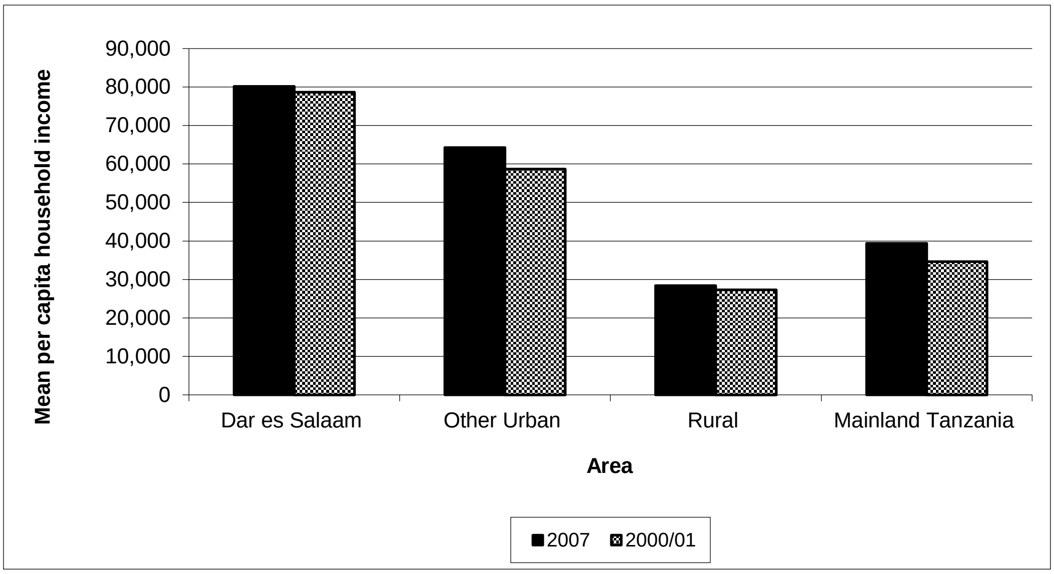
Since 2000/01, there has been a decline in the proportion of income from agricultural sources from 60% to about 50% in 2007 (Table 3.3). This could be the lagged effect of the severe drought that Tanzania experienced in late 2005 and early 2006 (HBS, 2007). This is significant because rural income seems to rely heavily on income from agriculture and its related activities.

Table 3.3: Shares in household income by source, Tanzania, 2000/01 and 2007

Source	Mainland Tanzania		Rural		Dar es Salaam		Other urban	
	2000/01	2007	2000/01	2007	2000/01	2007	2000/01	2007
Employment (cash)	12	13	7.8	8.1	41.1	35.9	24.1	22.1
Employment (in-kind)	0.5	0.2	0.5	0.2	0.6	0.1	0.4	0.4
Self-employment (non-farm)	20.6	30	17.8	27.3	29.1	37.6	32.8	37.1
Agriculture and related activities	51.4	39.7	60.4	49.6	1.9	2.4	19.6	17.7
Producers co-operatives	0.4	0.4	0.3	0.5	0.6	0.3	0.4	0.3
Interest and	0.1	0.1	0.1	0	0.2	0.1	0.1	0.1
Rents	0.5	0.5	0.2	0.3	1.8	1.4	1.2	1.1
Transfers and other receipts	14.7	16.1	12.8	14.1	24.7	22.1	21.2	21.3

Note: All figures are in percentages
Source: HBS (2007)

Figure 3.1: Mean per capita monthly income for households, Tanzania, 2000/01 – 2007



Note: All figures are in TShs (at current prices)
Source: HBS (2007)

There is also an increase in the proportion of income from transfers and employment. In Dar es Salaam and other urban areas, income from employment provided 36% and 22% of household income, respectively, in 2007. This is a slight decrease since 2000/01. However, in these areas, income from self-employment has increased from 29% in Dar es Salaam and 33% in other urban areas in 2000/01 to 38% and 37% in 2007 indicating a growing dependency on self-employment for income. Since 2000/01 there have been increases in (nominal) income in all areas in Tanzania, particularly in other urban areas (Fig 3.1).

3.2.3 Household Expenditure and Consumption

The HBS also used the diary method to collect information on household consumption and expenditure (this method is described in detail with reference to collecting data on individual calorie intake in Section 2.1.1). Each household was given a diary, which was used to record items that were purchased and consumed by the household on a daily for one month. Adults in the household were provided with additional diaries in order to record their personal expenditure outside the household. This information was added to the household consumption and expenditure diary.

The respondents were also asked to recall expenditure on non-food items in the last year.

The diary recorded items that were purchased as well as those that were consumed but not purchased such as items that were produced in the household, transfers, payments in kind for work done, for example, food for work. The quantity and value of all items was recorded. Items that had not been purchased were valued at local market prices. Thus, the HBS calculates a single monetary measure of household consumption that denotes household consumption expenditure. This includes food consumption, health and educational expenses, expenditure on consumer durables and expenditure on other non-durables per month (*ibid*).

The analysis in this section will depend more on the consumption expenditure of households rather than household income. It is often argued that is it preferable to look at what households actually spend rather than what they earn. The fundamental premise of this view is that households (and individuals) derive material well-being from the actual consumption of goods and services rather than from the income that they obtain (Slesnick, 2001).

Another argument that is often made in support of using consumption to look into resources of a household is that consumption is a better estimate of a household's long-term income. This is because income tends to fluctuate a great deal, especially in the short-term. This is particularly true in developing rural economies that depend on rain-fed agriculture. In contrast, consumption tends to be more stable over time and could be a better indicator of poverty in the short- and long-term (Ravallion, 1992).

Further, income tends to be reported less accurately than consumption. This is partially because income tends to fluctuate as mentioned above. Further, it is more likely that income data will suffer from recall bias (Johnson, 2004). Thus, consumption expenditure provides a more reliable measure of households' income, reducing reporting errors and smoothing out short-term fluctuations.

Table 3.4 presents the average levels of consumption expenditure per month for 2000/01 and 2007 at current prices. In 2000/01, the mean expenditure per capita was TShs 9.997. The median expenditure per capita was TShs 7,434, considerably lower than the mean expenditure per capita. Since then, the mean and median per capita expenditure have increased. In 2007, the mean expenditure per capita was TShs 20,012. The median expenditure per capita continued to be lower than the mean expenditure per capita – at TShs 14,992. In 2000/01 and 2007, mean per capita expenditure in Dar es Salaam was higher than that in other urban and rural areas.

Table 3.4: Average monthly household consumption expenditure, Tanzania, 2000/01 - 2007

Measure	Mainland Tanzania	Rural	Dar es Salaam	Other urban
2000/01				
Mean expenditure per capita	9,997	8,456	21,415	14,185
Median expenditure per capita	7,434	6,825	16,203	11,407
Mean expenditure per household	49,428	42,999	92,767	63,657
2007				
Mean expenditure per capita	20,212	16,418	42,074	27,100
Median expenditure per capita	14,992	13,408	32,383	21,388
Mean expenditure per household	96,600	82,715	154,904	118,582

Note: All figures are in TShs and at current prices
Source: HBS (2007)

Table 3.5: Mean expenditure per capita, by category, Tanzania, 2000/01 and 2007

Category	Mainland Tanzania		Rural		Dar es Salaam		Other Urban	
	2000/01	2007	2000/01	2007	2000/01	2007	2000/01	2007
Food - purchased	4,085	8,079	3,118	5,944	10,301	18,731	7,114	12,650
Food – not purchased	2,051	3,789	2,375	4,612	368	418	876	1,717
Total food	6,137	11,868	5,492	10,556	10,668	19,149	7,989	14,367
Durables	650	1,147	484	767	1,892	2,738	1,099	2,090
Medical expenditure	232	362	190	286	569	816	338	490
Education expenditure	227	550	138	248	974	2,387	431	1,059
Other non-durables	2,718	5,764	2,146	4,368	7,006	14,003	4,253	8,217
Telecommunications	33	522	6	194	304	2,980	74	877
Total consumption expenditure	9,997	20,212	8,456	16,418	21,415	42,074	14,185	27,100

Note: All figures are in TShs and at current prices.
Food not purchased' includes food produced for home consumption, received as payment in kind or gifts
Source: HBS (2007)

We are also able to compare the average monthly expenditure of households to the average monthly income of households from figures provided by the HBS. In 2000/01, average monthly consumption expenditure of households in mainland Tanzania, rural areas, Dar es Salaam and other urban areas, exceeded the average monthly income of households. This is also true for 2007. In fact, the gap between average monthly income and consumption expenditure of households in 2007 was more than two times the gap in 2000/01.

We can study the structure of consumption in Tanzania using the information from the HBS on the quantity and value of items purchased and consumed. Broadly speaking, consumption can be divided in to the following categories: food items that were purchased, food items that were not purchased but consumed, durables and non-durables[6], medical, education and telecommunications. Table 3.5 presents the mean expenditure per capita for 2000/01 – 2007. In both years, mean expenditure on all categories is highest in Dar es Salaam and lowest in rural areas, with the exception of home-produced food.

Table 3.6: Share in consumption by category, Tanzania, 2000/01 and 2007

Category	Mainland Tanzania		Rural		Dar es Salaam		Other Urban	
	2000/01	2007	2000/01	2007	2000/01	2007	2000/01	2007
Food – purchased	39	37.6	35.5	33.3	53.1	50.8	53.4	49.4
Food – not purchased	27	26.5	32.1	33.2	2.1	1.4	8	9.4
Durables	4.7	4.2	4.5	3.9	5.2	4.7	5.3	5.5
Other non-durables	25	26.7	24.1	25.8	31.6	31.5	27.5	28.6
Medical Expenditure	2.2	1.8	2.1	1.8	2.9	2.1	2.4	1.9
Educational Expenditure	2	1.8	1.7	1.4	4.1	3.9	3.1	2.9
Telecommunications	0.1	1.3	0	0.6	0.9	5.7	0.3	2.1
Total	100	100	100	100	100	100	100	100
Of which, total food	66	64.1	67.5	66.5	55.2	52.2	61.4	58.9

Note: All figures are in TShs and at current prices.
Food not purchased' includes food produced for home consumption, received as payment in kind or gifts
Source: HBS (2007)

We also look at the mean share of consumption expenditure by category (Table 3.6), in particular the share of consumption expenditure on food. Households in which consumption expenditure on food is a large proportion are vulnerable to food deprivation. This is because irrespective of their current food consumption, if they were to experience a reduction in income, it is likely that this would be accompanied by a reduction in the quantity (or quality) of food consumed (Smith and Subandoro,

[6] Non-durable items include personal effects, personal care, recreation, fuel, transport, utilities and services, clothes, alcohol and other items.

2007). Households in Dar es Salaam spend the lowest proportion on food (52%), while rural households have the highest food share (67%). The share of expenditure on food has declined overall and in all areas, particularly in Dar es Salaam and other urban areas. Households with higher incomes generally spend a lower proportion on food. Other categories have also seen slight falls in their shares, the exceptions being: expenditure on telecommunications, which has increased reflecting the introduction of mobile phones - especially in Dar es Salaam, where telecommunications now accounts for almost 6% of household expenditure; and an increase in the share of expenditure on other non-durables outside Dar es Salaam.

3.2.4 Tanzania: What and How Much are People Eating?

Food security is a well-established determinant and one of the most important determinants of nutritional status (Smith and Haddad, 2000). This implies that the more economic and physical access to food that households have, the more likely they are to be food secure and in turn, the better is their nutrition. There are three key issues that we need to analyse when we look into food security (see Section 2.2 for the definition of food security). One is the quantity of food that an individual is consuming, the share of income that is spent on food (discussed above) and the other is quality of food consumed (Smith and Subandoro, 2007).

Table 3.7: Usual number of meals consumed per day, Tanzania, 2000/01 and 2007

Usual no of meals per day	Mainland Tanzania		Rural		Dar es Salaam		Other Urban	
	2000/01	2007	2000/01	2007	2000/01	2007	2000/01	2007
One	1.1	1.1	1.2	1.2	0.4	0.3	0.8	1.1
Two	47.5	40.5	55.8	49.8	9.5	10.2	21.5	21
Three	51.1	58.3	42.8	48.9	89.6	89.2	77.1	77.6
Four	0.3	0.2	0.2	0.1	0.5	0.2	0.5	0.3

Note: All figures are in percentages
Source: HBS (2007)

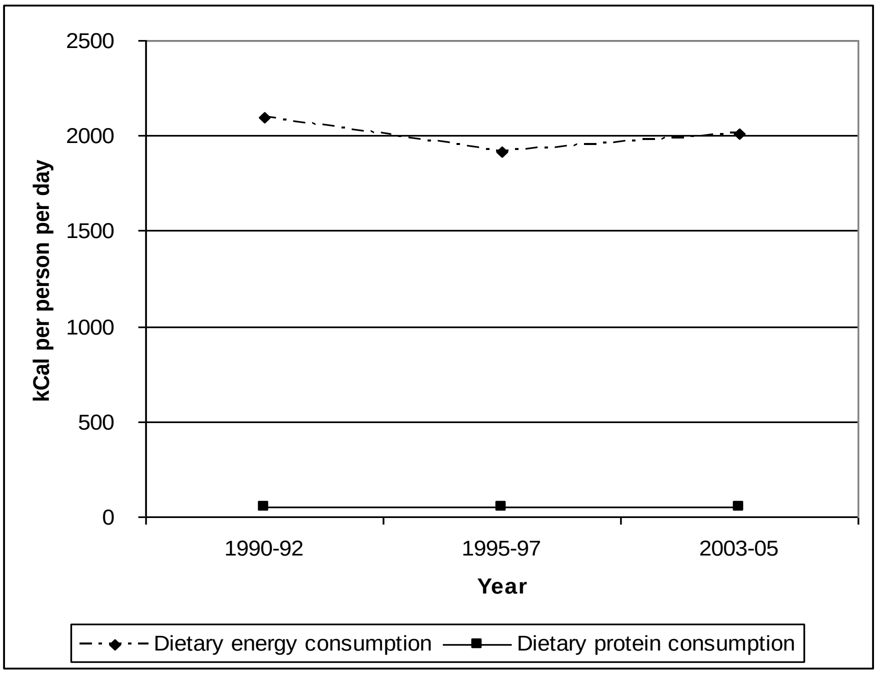
One way in which we can gauge the quantity of food consumed is by looking at food frequency ie the number of meals consumed per day. The HBS asks respondents a series of very specific questions on food security. These questions include those on the usual number of meals that are consumer by the household per day and the number of days in the previous week on which certain foods were consumed. Most households report that they usually consume either two or three meals per day (Table 3.7). In urban areas three meals is the norm. Since 2000/01, there has been a decrease in the proportion of households that consume two meals and an increase in the proportion that eats three meals a day.

The HBS also asked respondents whether the household had had fewer meals than the usual number on any days in the preceding month. Figures from the HBS (2007) indicate that respondents were most likely to report that they had had fewer meals than the usual in Dar es Salaam and least likely to report it in rural areas. The responses presumably reflect the expectation of more meals per day in urban areas. However, there has been a drop in the percentage reporting fewer than usual meals across all areas and particularly, in Dar es Salaam (*ibid*).

However, the information that is provided by such questions is not entirely reliable. The reference period for the HBS that collected this information is one (particular) month and does not take into account seasonal variation. Other problems that come up are recall bias and telescoping. Data could be subject to recall bias as respondents may have difficulty remembering the number of meals they ate over the reference period, particularly if the reference period is very long. Further, the data could also be subject to telescoping, where the respondent could include events that occurred before the recall period. This would imply that the longer the recall period, the more likely is recall bias; the shorter the recall period, the more likely is telescoping (Smith and Subandoro, 2007). However, the HBS collects information on the number of meals eaten by means of a daily food diary, which would reduce these errors.

Another indicator of the quantity of food consumed is the per capita daily consumption of dietary energy. We turn to estimates of dietary energy consumption and dietary protein consumption provided by the FAO for various countries in order to study per capita dietary energy consumption. Figure 3.2 presents the consumption of dietary energy in Tanzania over the period 1990 – 2005. Here, food consumption refers to the amount of food available for human consumption as estimated by the FAO Food Balance Sheets. However, actual food consumption may be lower than the quantity shown as food availability depending on the magnitude of wastage and losses of food in the household, for example, during storage, in preparation and cooking, as plate-waste or quantities fed to domestic animals and pets, thrown or given away. Another problem with FAO data is that it is of poor quality. This is due to the fact that methods of estimating food available for national consumption are outdated. Further, in the event that official estimates are not available from country governments, FAO makes its own estimates. Thus, the statistics provided by the FAO should be interpreted with caution as the reliability of FAO statistics has often been questioned (Section 2.1 has discussed these methodological challenges).

Figure 3.2: Total dietary and protein consumption, Tanzania, 1990 - 2005



Source: Food Security Statistics, FAOStat website <http://www.fao.org/economic/ess/food-security-statistics/en>

According to statistics from the FAO, the dietary consumption has decreased from an average of 2100 kCal per person per day in 1990-92 to an average of 1900 kCal per person per day in 1995-97. Since then, the energy consumption has recovered and in 2003-05, it was at an average of 2010 kCal per person per day in 2003-05. This is still lower than the energy consumption in the 1990-92 period.

However, these figures are fairly similar to those obtained by Smith and Subandoro (2007) in their evaluation of food security for Tanzania. In their study, they obtain estimates of food insecurity based on food acquisition data that is collected by national household budget/expenditure surveys for 12 SSA countries. The study aims at looking into (a) the extent and location of food insecurity within and across the countries; (b) the merit of using food data collected by these surveys to measure food insecurity; and (c) compare these estimates to those provided by the FAO and explore reasons for differences between the two. From the 2000 HBS for Tanzania, the estimate that the daily mean per capita dietary energy consumption is 2454 kCal. This estimate is at most 500 kCal more than those provided by the FAO for the 2000, which is 1985 kCal. However, a comparison of HBS estimates of coefficient of variation (CV) of dietary energy availability with FAO estimates of CV of dietary energy consumption show that the difference between the two is only 0.29, while for Zambia in 1996 it is 0.43.

The authors also compare estimates for the prevalence of national food deficiency. According to the HBS, in 2000, this was 43.9% while according to FAO statistics it was 43%. On the other hand, for Zambia, according to the 1996 HBS, the prevalence of 73.3% while according to the FAO, this was 32%. Thus, we can assume that FAO data for Tanzania are relatively more reliable for Tanzania than other SSA countries.

We also see average dietary protein consumption in Figure 6.2. Over time, this consumption trend has remained fairly stable. In 1990-92, average dietary protein consumption was 51 kCal per person per day. This was approximately 2.4% of total energy consumption. Since then, average dietary protein consumption decreased to around 48 kCal per person per day in 1995-97 (2.5% of total energy consumption) and remained at that level in 2003-05 (2.3% of total energy consumption). While total energy consumption is not very much lower than what is recommended, this proportion of protein consumption so low that it becomes a cause for concern - it is recommended that proteins form 10-15% of daily consumption (Insel *et al*, 2009).

Protein deficiency or protein energy malnutrition (PEM) is a serious cause of ill health and death in developing countries. PEM can manifest itself in several forms. Kwashiorkor, marasmus, and marasmic kwashiorkor are generally recognised as the clinically severe forms of protein energy malnutrition (Newman and Gulliver, 1979). Many low – middle income countries suffer from these forms of malnutrition as well as from other micronutrient deficiencies. This is because their diet is mainly based on cereals. This high dependence on cereals inhibits the absorption of nutrients such as iron and zinc in the body (Randolph *et al*, 2009).

The quality of the food that an individual consumes is just as important as the quantity that she consumes for the achievement of food security (Smith and

Subandoro, 2007). It is possible that an individual is able to meet her energy requirements because the quantity and frequency of her calorie intake are high but cannot lead an active and healthy life due to the deprivation or deficiencies of other nutrients, particularly proteins and iron, Vitamin A and iodine (Welch, 2004). Studies have documented that better quality of diet is associated with improved birth weight and nutritional status of children as well as reduced mortality. It is also widely recognised that rather than insufficient intake of calories, it is the inadequate quality of diet that is the main dietary constraint facing poor populations (Smith and Subandoro, 2007). For these reasons it is important that we take into consideration the quality of food that people are eating when we analyse food security and/or malnutrition.

The rest of this section will highlight the importance of diversity in diet and how this diversity contributes to better quality diets. Following this, it will look into different food groups that are consumed in Tanzania. It will then go on to discuss the composition of diet in the Kagera region and how food is consumed in particular social contexts.

Table 3.8: Food groups and most common forms in which they are available

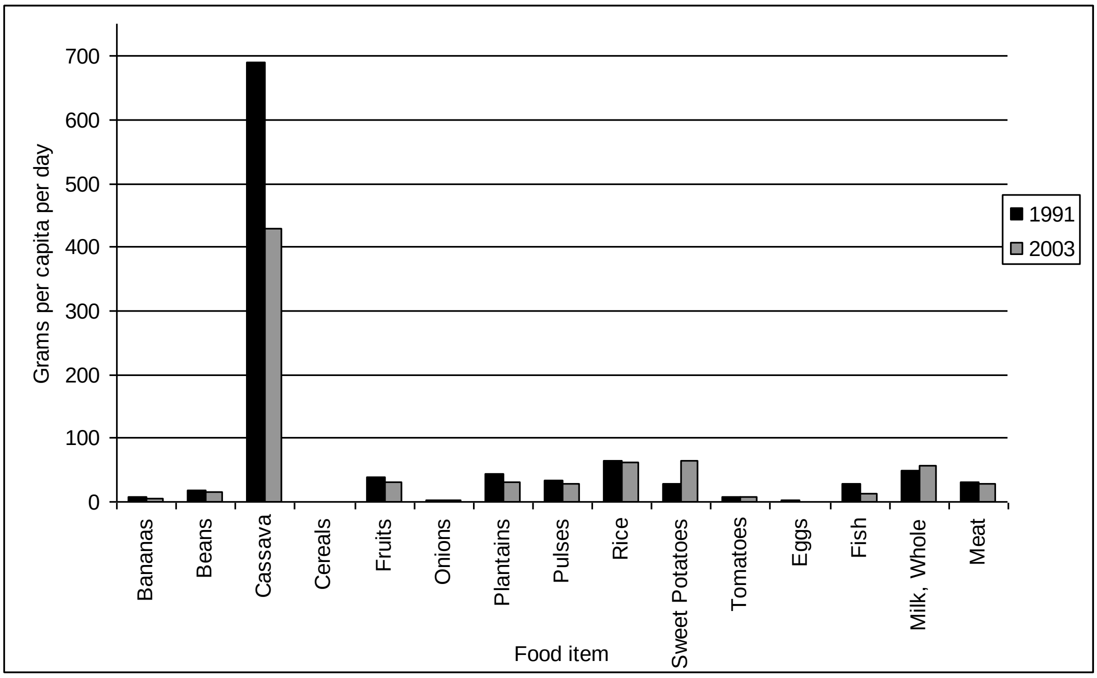
Food group	Most common foods	Forms in which available
Cereals	Wheat, rice, maize, oats, mullet, sorghum, teff	Whole, puffed or popped grains, meals, flours, pasta, baked goods such as bread and cake
Roots, tubers and plantains	Potatoes, sweet potatoes, yams, cocoyams, cassava, taro, sago, plantain bananas	Fresh, dry, flour, meal, fried chips
Pulses, legumes, nuts and seeds	Beans, dry peas, lentils, chickpeas, pigeon peas, green or black gram, groundnuts, coconuts, cashews, almonds, walnuts, sesame seeds, sunflower seeds, soybeans	Whole, shelled or unshelled, mature or immature, paste, flour, sauce, curd
Vegetables	Roots, bulbs and tubers: beets, carrots, leeks, onions, garlic, okra, radishes Leafy vegetables: bean sprouts, beet greens, brussle sprouts, cabbage, cassava leaves, celery, kale, lettuce, spinach, parsley, pumpkin leaves, sweet potato leaves, collard greens Others: tomatoes, broccoli, cauliflower, cucumbers, eggplant, sweet corn, pumpkins, squash, gourds, fresh peppers, fresh beans, fresh peas, mushrooms, chives, bamboo shoots, asparagus, local indigenous fruit	Fresh, dry canned, powdered, sauce paste

	vegetables	
Fruits	Sweet bananas Citrus fruits: oranges, tangerines, grapefruit, lemons, limes Fat-rich: avocados, olives Others: apples, apricots, berries, cherries, guavas, mangoes, melons, papayas, passion fruit, peaches, pears, pineapples, plums, jackfruit, watermelons, grapes, durian, star fruit, local indigenous fruits	Fresh, dry
Meats	Beef, pork, mutton, goat, buffalo, camel, horse, rabbit, game and wild meat, chicken, duck, goose, turket, guinea hen, insects	With our without bones, offal, other animal parts, bacon, ham, canned beef, sausages
Fish and seafood	Fish: salmon, trout, herring, mackerel, cod haddock Shellfish: lobster, crawfish, crab, shrimp, oysters, clams, mussels	Salted, smoked, dried, canned
Milk and dairy products	Cow/goat/sheep/buffalo/camel milk	Evaporated or powered milk, cream, cheese, butter, ice cream, cottage cheese, buttermilk, yoghurt, curd
Eggs	Hen/duck/goose/turtle eggs	
Oils and fats	Oils: vegetable/groundnut/ palm oil Fats: margarine, shortening, butter, ghee, lard, Shea butter, mayonnaise	
Beverages	Industrial and local beers, wines, spirits, fruit juices, tea, coffee, soft drinks	
Miscellaneous	Spices and condiments, salt, sugar, confectionery	

Source: Smith and Subandoro (2007)

As an indicator of dietary quality, the diversity of diet is a fairly good indicator for two reasons. One, it reflects how varied the foods typically consumed by a household are; and two, whether the diet meets the requirements for protein, energy and other essential nutrients (*ibid*). Examples of nutritionally significant food groups are cereals; roots, tubers and plantains; pulses, legumes, nuts and seeds; vegetable and fruits; meats, fish and seafood; milk and milk products; eggs; oils and fats. Table 3.8 lists these food groups, the kinds of food for each group and the forms in which they are commonly eaten. This table can help us to infer whether a household or individual has a low-quality diet or not based on the knowledge of which foods are eaten.

Figure 3.3: Consumption of various food groups, Tanzania, 1991 and 2003



Source: FAOStat website (http://www.fao.org/economic/ess/food-security-statistics/en)

Figure 3.3 presents information on the quantity of various food groups that were consumed in Tanzania on a daily basis in 1991 and 2003. Cassava consumption in 1991 was almost 700 grams per capita per day, falling to about 420 grams per capita per day, which is still fairly high. Cassava is a carbohydrate-rich food that also provides small amounts of vitamin C and manganese, which is an important mineral that aids metabolism of fats and protein. [7] In addition to cassava, other staples consumed in Tanzania are plantains, sweet potatoes and rice. Rice is an important source of protein and micronutrients such as iron, calcium and riboflavin.[8] Sweet potatoes provide vitamins A, C and E, manganese and copper while plantains provide potassium and vitamins B and C. [9] Like cassava, these staples are calorie dense but they are better sources of protein and other micronutrients. However, they are consumed in much smaller quantities than cassava (probably because they are too expensive or taste preference). Further, consumption of dairy products, eggs and meats are fairly low. These foods are also important sources of proteins and other

[7] http://www.nutritiondata.com/help/glossary#M
[8] http://www.fao.org/docrep/T0567E/T0567E0c.htm
[9] http://www.fao.org/docrep/t0207e/T0207E05.htm

micronutrients and their deficiencies can have severe health consequences (see Table 3.9 for a list of nutrients provided by these foods and the consequences of their deficiencies). [10]

Table 3.9: Nutrients provided by animal source foods

Nutrient	Sources	Consequences of deficiency
Vitamin A	Dairy, liver, fish-liver oil, egg yolk	Growth faltering, impaired development, impaired vision, blindness, impaired immune system
Vitamin B12	Animal source foods	Anaemia, disorders of the central nervous system
Riboflavin	Dairy, organ meats, eggs	Stunted growth, skin lesions, photophobia, anaemia, neuropathy
Calcium	Dairy and fish	Nutritional rickets
Iron	Meat and fish	Impaired growth, cognitive development and immune function in young children; impaired school performance in older children; and lower work capacity and maternal mortality in adults
Zinc	Meat and (shell)fish	Complications during pregnancy, low birth weight, impaired immune functions, maternal and infant mortality and morbidity, poor growth in infancy and childhood

Source: Randolph *et al* (2009)

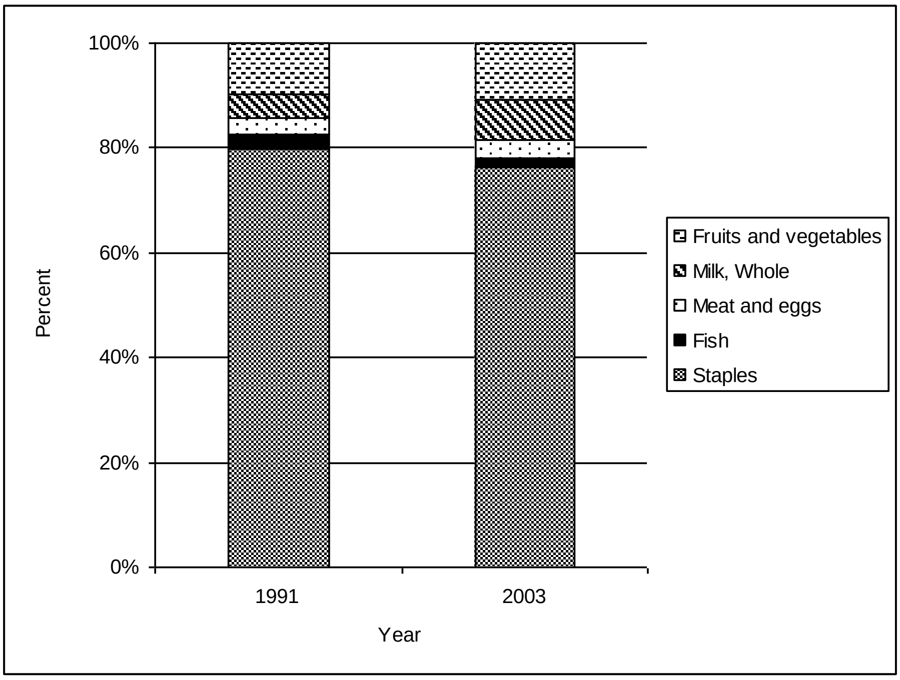
Thus, the high levels of consumption of cassava and lower consumption levels of other foods in Tanzania could indicate a diet is a cause for concern as far as dietary diversity is concerned. This is corroborated by evidence presented by Smith and Subandoro (2007). They use a measure similar to that developed by Arimond and Ruel (2004), which they modify and use which food groups rather than individual foods are used. The first groups comprises cereals, roots, and tubers; the second through fourth groups—pulses or legumes; dairy products; meat, fish and seafood, and eggs; the fifth —fats and oils; and the sixth and seventh groups—fruits and vegetables. Based on this system of classification, they calculate a score for

[10] It can be argued that many south Asian countries also have diets that are highly dependent on staples such as wheat and rice (Appadurai, 1981). Aside from the fact that individuals in these countries also consume fresh fruits and vegetables, meat and dairy products on a regular basis, wheat and rice are rich in protein and micronutrients, for example, minerals such as zinc, iron, calcium, potassium and vitamins B, E and K.

household dietary diversity and find that Tanzania has the fourth lowest score among a group of 12 SSA countries.

Another indicator of the quality of diet is the percentage of food that is acquired from staples. At the household level it may be measured as the percentage of dietary energy available from food staples in total dietary energy available. As energy dense starchy staples have small amounts of bio-available protein and micronutrients, the higher the percentage of dietary energy available from food staples, the lower the diet quality. Thus, those individuals who consume large amounts of such energy dense starch staples would be vulnerable to protein and micronutrient deficiencies. We can compute this for Tanzania using data on per capita calorie intake. In Figure 3.4, we present the percentages of different foods that are eaten. In 1991 and 2003, staples contributed to 80% of an individual's diet compared to other food groups, implying that indeed, the quality of diet in Tanzania, on an average, is quite poor.

Figure 3.4: Contribution of food groups to individual's diet, Tanzania, 1991 and 2003



Source: FAOStat website (http://www.fao.org/economic/ess/food-security-statistics/en)

3.2.5 Kagera: What and How Much are People Eating?

The majority ethnic group in the Kagera region is the Haya. Ethnography by Brad Weiss (1996) describes them as a largely agrarian and patriarchal people, whose villages are composed of many family farms. These farms are places of residence and almost all households occupy farmland. These family farms primarily produce perennial tree crops such as bananas and coffee. The former provides an edible staple, while the latter is a source of income for most households. All the farms in a Haya village lie next to each other and thus, the village is a close group of households on perennially cultivated land. However, recall from Table 6.2 that in rural areas in Tanzania 2000/01 and 2007, the share of household income from agriculture and related activates was less than 20%. Further, majority of the household income in these areas comes from non-farm self-employment and wage employment. Further statistics reveal that agriculture contributes to only about half of Kagera's GDP. [11] This would imply a greater degree of livelihood diversification than suggested by Weiss that has possibly increased over time.

The control of cultivable land and farms has always been the focus of political relations among the Haya. Each farm is held individually and inherited patrilineally but this may be dictated by specific understandings of "descent" and "individuality" among the Haya. The head of the household will try to ensure that after his death, his clan descendents will occupy his farm. In pre-colonial times, if the household head were to die without any male heirs, the control of the land would revert to the king, who then established patronage relations with tenants, especially those who were in need of land to cultivate. Today, in the absence of a male heir, the land can be sold to other individuals, though preferably to members of the same clan. If clan members are unable to match the price of purchase, the land may be sold to a different clan (*ibid*).

Weiss's (1996) ethnography describes a daily meal of the Haya. It may be composed of a variety of produce whether cereal, vegetable or meat. However, there are two basic categories that a meal is made up of. The first is a starchy staple that the Haya call *ekyakulya* (food). Bananas; *ugali* porridge made of maize, boiled cassava or millet; sweet potatoes; boiled cassava or rice are staples that are commonly available. Rice is an expensive item and is purchased by those who can afford it. Most flours, such as maize flour are also purchased. Plantains and bananas are the vastly preferred staple of the Haya. The months of July and August are dry and

[11] Tanzania National web site at <http://www.tanzania.go.tz/agriculture.html>

known as the season of hunger/famine. The hunger in this season is for bananas that flourish during March and April, when it rains heavily but mature less quickly as the dry season wears on. During this period, they rely on sweet potatoes and particularly, on cassava, which grows easily in dry and hot conditions.

The second component of the meal is the relish that is eaten with the staple. The variety of produce that the relish is made from is wide, though it is subject to seasonal availability. The most commonly eaten relish is beans. Many varieties of beans are grown on family farms. They are dried and stored after harvest in January and should be steadily available until the next harvest on a well- maintained farm. Other commonly eaten food items are tomatoes and onions, which are available for purchase throughout the year in local markets. Tomatoes are perhaps more widely consumed than onions as they are grown on household farmland. Other items that can be used in relish are leafy vegetables such as cabbage and spinach; leaves of most squashes, legumes and tubers; peanuts; small hot peppers as well as bambara nuts,[12] which are a prized accompaniment. Often remembered by contemporary Haya is a relish made from curdled milk mixed with beans or greens but this is rarely eaten today.

Meats are widely available but are not always very affordable. Beef is readily available in most areas and many (but not all) households keep goats and chickens though this is not always affordable. Goat meat is more expensive than beef and chicken is the most expensive. Fish is widely available and is an important source of income for several households. It is also available in local markets – fresh and/or dried. Of all meats, fish is perhaps the most affordable and easily available (*ibid*).

From this ethnographic account, it appears that like the rest of Tanzania, in Kagera too, the dependence on staples is very high. Vegetables and beans are eaten in very small proportions and as items that accompany the staple. Further, the intake of fruit is limited to sweet bananas. While meat and fish are available either in the market or at home, their consumption is subject to whether a household is able to afford to buy these on a regular basis (*ibid*). This is not only true of the Haya group but also for

[12] Bambara nuts are similar to groundnuts and can be eaten fresh or boiled after drying. They originated in West Africa and it is believed that these nuts can help improve nutrition. They are also known as jugo beans or *njugumawe* (in Swahili) (National Research Council of the National Academies, 2006)

other ethnic groups in the region, for example, the Nyoro. The Nyoro, too, have diets that are heavily dependent on staples such as sweet potatoes and cassava. Other foods commonly consumed are peas, beans, chicken and eggs. Meats such as beef along with milk are expensive and thus, relatively difficult to procure for poorer households. Typically, only Nyoro chieftains are believed to be able to afford (and consume) foods that are rich in fats (Kunahen, 2000).

Social Hierarchy, "Gastro-politics" and Hunger in Kagera

It is not uncommon to find that social life among the Haya, Nyoro, Warundi and other groups in Kagera (and in fact, in Africa) involves institutionalized restrictions on social contact between age and sex groups. Men and women and older and younger generations are often separated from each other in space and time by the manner in which social activities are arranged. Levine (1973) finds that interaction between the sexes and generations tends to be highly prescribed by custom, appearing unspontaneous and formal. Thus, relations between generations and sexes are often stiff and restrained.

Thus, in a household and in the wider community, men are ranked higher than women, married persons are ranked higher than those who are not, and men with adult children are ranked higher than their juniors. Indeed, women were and are systematically denied access to family farmland. Women's rights to land that belonged to their fathers (divorced and widowed women were not assured access to land that belonged to their natal home) and husbands (women move to their husbands' home after marriage) were recognised as late as 1944. This can be corroborated by evidence from a study by Sender and Smith (1990) in the West Usambaras, who found that women, particularly those who are single heads of households, have little or no access to land and inputs for agriculture. In many instances, they are forced to take up wage (formal or informal) employment. However, in some cases, women do have access to surrounding farmland at their natal and marital homes (Weiss, 1996). It is therefore not surprising that social interaction within and among households are shaped by the deference and respect paid to men by women and to adults by children.

These social hierarchies permeate into the way in which food is distributed and consumed in households. Appadurai (1981) describes this as "gastro-politics". By this he means "conflict or competition over specific cultural or economic resources as it emerges in social transactions around food". Thus, it follows that gastro-politics is a common feature of many cultures. Appadurai's paper is an ethnography of a Hindu South Asian household that explains the significance of food and how it is served within households, at weddings and at Hindu temples. Of food and food practices in the household, he asks who controls the hearth, and what the social prevalence is. We use the same parameters for the Haya in order to understand their gastro-politics.

Haya women are in complete control of the hearth, so much so that they resent their men coming into the kitchen (Weiss, 1996). The fact that the responsibility of cooking and preparation of meals falls to the women, implies a general (and perhaps inherent) subordination to men (Appadurai, 1981). Meal provision is a service provided by wives for husbands. The superiority of men is expressed largely through their priority in being served food. They are usually served first, receive more protein rich foods (especially if they are engaged in laborious tasks) and often eat alone. Children and their mothers eat after the older men in the household have eaten. This is particularly true for food items such as meat, which is a rare delicacy for most people. The older men have it first, women are allowed to have what is left over, and children may receive none. The frequent exclusion of children from meat-eating occurs even among relatively affluent urban families (Levine, 1973). This is characteristic of many developing countries – children and women eat after men. It is probable that in times of food scarcity, these two groups are the most likely to be food and/or nutrition insecure.

Among the Haya, eating well means filling up and not being able to become full is to have hunger. The significance of food is not merely calorie provision and hence, hunger is not just a lack of resources. The Haya use hunger as a form of evaluation. For example, as explained earlier, during the dry seasons, the Haya switch from eating bananas as a staple to cassava and sweet potatoes that are chiefly grown by women. By stating that this period is one of hunger, it is a means of devaluating certain food-related activities and the agents that are involved in them (Weiss, 1996).

In interpersonal relations, hunger is discussed as something that is abstract. For example, if there is a decrease in rainfall, people may talk of the hunger that is likely to ensure from this. However, the Haya will rarely refer to themselves as being hungry. To admit to being hungry would be to admit to not being able to provide for one's self and one's family. Moreover, it is believed to be insulting to ask guests if they are hungry. In doing so, the host would be forcing their guest to admit their inability to provide for themselves in order to accept hospitality. Similarly, neighbours who visit in the evening are asked to stay for the evening meal, but they are expected to excuse themselves from joining the household. Thus, it appears that hunger is not something that should be acknowledged and that it is perhaps, some kind of social intrusion.

3.3 Diversity of Ethnic Groups

Tanzania is home to diverse ethnic groups, with the majority being African. Other minority races are Europeans, Asians and Arabs that historically have played an important role in the development of societal structures but are not politically significant any longer. The African majority is divided into numerous, smaller groups and most comprise approximately 20% (or less) of the total Tanzanian population (Mawhood and Wallis, 1993). There are approximately 120 peoples in Tanzania that are seen as broader ethnic groups. Despite the presence of such a large number of ethnic groups, the Tanzanian population has a national feeling rather than distinct ethnic feelings. This may be traced back to the period after World War I when Tanzania was handed over to by the German administration to the British.

Until the end of World War I, Tanzania was ruled by the German colonial administration whose approach towards classifying the Tanzanian population into different ethnic groups was far less vigorous than that of the British in Kenya. The German administration strove to maintain relatively homogenous ethnic entities (Jerman, 1997). However, these ethnic entities were not governed by local ethnic leaders but by African agents – *maakida*. The *maakida* were mostly well-educated

Muslims from the coastal area who spoke Swahili (Tripp, 1999). The imposition of these foreign Tanzanian leaders governing population entities that spoke a different vernacular had already hindered the development of strong ethnic consciousness as arisen in Kenya.

When Tanzania was conferred to the British, it received very little attention from the ruling colonists compared to other colonies. The agenda of the British government instead was to develop Kenya as the centre of east African development and thus, Tanzania was treated as a "by-product" of the development project in Kenya (Weber, 2010). In Kenya, the British colonists operated a divide and rule policy. They consciously created homogenous ethnic groups and separated them. In addition, they also settled Europeans in between neighbouring ethnic entities to prevent inter-ethnic cooperation. This increased ethnic consciousness in Kenya through the feeling of exclusiveness and enabled the British colonialists to effectively rule the Kenyan population without having to fear a united resistance owing to the creation of cut off ethnic units (Ogot, 2005). The British colonial rule did try to pursue a divide and rule policy as they had done in Kenya in order to suppress the nationalist Tanzanian feeling. However, there was opposition to this approach. British officials advocated regional instead of ethnic-based administrative boundaries and the development of village and regional policies rather than the scientifically advocated creation of "tribes" (Jerman, 1997).

As opposed to Kenya, Tanzania was home to only a few European settlers demanding relatively little infrastructure. Since the Tanzanian population was not burdened with heavy costs, there was less need to oppress them systematically. This led to the formation of regional and national associations comprising various ethnic groups, such as the Mbeya District Original Tribes Association and the Kuria Union emerged (Tripp, 1999). Most importantly, the roots of the nationalist movement in Tanzania lay in the Tanganyika African Association, a truly national association uniting all ethnic groups.

In the post-independence period, Nyerere was able to pursue his vision of a united Tanzania. Owing to the low influx of European settlers in Tanzania, he was also freed from the need to redistribute land after the independence. Further, the implementation of the Ujamaa policy granted equal access to land to the Tanzanian population regardless of their ethnic identity. In addition,n to make resource distribution equal, Nyerere implemented strong nation building policies focusing on the promotion of Swahili and fostering inter-ethnic cooperation. Thereby, ethnic identity was effectively barred from the political sphere creating what is present even today – a national rather than distinct ethnic identity (Weber, 2010).

Given that most of the native Africans have Bantu origins, there is negligible ethnic conflict or ethnic exclusion in the country. Moreover, ethnic groups have lived in sparsely populated areas since pre-colonial times and chieftainship is not very prevalent in such a scenario. Further, the fact that they speak a common language – Swahili- is a uniting factor, which has resulted in a non-segregated ethnic composition in Tanzania, especially in the post-independence period. Another factor that has contributed to the ethnic unity is the lack of significant links between particular ethnic groups and occupational or social categories (Heale and Wong, 2009). However, there are some differing opinions on this. Literature points to evidence that there has been some discrimination on the basis of ethnicity in access to educational opportunities (Samoff, 1979).

3.4 Child Health and Nutrition

In Tanzania, majority of the diseases affecting the population are those that are communicable and preventable. These include HIV/Aids, malaria, water borne diseases and respiratory diseases. The burden of disease in the country also consists of lifestyle diseases such as cancer and cardiovascular disorders (World Bank, 1999; Mhalu, 2005). A 1994 study by the Ministry of Health (MoH) in Tanzania estimated that approximately 17% of all deaths were due to malaria and diarreheal disease and pneumonia, tuberculosis and Aids were responsible for 5-6% each (MoH, 1994). From available data, a World Bank study calculated that in 1999, out of every 1,000 children born, 92 were likely to die by the age of one, 49 by the time they were five and 70 were likely to die by the age of 15 due to such diseases (World Bank, 1999). Between the ages of 15 and 34, an additional number of deaths of up to 200 could occur. The study stipulated that of these deaths, majority would be the result of malaria, followed by respiratory infections, water borne diseases and Aids (though this would be more likely to affect young adults).

Children are more likely to fall prey to diseases such as malaria, cholera, diarrhoea and tuberculosis as they have weak immune systems that make them more susceptible to disease and infection. Further, children who have positive HIV statuses or live with other household members with HIV/Aids are also at risk of infections and disease. The situation is direr for children who belong to relatively poorer households as they have fewer resources in terms of access to health and sanitation facilities that makes them more vulnerable.. The occurrence of frequent illnesses is made worse by inadequate and poor diets as the body is not able to generate energy to fight the disease. This coupled with a dearth of resources to cope with the effects of illness is one of the leading causes of child undernutrition and malnutrition and vice versa (Cogill, 2003; Svedberg, 2000). PEM is the most widespread and leading nutritional disorder in Tanzania (Msuya, 1999). Children under the age of five years are the most affected. PEM often results from consuming inadequate food and is frequently aggravated by infections. Malnutrition and undernutrition among children increases their risk of morbidity and mortality and is related to impaired mental development (this is discussed in detail in Section 2.3).

Table 3.10: Undernutrition among children under the age of 5, east Africa

Country	Stunted (height-for-age z-score)	Wasted (weight-for-height z-score)	Underweight (weight-for-age z-score)
	2002-2006	2002-2006	2002-2006
Tanzania	44.4	3.5	16.7
Zambia	52.5	6.2	23.3
Zimbabwe	35.8	7.3	14
Rwanda	51.7	4.8	18
Kenya	40.9	7.7	18.4
Burundi	57.7	9	35.2
Uganda	38.7	6.3	16.4

Source: WHO Global Health Observatory (2002-2006)
Note: All figures are in percentages

The malnutrition situation in Tanzania is not very different from that in other countries in the east African region (see Table 3.10). While Tanzania had some of the lowest proportions of children under the age of five who were wasted and underweight, it also had one of the highest proportions of stunted children in the 2002-2006 period. The following sections present more detailed discussion of the national trends in child undernutrition in Tanzania and Kagera over time.

3.4.1 Undernutrition among Children in Tanzania

Table 3.11 presents GDP per capita (2000 constant US dollars) and select health statistics for east African countries for 2000. In 2000, Tanzania had the fourth highest GDP per capita of the eight east African countries listed. It had one of the highest life expectancies at birth, which along with better health and education outcomes are endogenous outcome of growth (Cervellati and Sunde, 2005). The table shows that Tanzania performs well on some standard indicators of well-being. She has lower infant mortality rates (IMR) and under-five mortality rates than her neighbours. This would indicate that health services and perhaps, access to these services is better in Tanzania than other countries in the region. However, what is inconsistent with this level of well-being is that in 2000, Tanzania had the second highest proportion of underweight children compared to countries that had performed relatively poorly in terms of GDP per capita and other well-being indicators (Table 3.11) Why is the prevalence of undernutrition in Tanzania so high, in spite of seemingly better health and economic environments? The rest of this section will look at trends in nutrition among children under the age of five in Tanzania over time in order to gauge where differences in nutrition status arise.

Table 3.11: Select indicators of well-being, east Africa, 2000

Country	GDP per capita (constant 2000 UDS)	Life expectancy in years at birth (both sexes)	Under -5 mortality rate (per 1000 live births	IMR (per 1000 live births)	Underweight (children under age of 5 years)
Zimbabwe	594.06	45	89	58	13
Kenya	406.1	53	117	77	17.5
Zambia	309.32	42	182	102	28
Tanzania	266.01	49	118	88	29.4
Uganda	253.48	46	145	85	22.8
Rwanda	218.02	46	183	110	20.3
Malawi	150	48	155	95	21.5
Burundi	109.55	48	181	109	38.9

Note: All figures are in percentages except for GDP per capita. Data is from the most recent point in time for which where figures for all countries were available.
Source: GDP per capita data are taken from the World Bank World Development Indicators (ed: 2009) <http://www.esds.ac.uk> and the health related figures from the World Health Organisation Statistics < http://www.who.int/whosis/en/>

A number of nutrition surveys have been carried out in Tanzania in the last two decades by the TFNC and international donor agencies. However, most of these have been spot surveys, for example, in the Ifakara district. The Ifakara Health Research and Development Centre operates a demographic surveillance system in a defined geographical area of 25 villages in Kilombero and Ulanga districts, ensuring that all residents of the area are registered and that all births, deaths and in and out migrations are recorded on a regular basis. The survey provides information on population, fertility and mortality in a rural Tanzanian population of approximately 65,000 people. This information is used by health planners to optimise the use of scarce resources for health care. The system also provides a framework for research studies: for example, studies of average household income, or of resistance to existing anti-malarial drugs.[13]

A nutrition survey was conducted in rural Lindi in the early 1990s to determine the magnitude of anaemia and iron deficiency in different age and sex groups as related to nutritional status, parasitic infections, food iron intake, and socioeconomic factors. It was found that more than half of the subjects had anaemia and that almost two-thirds of the anaemia was associated with iron deficiency. Preschool children were the most affected - almost 84% were anaemic. Further, half of the non-anaemic preschool children and 90% of all severely anaemic respondents were iron deficient. Parasitic infections were only associated with anaemia and iron deficiency in school children and adolescent and adult males. Malaria was associated with anaemia and infestation was associated with anaemia and iron deficiency in adolescents and adults (Tatala, 1998). While such information does provide insights into nutrition and health, they are not nationally representative ones. In order to understand the magnitude of the child nutrition problem, we need to look at the whole picture.

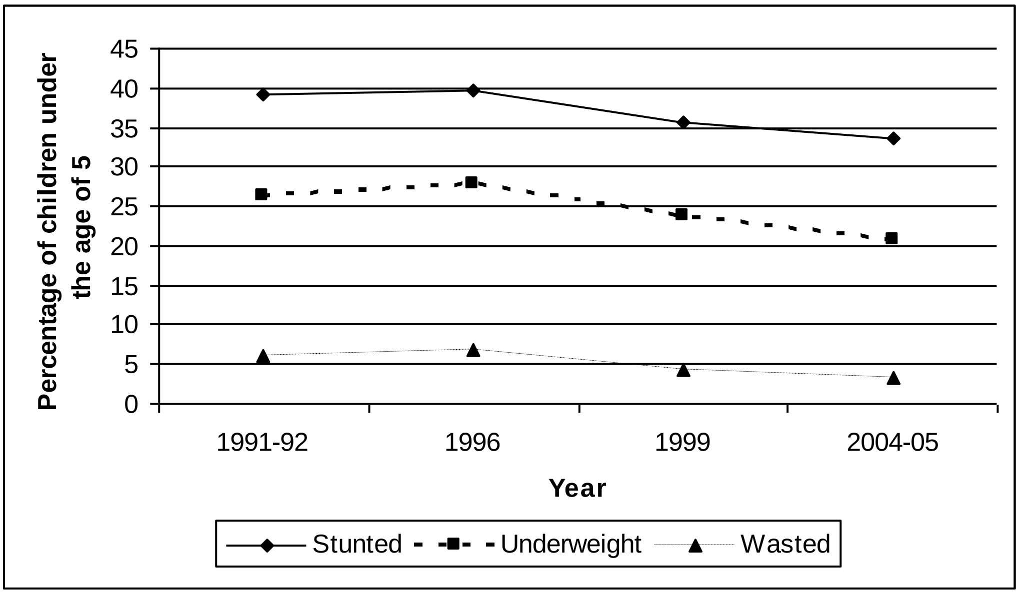
The demographic and health surveys carried out by the MEASURE Demographic and Health Survey (DHS) project are perhaps the most representative of national statistics and trends. The MEASURE DHS project has been providing technical assistance to a large number of surveys in over 85 countries since 1984. The surveys collect and disseminate nationally representative data on, fertility, family planning, child and maternal health and nutrition, and disease burden. In this section, we present figures on child undernutrition in Tanzania between 1991-92 to 2004-05. This 14 year period is also the same as that between the two rounds of the KHDS.

[13] http://www.mimcom.org.uk/ifakara/ICDSSUnit.htm

Anthropometric Indicators

According to figures from the 1991-92 Tanzanian DHS, 39.08% of children under the age of five were stunted, 26.8% were underweight and 6.15% were wasted. During this period Tanzania had one of the highest rates of undernutrition in SSA and the world (Fig 3.5). The 1996 DHS saw a small increase in the prevalence of stunting, underweight and wasting. However, after that period there was a steady decrease in the prevalence of undernutrition. In 2004-05, we see that 33.53% of children under the age of 5 were stunted, 20.82% were underweight and 3.37% were wasted.

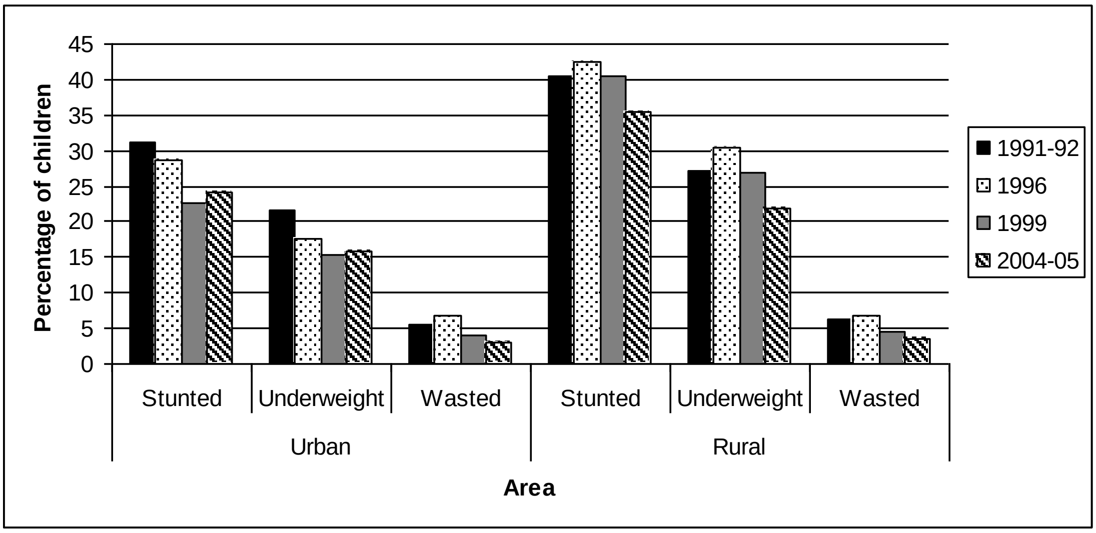
Figure 3.5: Undernutrition among children under the age of five in Tanzania, 1991-92 to 2004-05



Source: Tanzania Demographic and Health Survey (various years)

On disaggregating these figures by the urban/rural residence of children, we see that the prevalence of undernourished children in rural areas is much higher than in urban areas. For example, in 1991-92, 31.07% of children under the age of five in urban areas were stunted whereas 40.57% in rural areas were stunted. Such a pattern is also seen for the prevalence of wasting – 5.61% and 6.25% of children were wasted in urban and rural areas, respectively. Similarly, in urban areas, 21.69% of children were underweight while in rural areas, the proportion of underweight children was larger (27.13%). Figure 3.6 shows us that this trend is persistent over time. In 2004-05, 35.53% of children under the age of five were stunted, 21.88% were underweight and 3.45% were wasted. However, in urban areas, the prevalence of undernutrition was much lower - 24.09% of children under the age of five were stunted, 15.81 were underweight and 2.98% were wasted.

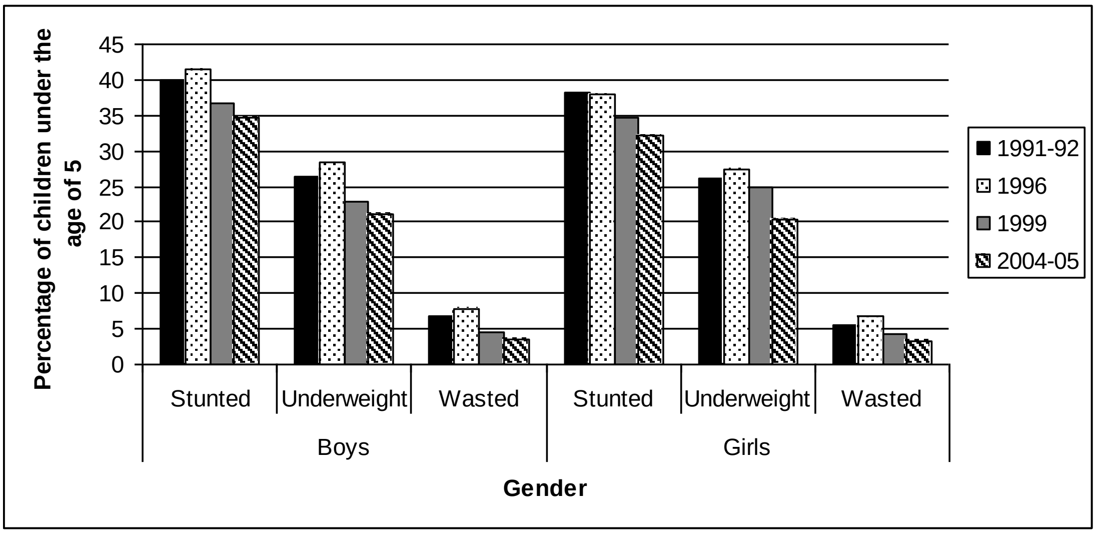
Figure 3.6: Undernutrition among children under the age of five, by location, 1991-92 to 2004-05



Source: Tanzania Demographic and Health Survey (various years)

We also disaggregate these figures by gender as shown in Figure 3.7. While the nutritional status of children has improved since the 1991-92 survey, we see that over the 14 year period, a gender gap persists - more boys are undernourished than girls.

Figure 3.7: Undernutrition among children under the age of five, by gender, 1991-92 to 2004-05



Source: Tanzania Demographic and Health Survey (various years)

Tables 3.12a, 3.12b and 3.12c present the proportion of undernourished boys and girls in urban and rural areas. In urban and rural areas, we see that from 1991-92 to 2004-05, a higher proportion of boys was stunted than girls. This is also true for underweight and wasting.

Table 3.12a: Stunting among children under the age of five, 1991-92 to 2004-05

Year	Urban		Rural	
	Boys	Girls	Boys	Girls
1991-92	32.5	29.57	41.47	39.7
1996	29.68	27.29	44.5	40.56
1999	22.1	22.99	41.87	38.96
2004-05	26.75	21.31	36.54	34.53

Note: All figures are in percentages
Source: Tanzania Demographic and Health Survey (various years)

Table 3.12b: Underweight children under the age of five, 1991-92 to 2004-05

Year	Urban		Rural	
	Boys	Girls	Boys	Girls
1991-92	20.47	22.98	27.6	26.58
1996	17.1	17.31	31.57	29.5
1999	16.17	14.4	25.22	28.56
2004-05	16.37	15.22	22.29	21.48

Note: All figures are in percentages
Source: Tanzania Demographic and Health Survey (various years)

Table 3.12c: Wasting among children under the age of five, 1991-92 to 2004-05

Year	Urban		Rural	
	Boys	Girls	Boys	Girls
1991-92	6.28	4.09	6.82	5.7
1996	7.9	5.75	7.65	5.94
1999	4.85	3.05	4.38	4.61
2004-05	2.78	3.2	3.65	3.26

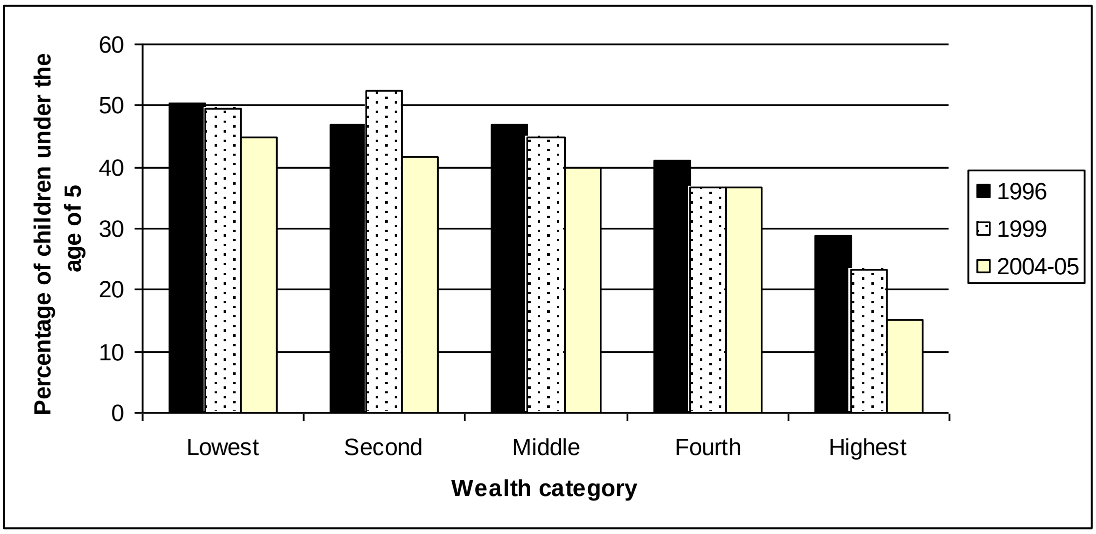
Note: All figures are in percentages
Source: Tanzania Demographic and Health Survey (various years)

Figures 3.8a, 3.8b and 3.8c present undernutrition among children under the age of five by wealth quintiles from 1996 to 2004-05. [14] Overall, we notice two trends: one, the proportion of stunting remains persistently high in the lowest wealth quintile and the lowest in the highest wealth; and two, we see that for all wealth categories, the proportion of stunted children has decreased from 1996 to 2004-05 (Fig 3.8a). The most dramatic decrease was seen in the highest wealth quintile. In the lowest, middle and highest wealth quintiles, the proportion of stunted children continued to decrease from 1996 to 2004-05. However, in the second wealth quintile, there was an increase

[14] No wealth data was collected for the 1991-92 DHS.

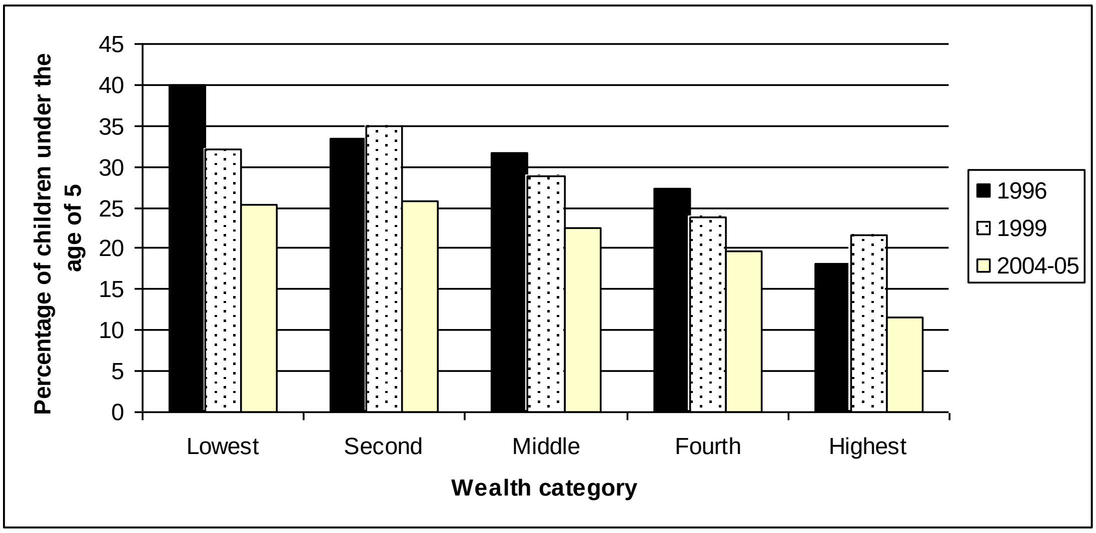
in the proportion of stunting in 1999, which then fell considerably in 2004-05. In the fourth wealth quintile, the proportion of stunting fell in 1999 and remained at that level in 2004-05.

Figure 3.8a: Stunting among children under the age of five, by wealth quintile, 1996 to 2004-05



Source: Tanzania Demographic and Health Survey (various years)

Figure 3.8b: Underweight children under the age of five, by wealth quintile, 1996 to 2004-05

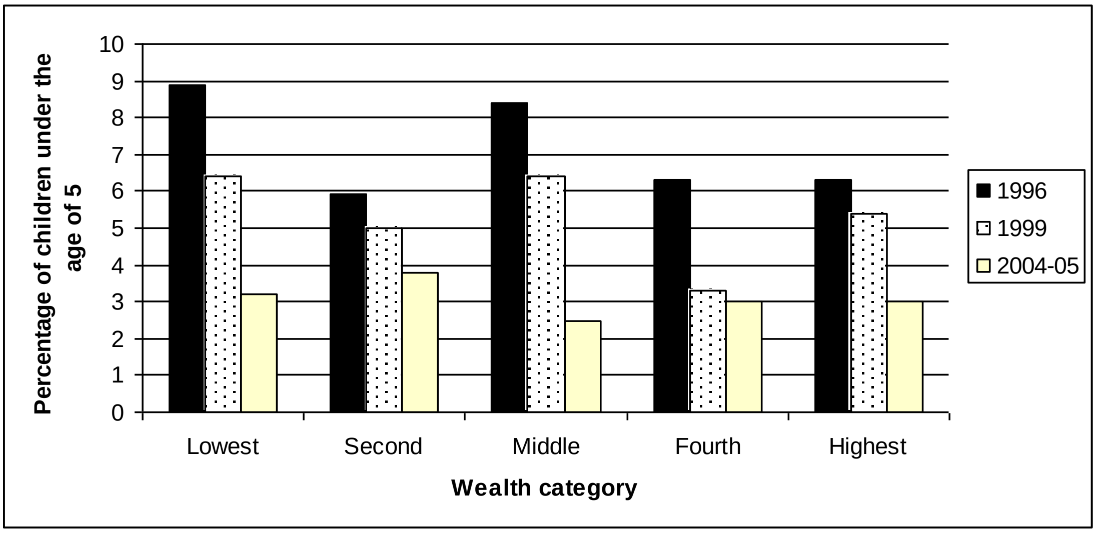


Source: Tanzania Demographic and Health Survey (various years)

Figure 3.8b shows us the proportion of underweight children under the age of five. We see that over time, the proportions of underweight children remain highest in the lowest wealth quintile and the lowest in the highest wealth quintile. This is similar to what we have seen for stunting. Further, as seen with stunting, there is an overall decrease in the proportion of underweight children from 1996 to 2004-05 in each wealth quintile. The most dramatic decrease in the proportion of underweight children was seen in the lowest wealth quintile. The proportion of underweight children in the lowest, middle and fourth wealth quintiles has steadily decreased over time. However, in the second and highest wealth quintiles, there is an increase in the proportion of underweight children in 1999. By 2004-05, this proportion decreases substantially in both these wealth groups.

As seen with the stunting and underweight trends, we do see a decrease in the proportion of wasted children from 1996 to 2004-05 (Fig 3.8c). This is true for all wealth quintiles. In 1996, the lowest wealth quintile had the highest proportion of wasted children. The lowest proportion of wasted children, however, was in the second wealth quintile. However, by 2004-05, the second wealth quintile had the highest proportion of wasted children and the middle wealth quintile had the lowest proportion. The largest decrease was for the lowest wealth quintile, followed by the middle, fourth and highest wealth quintiles, showing a substantial improvement in long-term nutritional status. The least substantial decrease was for the second wealth quintile. Given the evidence for all three indicators of undernutrition that shows poor nutrition over time for children in this wealth category, these children may benefit from targeted nutrition intervention programmes

Figure 3.8c: Wasting among children under the age of five, by wealth quintile, 1996 to 2004-05

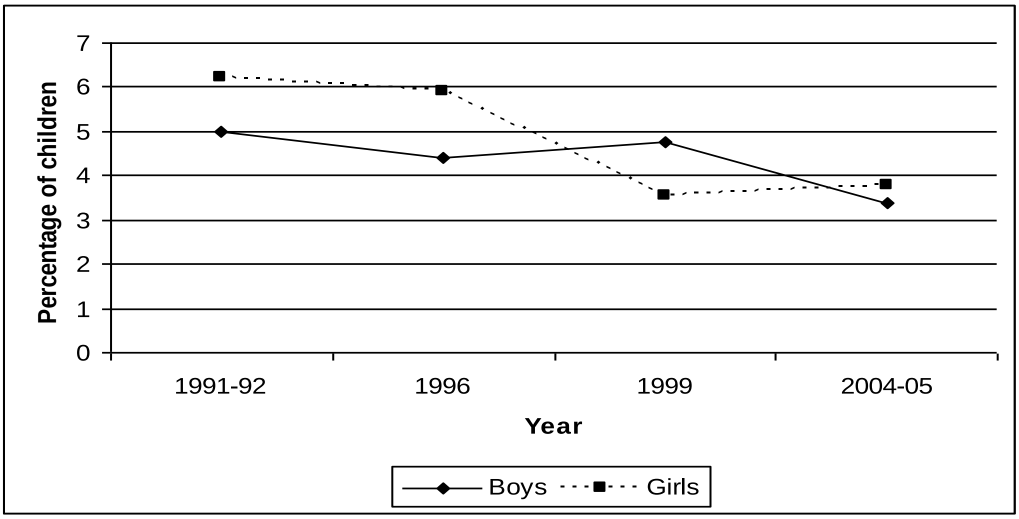


Source: Tanzania Demographic and Health Survey (various years)

Low Birth Weight

In Tanzania, many babies are born with low birth weight. Medical studies document that low birth weight results in childhood undernutrition (Victoria *et al*, 2008). Thus, it can be said that undernutrition takes shape during pregnancy and could persist over time in children, all the way up to adulthood.

Figure 3.9: Children with low birth weight, by gender, 1991-92 to 2004-05

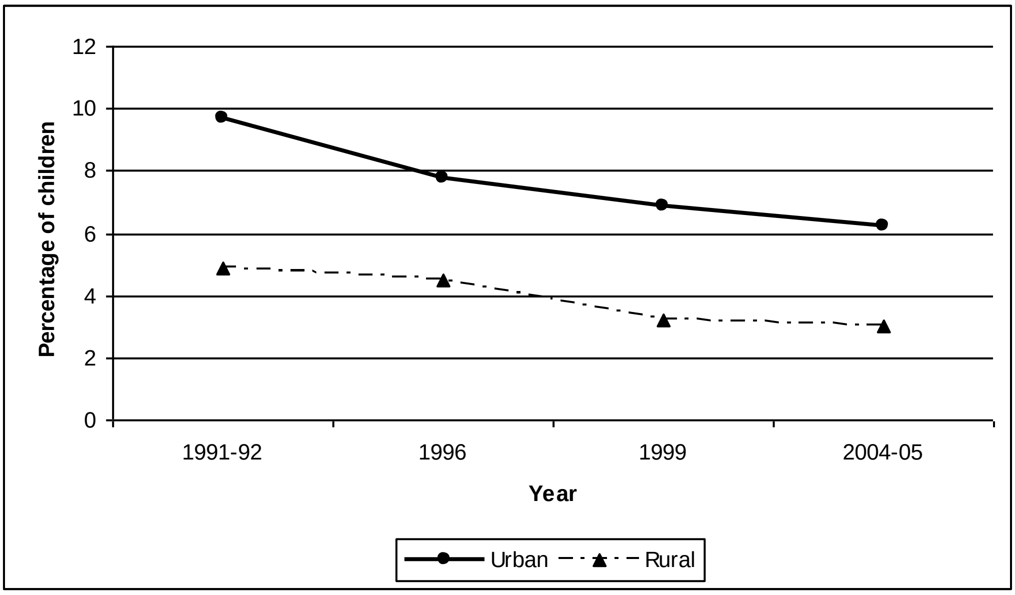


Note: All figures are in percentages
Source: Tanzania Demographic and Health Survey (various years)

The DHS collects data on birth weight for all children irrespective of whether they are alive at the time of survey or not. A DHS methodological report (Pullum, 2008) states that the question about children's birth weight produces accepted values for about 47% of children who survived and for about 20% of children who died. Birth weight data is only collected for children born in hospitals, clinics or other health institutions. The report does not mention whether observations for birth weight depend on respondent recall or whether they are checked against relevant documentation.

Between 1991-92 and 2004-05 the prevalence of low birth weight (less than 2.5 kg) has decreased. Figure 3.9 shows that in 1991-92, a far larger proportion of girls (6.23%) had low birth weight compared to 4.98% of boys. Between 1996 and 1999, there was a dramatic improvement in the birth weight of girls. By 2004-05, a similar proportion of girls and boys had low birth weights.

Figure 3.10: Children with low birth weight, by location, 1991-92 to 2004-05



Note: All figures are in percentages
Source: Tanzania Demographic and Health Survey (various years)

Figure 3.10 presents the prevalence of low birth weight by urban rural location. There is an overall decrease in the proportion of children with low birth weight. We also notice that in urban areas, the proportion of children with low birth weight is almost double that in rural areas. This is surprising because access to health facilities, pre- and ante- natal care in rural areas is poor, so the prevalence of low birth weight in rural areas should be higher. If low birth weight indicates that undernutrition will be persistent in early childhood and perhaps even later on in life, this birth weight trend contradicts that depicted by Figure 3.2. However, as mentioned earlier, since the DHS collects birth weight information for only those children who were born in institutions. Since most births in rural areas take place at home, the corresponding birth weight observations are not documented and thus, this information is incomplete. It is likely that if birth weight data for all children whose mothers were surveyed by the DHS was collected, we would see that the prevalence of low birth weight in rural areas would be higher than that in urban areas. Hence, these figures should be interpreted with caution.

3.4.2 Undernutrition among Children in Kagera

The extent of data and analysis on the problem of undernutrition in Kagera is very limited. While the Tanzanian DHS does collect information at a regional level, the disaggregation is not enough for us to see what the situation in Kagera is. Instead we rely on evidence presented in existing literature. However, this information is also dated.

Table 3.13: Nutritional status of children in Kagera region, Tanzania, 1991-1994

	Stunted	Underweight	Wasted
Girls	**35**	**25**	**5**
Boys	43	30	6
Total	39	28	6

Note: All figures are in percentages
Source: Alderman et al (2005)

In their study, Alderman *et al* (2005) find that between 1991 and 1994, on an average, 28% of children aged 0-5 were moderately underweight. Around 40% of the children were stunted but only 6% were wasted (Table 3.13). The data used by the authors are not representative of Kagera. The research design of the KHDS called for collecting extensive socioeconomic information from households with and without adult deaths in communities with high and low adult mortality rates. However, a comparison between the levels of undernutrition in Tanzania for 1991-99 depicted in Figure 3.4 and Table 3.13 show that that the nutritional pattern in Kagera is not very different from that found elsewhere in the country.

This section has given us an overview of the health problems faced by the Tanzanian population as well as the prevalence and patterns of undernutrition among children under the age of five in Tanzania at a national level. We also have a picture of undernutrition among children in Kagera, which is the region that is of interest to us. The next section will discuss the trends in education in Tanzania and in Kagera.

3.5 Education

Education is often a key determinant of the lifestyle and status an individual enjoys in a society. This section presents trends in educational attainment among household members and school attendance, repetition, and drop-out rates among youth as indicated by the 2004-05 TDHS. These figures are based on the assumptions that the official age of entry into primary school is seven; primary school consists of seven years of schooling; individuals with at least some post-primary training are assumed to have completed primary school; and that it takes six years to finish secondary school.

There was a gender gap in educational attainment men and women. Although the majority of the household population aged six and older that was surveyed was educated to some level, 25% of men and 33% of women had never attended school. Further, for men, the median number of years of schooling was 3.2 while that for women was 2.4. Urban residents were more likely to have attended school and to have remained in school for longer periods than individuals in rural areas. Between regions, educational attainment differed significantly. The highest proportions of population who had never been to school were in Tabora (44% of men and 55% of women). The region with the lowest proportions who had never attended school is Kilimanjaro (12 % of men and 15% of women). A more detailed discussion of the national trends in education in Tanzania over time is presented in the rest of this section.

3.5.1 School Education in Tanzania

Being denied the right to primary education deprives individuals as children and as adults as it handicaps them for life. Unless individuals are given educational opportunities as children, youths or adults, they may be unable to cope with situations that require reading, writing and arithmetic, harming their potential to achieve a high standard of living as the lack of education or literacy is strongly correlated with poverty. A quality primary education strengthens the capabilities of individuals and their families as well as the wider community to access health, political, economic and cultural opportunities and services (UNESCO, 2006; 2008).

There has been a considerable growth in educational opportunities in most parts of the world in the last four decades, particularly since the World Conference on Education held in Dakar in 2000. Between 1999 and 2005, there were large increases in new entrants into primary school in SSA, South and West Asia and the Arab States, while East Asia and the Pacific, Central Asia and North America and Western Europe saw a fall in the proportion of children that started primary school (UNESCO, 2008). According to the 2008 *Education for All Monitoring Report*, the increase in new entrants into primary school between 1999 and 2005 was almost

40% in SSA. Further, the increase in the primary school gross enrolment ratio (GER) for the region during same period was 36%. Both these are key achievements but most countries in the region are still very far from achieving universal primary education.

Table 3.14: Primary school gross enrolment ratio, east Africa, 1999 and 2005

Country	1999	2005
Zimbabwe	100	-
Kenya	91	107
Zambia	82	115
Tanzania	67	105
Uganda	126	119
Rwanda	100	137
Malawi	136	117
Burundi	49	88

Note: Data is from the most recent point in time for which where figures for all countries were available.
Source: UNESCO Statistics < http://stats.uis.unesco.org>

Table 3.14 presents the changes in primary school GER for select east African countries from 1999 to 2005. In 1999, we see that Tanzania had the second lowest GER for primary school, far lower than her neighbours. Over the six year period, we see that GER for primary school increased for most countries in the region -Kenya, Zambia, Tanzania, Rawnda and Burundi- while it fell for Uganda and Malawi. However, even in 2005, Tanzania still has the second lowest GER for primary school. Further, according to WDI indicators, in 2005, Tanzania had a primary school completion rate that was one of the lowest among the group of East African countries listed in Table 3.6. Compared to Tanzania's primary school completion rate of 55%, countries such as Kenya and Zambia had rated of 90% and 86% respectively. What is the reason for Tanzania's poor primary school GER and completion rate? Is this due to lack of access to schools, the opportunity costs of sending children to school or is poor school progress linked to children's poor health as many studies suggest?

The rest of this section will briefly discuss the school system in Tanzania and look at trends in school enrolment and grade achievement among children of school-going age (and older) in order to gauge where differences in schooling efficiency and outcomes arise. We also look into the incidence of late enrolment and grade repetition by looking at the age at which these children complete primary school.

School Structure in Tanzania

Tanzania's formal education system follows a 2-7-4-2-3+ structure. The two first years comprise non-compulsory pre-primary education i.e. pre-school, which children begin at the age of five. Pre-primary education is provided and managed by the government, individuals or private institutions. Not surprisingly, there are far more pre-schools in urban areas than in rural areas. Enrolment in these schools has generally been low but is expected to increase steadily as more preschool classes open on government primary school premises (Mrutu *et al*, 2005).

Pre-primary education is followed by seven years of compulsory primary school education from grades 1 to 7. The official age of entry into grade 1 is seven, even though some children may enrol when they are older. Education in Tanzania is bi-lingual and children learn (in) Swahili and English.[15] Tanzania follows an automatic promotion policy, whereby students are nearly always promoted to the next grade at the end of the school year. Given this promotion policy, it may be difficult to capture grade repetition in education statistics. The exception is when children finish grade 7 and are required to take the Primary School Leaving Examination (PSLE), which acts as an entrance exam for secondary school. Secondary education is split into ordinary level (two years) and advanced level (four years) of education. Generally, uptake into ordinary secondary school from primary school is small and uptake into advanced secondary school from ordinary secondary school is even smaller. University education ordinarily covers a minimum of three years (*ibid*).

As discussed in Section 3.4, the DHS carried out by the MEASURE DHS project are perhaps the most representative of national statistics and trends. The surveys collect and disseminate nationally representative data on school attendance, educational attainment, as well as on grade repetition and dropouts for household members aged six and above. In this section, we present figures on education indicators of children aged between seven and 18 years in Tanzania between 1991-92 and 2004-05. This 14 year period is also the same as that between the two rounds of the KHDS. The Ministry of Education and Culture (MoEC) in Tanzania also collects data on relevant education indicators but these are available only from 2002 until 2008. Thus, the DHS data is better suited for the overall purpose of gaining an understanding of

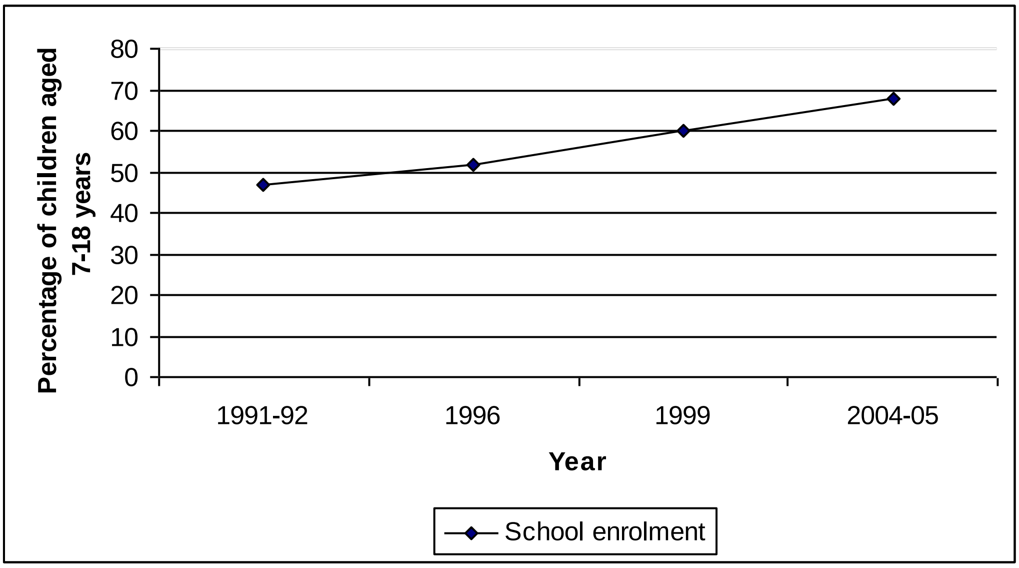
[15] National web site of the United Republic of Tanzania <http://www.tanzania.go.tz/educationf.html>

national trends in education over time and the 2004 MoEC data can be compared to 2004-05 DHS data.

School Enrolment

School enrolment in Tanzania has seen a rapid increase between 1991-92 and 2004-05, most likely due to the Primary Education Development Programme (PEDP) that was set up by the Ministry of Education and Culture in 2001, that amongst other things did away with primary school fees that could cost as much Tsh 10,000 per annum. Figures from the TDHS show that school enrolment among children between the ages of seven and 18 years increased very steadily from 46.7% in 1991-92 to 59.9% in 1999 and 67.8% in 2004-05 (Fig 3.11).

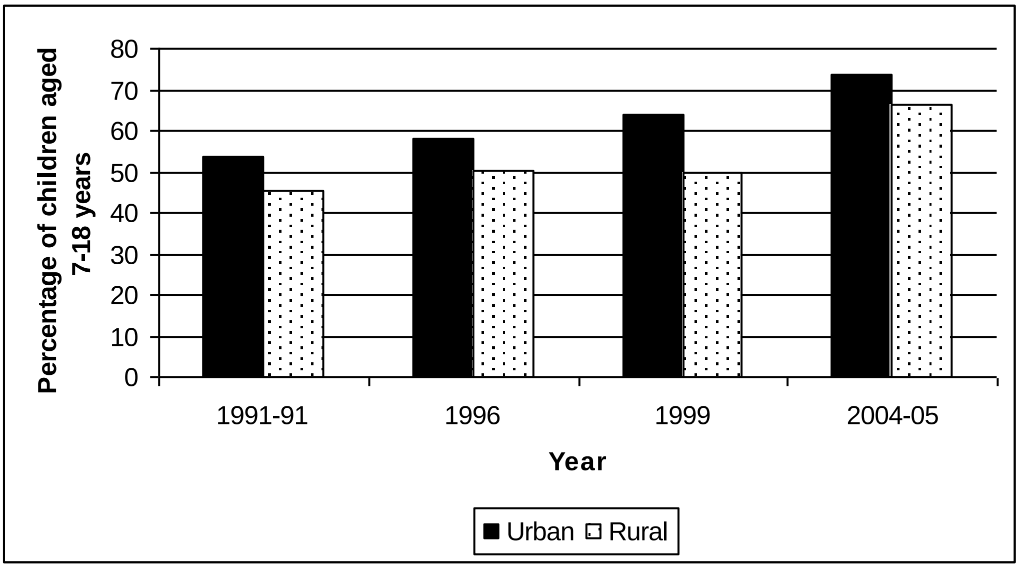
Figure 3.11: School enrolment for children aged 7-18 years in Tanzania, 1991-92 to 2004-05



Source: Tanzania Demographic and Health Survey (various years)

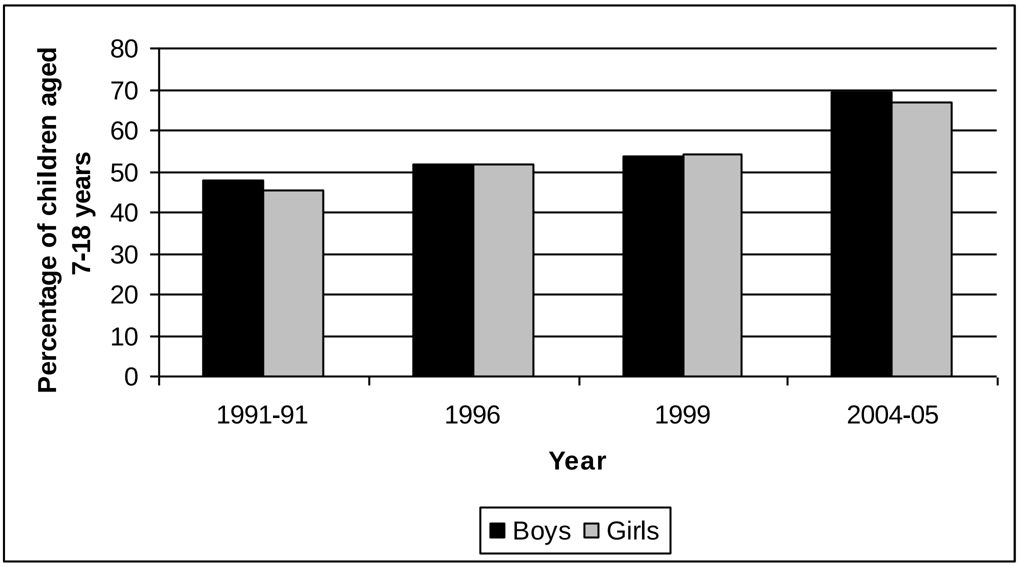
Decomposing the enrolment data by urban-rural location, we see that enrolment in urban and rural areas has increased over the 14 year period. In 1991-92, 53% of children aged between seven and 18 years were enrolled in school in urban areas. This increased slightly to 58% in 1996 and then more dramatically to 64% in 1999 and 74% in 2004-05 (Fig 3.12). In rural areas, while school enrolment has increased over the years, it is significantly lower (at the 1% level) than that in urban areas. Of children aged between seven and 18 years, 45% were enrolled in 1991-92, increasing to 50% in 1996. However, in 1999, school enrolment in rural areas for this age group fell slightly to 49% before increasing very sharply to 66% in 2004-05.

Figure 3.12: School enrolment for children aged 7-18 years in Tanzania, by location, 1991-92 to 2004-05



Source: Tanzania Demographic and Health Survey (various years)

Figure 3.13: School enrolment for children aged 7-18 years in Tanzania, by gender, 1991-92 to 2004-05



Source: Tanzania Demographic and Health Survey (various years)

Figure 3.13 shows enrolment by gender for Tanzania over the 14-year period. In 1991-92, enrolment among children aged seven-18 years was significantly higher for boys (47.8%) than girls (45.6%) at the 1% level. However, in 1996 and 1999, similar proportions of boys and girls were enrolled in school – around 51% and 54%, respectively. By 2004-05, the gender gap seen 14 years ago emerges again, though much smaller now – 69% of boys in this age group were enrolled in school compared to 67% (significant at the 1% level).

Table 3.15: School enrolment among children aged 7-18 years in Tanzania

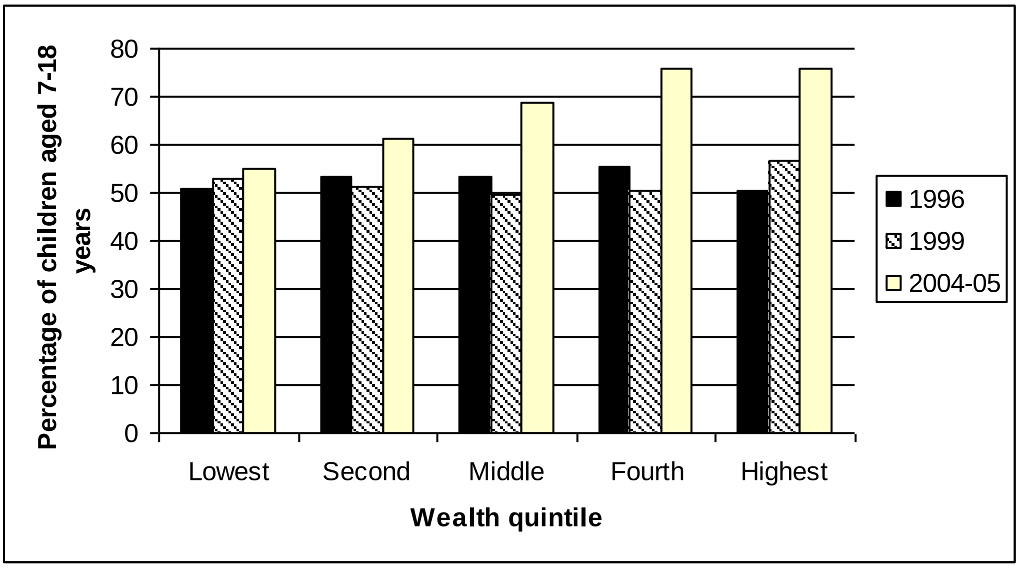
Year	Urban		Rural	
	Boys	Girls	Boys	Girls
1991-92	55.16	51.72	46.28	44.3
1996	58.08	58.17	50.44	49.71
1999	64.41	63.8	49.62	50.18
2004-05	75.56	72.01	67.59	65.17

Source: Tanzania Demographic and Health Survey (various years)

Table 3.15 presents school enrolment among children aged seven-18 years by gender and urban/rural location. Over the 14 year period, the proportion of boys and girls enrolled in school has steadily increased, the proportion of enrolled girls being slightly smaller than that of enrolled boys. In rural areas, the trend is not as straightforward. We see that the proportion of enrolled boys increased between 1991-92 and 1996, then decreased very slightly in 1999, following which there was a rapid increase in the proportion of enrolled boys in 2004-05. We see a persistent increase in the proportion of enrolled girls for the entire period. This category of children is the most disadvantaged as the enrolment is lowest for rural girls.

In Figure 3.14, we present enrolment among children aged seven-18 years by wealth category. We are only able to do so for 1996, 1999 and 2004-05 as the 1991-92 TDHS did not compute a wealth index. From 1996 to 2004-05, there is an increase in the proportion of enrolled children in each quintile. We would expect that as we move from the lowest to the highest quintile, the proportion of enrolled children will also increase as better off households would incur less direct and opportunity costs of schooling. However, Figure 3.14 shows something different. In 1996, the smallest proportion of enrolled children were in the lowest (50.7%) and highest wealth (50.5%) quintiles, while the highest proportion was in the fourth wealth quintile (55.4%). In 1999, the lowest proportion of enrolled children was in the middle wealth quintile (49.6%) while the highest proportion was in the highest wealth quintile (56.8%). In 2004-05, we see the expected pattern with the lowest proportion of enrolled children in the lowest wealth quintile (55.1%) and the highest proportion in the highest quintile (75.7%).

Figure 3.14: School enrolment for children aged 7-18 years in Tanzania, by wealth, 1991-92 to 2004-05



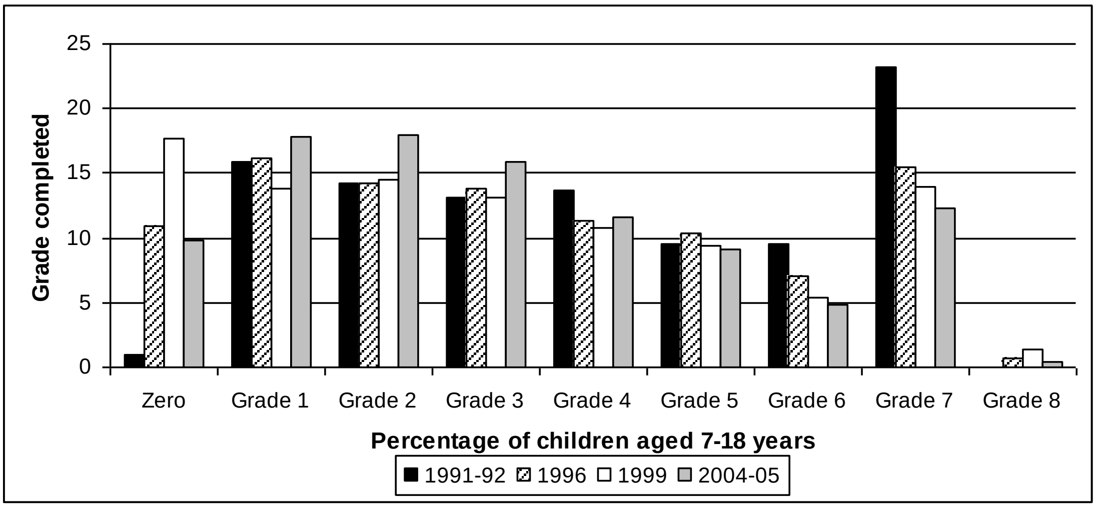
Source: Tanzania Demographic and Health Survey (various years)

Next, we look at the schooling achievements of children in this age group over time by looking into the highest grade completed.

School Achievement

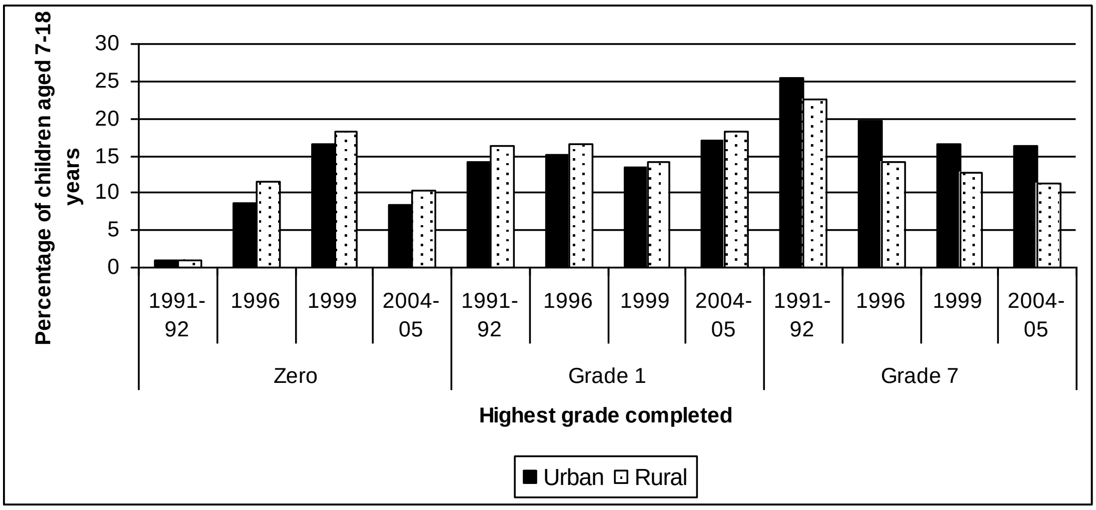
Figure 3.15 presents the proportions of children aged seven-18 years who have completed grades 1 to 7 in each of the TDHS survey years from 1991-92 to 2004-05. We first look at children who do not have any years of schooling. In 1991-92, a very small proportion of children had no schooling (1.03%). However, this proportion increased to almost 11% in 1996 and then to 18% in 1999 after which it fell to 10% in 2004-05. We now move onto completion of grade 1. In 1991-92, 15.9% of children had completed grade 1. This proportion increased slightly in 1996 (16.2%) but fell by 1999 (13.8%). By 2004-05, it had increased again (17.6%). We also look into the proportion of children in this age group who have completed grade 7 i.e. primary school. In 1991-92, 23.16% of children had completed grade 7. Since then, the proportion of children who completed grade 7 has decreased steadily –only 15.5% of children completed grade 7 in 1996, 14% in 1999 and 12% in 2004-05.

Figure 3.15: Highest grade completed by children aged 7-18 in Tanzania, 1991-92 to 2004-05



Source: Tanzania Demographic and Health Survey (various years)

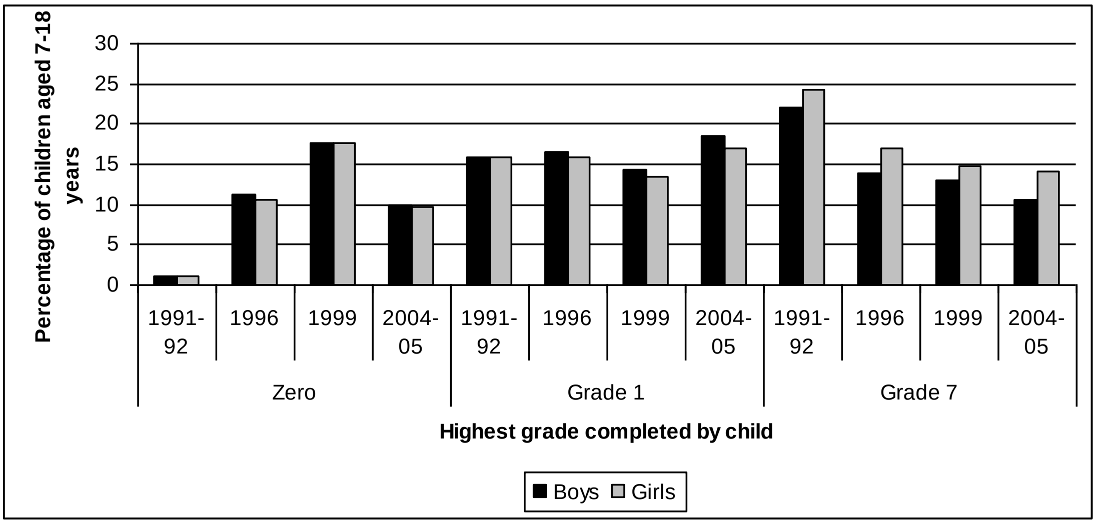
Figure 3.16: Grade completion for children aged 7-18 years in Tanzania, by location, 1991-92 to 2004-05



Source: Tanzania Demographic and Health Survey (various years)

Decomposing these figures by urban-rural location, we see that except for 1991-92, a higher proportion of children in rural areas have completed zero years of education (Fig 3.16). This is not very surprising and an expected trend as rural households are poorer and are less likely to be able to bear the costs of schooling even if they have access to schools. When it comes to grade 1 completion, we see that in all four years, higher proportions of children in rural areas have completed grade 1. However, this trend reverses when we look at grade 7 completion – in all four years, considerably higher proportions of children in urban areas have completed primary school than in rural areas.

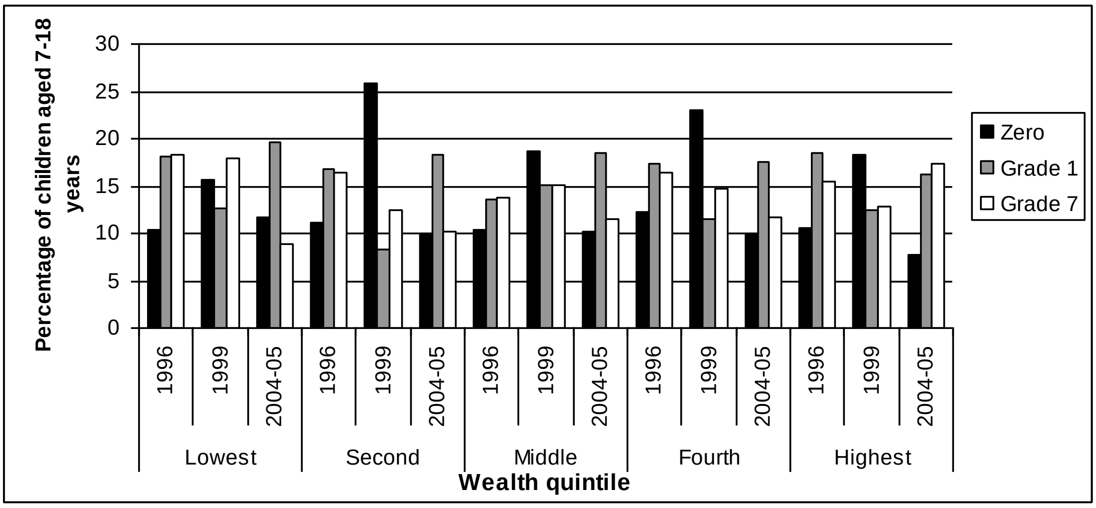
Figure 3.17: Grade completion for children aged 7-18 years in Tanzania, by gender, 1991-92 to 2004-05



Source: Tanzania Demographic and Health Survey (various years)

Decomposing these figures by gender, we see similar proportions of boys and girls have completed zero years of education (Fig 3.17), except in 1996, when a smaller proportion of girls had completed zero years of education. When it comes to grade 1 completion, we see that except in 1991-92, higher proportions of boys completed grade 1 compared to girls. However, this trend reverses when we look at the completion of grade 7 – in all four years, considerably higher proportions of girls completed primary school than boys.

Figure 3.18: Grade completion for children aged 7-18 years in Tanzania, by wealth, 1991-92 to 2004-05



Source: Tanzania Demographic and Health Survey (various years)

We expect that larger proportions of children who live in relatively poor households will have completed the lower grades while larger proportions of children from the very rich households will have completed the higher grades. In 1996 (Fig 3.18), the lowest wealth quintile had the smallest proportion of children who had no education (10.3%) while the fourth quintile had the highest (12.2%). The lowest wealth quintile also had the smallest proportion of children who had completed only grade 1 (13.5%) while the highest quintile had the largest proportion (18.5%). The middle quintile had the lowest proportion of children who had completed primary school (13.9%) while the lowest wealth quintile had the highest (18.4%)!

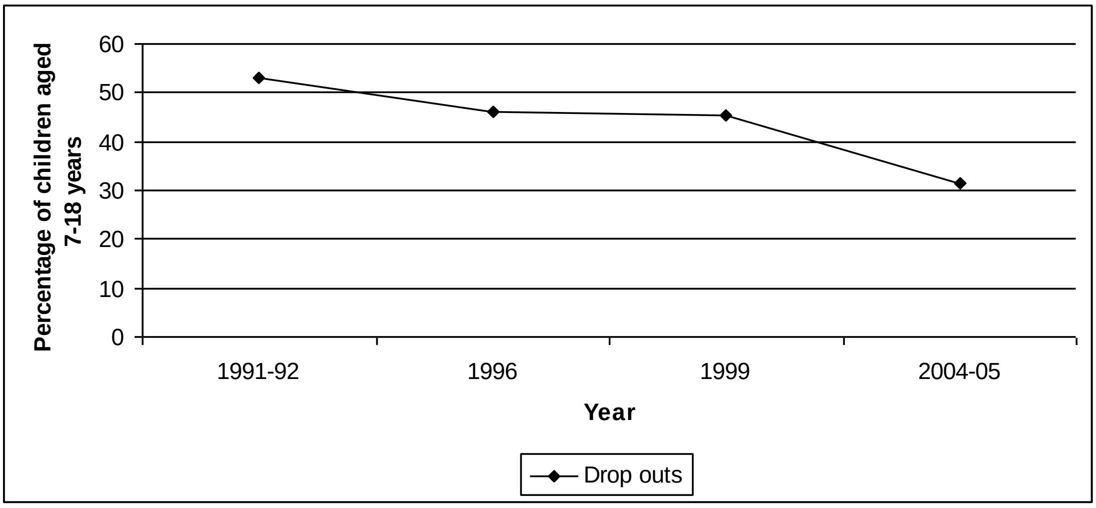
In 1999, the lowest wealth quintile had the smallest proportion of children who had no education (15.6%) while the middle quintile had the highest (25.8%). The middle wealth quintile also had the smallest proportion of children who had completed only grade 1 (8.25%) while the lowest quintile had the largest proportion (12.6%). The middle quintile had the lowest proportion of children who had completed primary school (12.4%) while the lowest wealth quintile had the highest (18%).

In 2004-05, the highest wealth quintile had the smallest proportion of children who had completed only primary education (7.8%) while the lowest quintile had the highest (11.7%). The highest wealth quintile also had the smallest proportion of children who had completed only grade 1 (16.2%) while the lowest quintile had the largest proportion (19.6%). The lowest quintile had the lowest proportion of children who had completed primary school (8.8%) while the lowest wealth quintile had the highest (17.4%).

Drop-outs

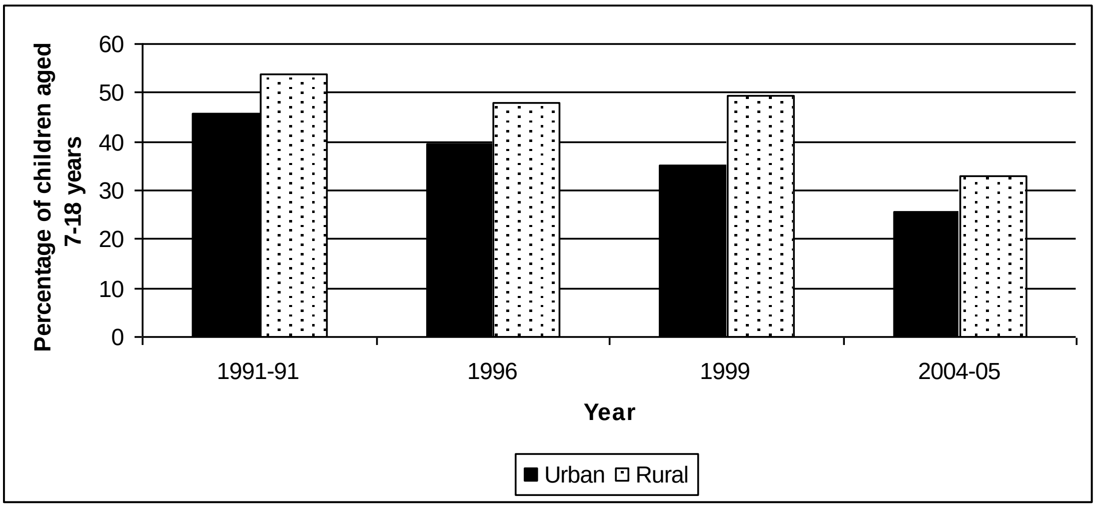
Next, we look at the proportion of children aged seven-18 years who have dropped out of school and the changes in these proportions over time. In 1991-92, the proportion of children who had dropped out of school was approximately 53% (Fig 3.19). In subsequent years, this decreased – in 1996, around 46% of children had dropped out of school and in 1999, approximately 45% of children had dropped out of school. After the PEDP was implemented, the proportion of children who had dropped out of school was about 32% in 2004-05.

Figure 3.19: Dropouts among children aged 7-18 years in Tanzania, 1991-92 to 2004-05



Source: Tanzania Demographic and Health Survey (various years)

Figure 3.20: Dropouts among children aged 7-18 years in Tanzania, by location, 1991-92 to 2004-05



Source: Tanzania Demographic and Health Survey (various years)

Looking at rural-urban differences in the proportion of children who have dropped out from school, we see that in each of the survey years, a higher proportion of children who live in rural areas have dropped out of school than children living in urban areas (Fig 3.20). These differences are significant at the 1% level. In urban areas, we see a persistent decrease in the proportion of children who have dropped out from school – in 1991-92, 45.7% had dropped out; in 1996, 39.6% dropped out; in 1999, 35.2% dropped out; and in 2004-05 25.6% had dropped out. However, in rural areas, the pattern is not as straightforward. The proportion of children who dropped out from school decreased from 53.8% in 1991-92 to 47.9% in 1996; then increased slightly to 49.2% and then fell again to 33.1% in 2004-05 (Fig 3.20).

When decomposing these figures by gender, we see that in all survey years, the proportion of girls and boys who dropped out from school has decreased over the period (Fig 3.21). In 1991-92, the proportion of girls who dropped out was significantly higher (53.4%) than that of boys (51.4%). A similar proportion of boys and girls had dropped out of school in 1996 (around 46%) and 1999 (around 45%). In 2004-05, the proportion of girls who dropped out was significantly higher (32.9%) than that of boys (30.4%).

Figure 3.21: Dropouts among children aged 7-18 years in Tanzania, by gender, 1991-92 to 2004-05

Source: Tanzania Demographic and Health Survey (various years)

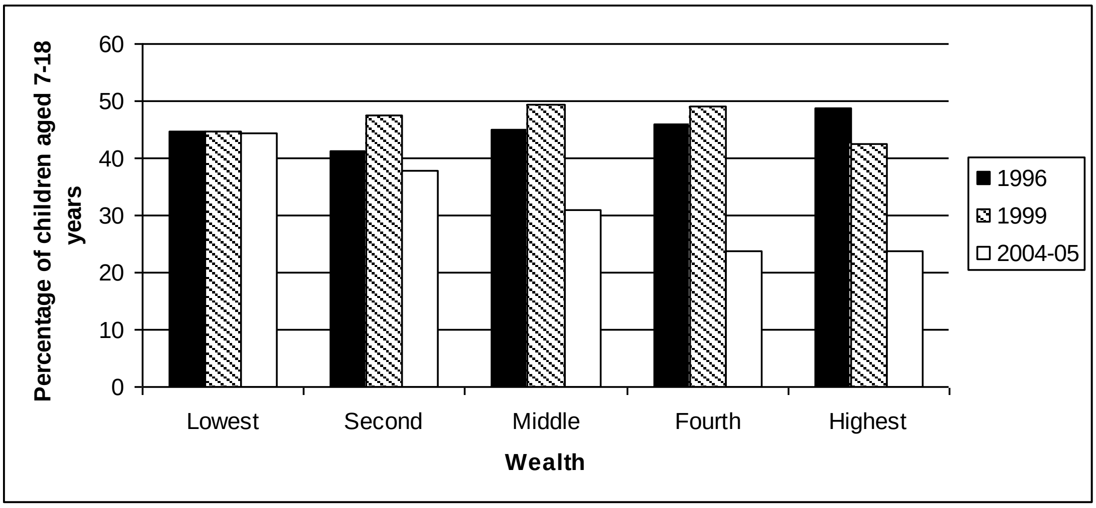
Table 3.16 shows the proportion of drop outs by urban-rural location and gender of children aged between seven-18 years. Again, we see that higher proportions of children who live in rural areas drop out of school and that the group that is the most disadvantaged is that of girls who live in rural areas. In all survey years, except 1999, a higher proportion of rural girls dropped out of school than rural boys. In urban areas however, the pattern is not similar. In 1991-92 and 2004-05, a higher proportion of urban girls dropped out of school than urban boys but for 1996 and 1999, the reverse is true.

Table 3.16: Dropouts among children aged 7-18 years, 1991-92 to 2004-05

Year	Urban		Rural	
	Boys	Girls	Boys	Girls
1991-92	44.21	47.13	52.83	54.75
1996	39.69	39.51	47.62	48.1
1999	43.25	36.12	49.35	48.89
2004-05	23.74	27.19	31.83	34.39

Source: Tanzania Demographic and Health Survey (various years)

Figure 3.22: Dropouts among children aged 7-18 years in Tanzania, by wealth, 1991-92 to 2004-05



Source: Tanzania Demographic and Health Survey (various years)

Next we look at the proportion of children who have dropped out from school by wealth (Fig 3.22). We expect there will be a higher proportion of children who have dropped out from school in the lowest wealth quintile than in the higher quintiles. In 1996, we see that the highest proportion of children who had dropped out was in the highest wealth quintile (48.7%) while the lowest proportion was in the second quintile (41.1%). In 1999, the highest proportion of children who had dropped out was in the middle wealth quintile (49.3%) while the lowest proportion was in the highest quintile (42.6%). In 2004-05, we see the expected pattern - the highest proportion of children who had dropped out was in the lowest wealth quintile (44.3%) while the lowest proportion was in the highest quintile (23.9%). Over time, we see that the proportion of children who have dropped out in the lowest quintile has remained the same while the largest decreases have taken place in the top three quintiles, suggesting that the PEDP has not been very beneficial to children in the poorest households in Tanzania.

3.5.2 School Education in Kagera

Several small education and schooling related studies were conducted in Tanzania between 1991 and 2004. Of these, the most comprehensive survey, though slightly dated, was conducted in 1999-2000 by the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ), which focussed on students in grade 6 and assessed the literacy and mathematics achievements of these children. Given the automatic progression policy in Tanzania, this allows us to look at children's schooling and educational achievements, by region, before they take the PSLE examination and identifies areas that need improvement before children come to this crucial stage. It also allows us to understand where Kagera stands in terms of education and schooling progress as well as how the education-related outcomes of children in Kagera differ from those in other regions in Tanzania.

The official age of entry to primary school is seven years and the primary age cycle is seven to 13 years. The SACMEQ survey found that the mean age for grade 6 students in Tanzania was approximately 180.4 months, which is approximately 15 years. Students from the Eastern and Kilimanjaro regions had mean ages of 171.4 and 171.9 months respectively, much lower than the national average, while Kagera had the highest mean age of 189.7 months (Mrutu *et al*, 2005). This suggests that children in Kagera are more likely to go to school at an older age than elsewhere in the country. Another reason for these age patterns is grade repetition, especially at grade 4. At grade 4 students who fail to score a pass mark in the national grade 4 examinations have to repeat the grade. The SACMEQ survey also found that at the national level, a higher proportion of students in grade 6 were girls (52%). The Central (57.8%) and Kilimanjaro (57.6 %) regions had the highest proportion of girls enrolled in grade 6 while Kagera had the (44.9%), far lower than even the national average. In Tanzania, approximately 29% of grade 6 students went to schools located in urban areas The Eastern region had 70% of its schools located in urban areas, whereas Kagera had one of the lowest proportions (14%) along with the Southern (5.9%) and Kilimanjaro (6.4%) regions.

In addition to these basic data, the survey also collected information on school absenteeism and repetition rates. In Tanzania, on an average, grade 6 students were absent for 2.1 days. Mwanza had the highest mean of 3.2 days, Kagera a mean of 2.9 days while Southern Highlands had the lowest of 0.9 days. Majority of students reported that they had missed school because they were ill (33%). Other reasons for missing school were family related (9.3%), for work (5.2%) and school fees being too high (1.7%). In Kagera, almost 46% of students reported missing school because of illness. This is not unexpected as this region has the highest HIV/Aids infection rates, and it follows that the number of children affected by illness is likely to be much higher than that in other regions. Approximately 16% of children in the region reported missing school for family related reasons such as caring for younger siblings. Around 5% of children in Kagera reported that they missed school because of work and 4 % because school fees were expensive.

The policy of the MoEC allows for children to repeat a grade in some cases such as if the student has not attended school for long period (due to illness etc.) or if teachers and parents feel that the student will not to be able to follow instructions in the next year of study, or if she is seriously underachieving (*ibid*). Students may repeat a grade only twice in their primary school cycle. The highest repetition rates tend to occur at grade 4 level where students take for the national grade 4 examination, as discussed above. On average, 23% of grade 6 pupils in Tanzania repeated a class at least once. The highest repetition rate was in Mwanza (36.8%) followed by Southwest region (36.7%) and Kagera (33.9%). Central and Eastern regions had the lowest percentages of repetition of 5.5% and 12.9%, respectively.

Over the 14 year period from 1991 to 2004, school enrolment among children aged between seven and 18 years in Tanzania has increased over time, especially after the PEDP was rolled out. However, Tanzania continues to have one of the lowest GERs among her east African neighbours. TDHS data for this period shows us that there is a gender gap in school enrolment as well as an urban-rural gap and relatively smaller proportions of girls who live in rural areas were enrolled in school in the TDHS survey years. Children who live in better off household were more likely to be enrolled in school in all survey years as these households would incur less costs of schooling. Despite the increase in enrolment owing to the rolling out of the PEDP, smaller proportions of children have completed grade 7 i.e. primary school but we are likely to see this as any consequent effects of the PEDP would be lagged ones. Again, there is an urban-rural gap in completion, where fewer children in rural areas have completed grade 7. There is also a gender gap, where a higher proportion of girls have finished primary school. And again, more children who live in better off households finish primary school. The proportion of children who dropped out of school has decreased over the 14 year period, the drop being steepest in the period between 1999 and 2004-05; perhaps this is linked to the PEDP. The proportion of children who have dropped out of school is higher in rural areas than urban areas and girls than boys. Wealthy households have relatively lower proportions of dropped out children.

With this picture of schooling and achievement, we looked at some indicators of schooling efficiency in Kagera with the help of the SACMEQ survey that collects school related data for children enrolled in grade 6. We found that Kagera had the oldest grade 6 children in the country, implying high rates of grade repetition and delayed enrolment into primary school. There was also a severe gender gap for school enrolment in Kagera- it had the lowest proportion of girls enrolled in grade 6 in the country. Children in Kagera were also likely to miss school for more number of days than children in other parts of the country; Kagera also had the highest incidence of missing school due to illness in the country.

3.6 Concluding Remarks: Tanzanian Policy, Consumption, Nutrition and Households

In this chapter we have presented a brief history of the social policy in Tanzania and discussed, in particular, the national nutrition policy that is in place. Using statistical data from the Tanzanian NBS and FAO and ethnographic evidence collected by Weiss (1996), we have presented trends in household consumption in Tanzania and changes in these between 2000/01and 2007. We see that households in urban areas have higher average annual incomes those in rural areas and that the main sources of household income are agriculture and related activities. Mean household expenditure was much higher in urban areas than rural areas and that there was an increase in household expenditure between 2000/01 and 2007. However, the share of food in consumption is approximately 60% in urban and rural areas in both years. The HBS indicated that in 2000/01 and 2007, majority of Tanzanian households eat three meals a day. However, FAO statistics suggest that between 1990/92 and 2003/05, the average calorie intake of an individual country decreased. Further, the data from the FAO shows that the diet in Tanzania and particularly in Kagera, is heavily dependent on carbohydrates and staples but deficient in foods that supply essential micronutrients, leading to poor nutrition statuses of individuals. Further, the complex social constructs around food production, consumption and hunger in this region are likely to put very young children at risk of malnutrition and undernutrition. Why is there such a large proportion of undernourished children in Tanzania and Kagera? Why has this proportion not reduced over time despite government policies to alleviate the situation?

We then use DHS data from 1990 to 2004 to get a clearer picture of trends in undernutrition among children in Tanzania that have remained very high in all the survey years. When we compare these to child undernutrition statistics presented by Alderman *et al* (2005) the trends in Kagera are similar to those seen at the national level in the early 1990s. We also use statistics from the DHS to look at children's schooling efficiency outcomes such as school enrolment, dropouts and grade achievement. When we compare these to statistics presented by Mrutu *et al* (2005), we find that Kagera performs poorly on these measures compared to the national averages as well as averages for other regions in Tanzania.

Why does Kagera have poorer schooling outcomes than other regions in the country? Is this linked to children's poor health as some literature suggests? Could this also be linked to the indirect and opportunity costs of schooling? Given that this region has a high incidence of HIV/Aids, which leads to higher rates of morbidity, mortality and household vulnerability; could this also affect children's health and well-being? How do various socio-economic factors interact with each other and how does this affect schooling achievement?

4. Kagera Health and Development Survey

This chapter briefly discusses the Kagera and Health Development Survey that is used for the empirical analysis. It describes the research and sampling design of the two rounds of the KHDS. Complete details of the same are presented in Appendix 1. This chapter also describes the information collected by the survey; for details of the same, see Appendix 1. Specific data-related problems encountered while using the KHDS will be discussed in a Chapters 5, 6 and 7

Figure 4.1: Kagera region in Tanzania

Source: Beegle *et al* (2006)

In 1991, the Population and Human Resources Department and the Africa Technical Department of the World Bank jointly launched a research project on "The Economic Impact of Fatal Adult Illness from AIDS and Other Causes in Sub-Saharan Africa". The research project stemmed from the ideas that poverty worsens health; that it is difficult to establish that poor health worsens poverty or that health improvements can stimulate economic growth; and particularly, the dramatic increase in the mortality rate among adults in their most productive years in SSA. It aimed to answer the question of what the impact of these factors on poverty and human capital could be, in a region where incomes, schooling, and health status are already low (Beegle *et al*, 2006).

To measure the impact of adult mortality and morbidity on the welfare of individuals and households, the research project conducted a longitudinal household survey, known as the Kagera Health and Development Survey (KHDS), in the Kagera region of Tanzania from 1991-94. This region, located on the western shore of Lake Victoria adjacent to Uganda and Rwanda and not far from Zaire, is at political and economic crossroads that is also at the epicentre of the Aids epidemic in east Africa. In 2004, a second survey round was conducted.

4.1 KHDS1

The KHDS interviewed more than 800 households from nearly 50 communities in all five districts of Kagera in the period 1991-94. Households, community leaders, health facilities, schools, and market vendors were queried in six-seven month intervals for up to four survey periods. Traditional healers were also interviewed once. The aim of the second round conducted in 2004 (KHDS2) was to track members of the KHDS1 households. Although the KHDS questionnaires are adapted from the World Bank's LSMS questionnaires, the KHDS is unique as it is wholly longitudinal. This feature gives us the opportunity to measure changes in household consumption and assets between interviews and thus, over time and we may be able to study issues such as household saving or dissaving that key household-level coping mechanisms amongst others.

4.1.1 Research and Sampling Design

The research design called for a longitudinal survey of a sample of households, some of which would have experienced an adult death (or were likely to do so) and some of which had not. Some of these households were to be drawn from communities with high adult mortality rates, and others from low-mortality communities. The KHDS used a random sample that was stratified geographically and according to several measures of adult mortality risk. The household sample was drawn in two stages. Stratification was based on geography and mortality risk in both stages. Communities and clusters were selected in the first stage and households in the second.

Selecting communities and clusters

The 550 primary sampling units (PSUs) in Kagera were classified according to eight strata defined over four agronomic zones and, within each zone, the level of adult mortality (high and low).[16] Clusters of households were drawn randomly from the PSUs in each stratum, with a probability of selection proportional to the size of the PSU. Within each agronomic zone, PSUs were classified according to the level of adult mortality. Owing to the fact that adult mortality rates were much higher in some zones than others and the distribution was quite different within zones, “high” and “low” mortality PSUs were defined relative to other PSUs within the same zone. A PSU was classified as in the “high” mortality category if its ward adult mortality rate was at the 90th percentile or higher of the ward adult mortality rates within a given agronomic zone (see Appendix 1 for the distribution of households across the strata according to adult mortality rates).

Having classified all of the PSUs in Kagera into the eight strata, the KHDS interviewed households within PSUs in clusters of 16 households each. The research design and the budget called for surveying 50 clusters of 16 households each, for a total sample of 800 households. The field teams were able to successfully enumerate only 52 PSUs, from which 54 clusters could be drawn. The problems faced when enumerating the PSUs are further discussed in Appendix 1.

[16] A PSU is a geographical area delineated by the 1988 Tanzanian Census that usually corresponds to a community or, in the case of a town, to a neighbourhood.

Selecting households

In the KHDS, a household was defined as a person or group of persons who live in the same dwelling and eat meals together for at least three of the 12 months preceding the date of the survey. There are four exceptions to this definition: one, persons who have recently joined the household, such as spouses, newborn infants, adopted orphans and others who intend to stay until the next interview. Two, the head of the household is identified by the household without any criteria established by the study team and is considered a household member regardless of his/her length of absence. Three, "*makubaliano*" servants, who live with the household without contracts, are considered household members as long as they satisfy the residency requirement. Four, tenants and boarders are not household members, regardless of their length of residence.

Households within each of the selected PSUs were assigned to one of two strata—"sick" or "well"—based on the results of an enumeration of all households in each community. Sixteen households were selected at random per cluster, of which 14 were selected from the "sick" group and two from the "well" group. In selecting the 16 households to be interviewed in each PSU from which a cluster was drawn, 14 were selected at random from among the "sick" households in that PSU and two were selected at random from among the "well" households. In one cluster, where the number of "sick" households available was less than 14, all available sick households were included in the sample and the balance was from well households. The final sample drawn for the first passage was therefore 816 households in 51 clusters drawn from 49 PSUs (Table 4.1).

Table 4.1: Distribution of households by stratum, KHDS1

	Adult Mortality Rate, 1998		
Agroeconomic Zone	**Low**	**High**	**Total**
Tree Crop	128	112	240
Riverine	80	112	192
Annual Crop	96	64	160
Urban	96	128	224
Total	400	416	

Source: Beegle *et al* (2006)

Between March 15 and June 13, 1991, 29,602 households were enumerated in 52 PSUs. In addition to recording the name of the head of each household, the number of adults in the household (15 and older), and the number of children, the enumeration form asked whether any adults in this household were ill at this moment and unable to work; and if so the age of the sick adult and the number of weeks he/she has been too sick to work. The form also asked whether any adult aged between 15 and 50 in this household died in the past 12 months; and if so, the age of each adult and the cause of death. To further increase the probability of capturing households with adult deaths in the sample, households were stratified according to the extent of adult illness and mortality. The households in each enumerated PSU were classified into two groups, based on their response to the enumeration. “Sick” households were those that had either an adult death 15-50 due to illness in the past 12 months, an adult too sick to work at the time of the survey, or both (n=2,169). “Well” households were those that had neither an adult death 15-50 due to illness nor an adult 15- 50 too sick to work (n=27,433).

4.1.2 Household Attrition and Replacement

Attrition from household sample

Among the original 816 households selected from the enumeration, 47 (5.8%) could not be interviewed during the first passage (ie in 1991-92) which occurred 7-12 months after the enumeration. The most important reason for attrition was that the household had moved. In about a third of these cases, the move was related to the death of a household member. During the first passage, a total of 840 households were interviewed. By the end of the fourth passage (1993-94), more than two years later, 81 households (9.6% of the 840 interviewed in the first passage). In 80% of the cases, the reason for attrition was that the household moved; about a third of those moves were related to an adult death in the household, including one case in which a single-person household died. Only 13 households -16% of the household attrition during the panel - refused to participate. Of all 840 households interviewed during the first passage, only 1.5% of the households completing a questionnaire in the first passage refused to be interviewed by the end of the survey.

4.1.3 Selecting Health Facilities, Markets and Healers

The sample of health facilities, schools, and markets that were interviewed or visited was selected based on the information provided by community leaders. The facilities interviewed generally represent those closest to the cluster, and thus do not represent a random sample of facilities in Kagera region. Traditional healers were randomly selected within each community.

Health facilities

The sample consisted of the nearest health facility (dispensary, health centre, or hospital) to each cluster, as indicated on the community questionnaire. Where there was more than one health facility in the cluster (i.e., Bukoba town), all health facilities were to be interviewed. At the same time, some clusters shared the same facilities. The number of facilities interviewed over time increased from 42 in the first passage to 61 by the fourth passage.

Primary schools

The sample consists of the nearest primary school to each cluster. In the event that there were several primary schools in a cluster, a separate questionnaire was completed for each. As a result, 62 primary schools were interviewed in the first passage. This increased by the fourth passage to 64 because of two schools inadvertently omitted in earlier passages.

Markets

During the first passage, price data were collected from the nearest market to each cluster. There was no distinction made between whether the data were collected from an open market with several stalls, vendors or whether it was a "*duka*" or shop of a local merchant, with the type of establishment being noted on the form.[17] For the second through fourth passages, in principle, two price questionnaires were completed for each cluster. One was completed for the nearest marketplace and another was completed for the nearest *duka*(s).

[17] In theory, there should have been 51 price questionnaires for the first passage, one per cluster. However, in some clusters the interviewer completed separate questionnaires for markets and dukas, even in the first passage. Further, two PSUs and four clusters were selected from the Hamgembe neighborhood of Bukoba town. However, the interviewers failed to realize that a price questionnaire was to be completed each time a Hamgembe cluster was interviewed.

Traditional healers

During the third passage, respondents to the community questionnaire were asked to list all of the traditional healers in the community. A total of 317 healers were listed, with two-13 recorded per cluster. Two healers were selected at random from the list in each cluster to receive the healer questionnaire. An enthusiastic interviewer in fact interviewed a third healer in one cluster, so 103 of these questionnaires were completed in the third passage—two per cluster in 50 clusters and three in one cluster.[18]

4.2 KHDS2

The KHDS2 took place in 2004 as a fifth round following on the four rounds of the baseline KHDS 91-94. The KHDS 2004 was designed to provide data to understand economic mobility and changes in living standards of the sample of individuals interviewed 10-13 years ago. The KHDS 2004 attempted to re-interview all respondents ever interviewed in the KHDS 1991-94. This entailed attempting to track these individuals, even if they had moved out of the village, region or country. Where possible, comparability is maintained with the KHDS 1991-94 survey instruments. However, the questionnaires for the KHDS 2004 were revised to reflect changes in the region since 1994. Further, the household questionnaire was redesigned in an effort to capture key transitions that have occurred since the previous survey (Beegle et *al*, 2006)

4.2.1 Sampling Strategy

Households

KHDS2's sampling strategy was to re-interview all individuals who were household members in any round of the KHDS 1991-94 and who were alive in the last

[18] The results of the survey of traditional healers are described in Semali and Ainsworth (1995).

interview.[19] The household in which these individuals live were administered the full household questionnaire. For all household members alive during the last interview in 1991-94, but found deceased by 2004, information about the deceased was collected in a mortality questionnaire that collected data on the circumstances of their death, their living arrangements and limited information on health seeking behaviour prior to death. The respondents for this questionnaire were typically panel respondents who were previous household members with the deceased, other relatives, neighbours or close friends. Excluding households in which all previous members are deceased (17 households and 27 people), the field team managed to re-contact 93% of the baseline households. Not all 912 households received four interviews. Not surprisingly, households that were in the baseline survey for all four rounds had the highest probability of being re-interviewed. Of these 746 households, 96% were re-interviewed.

Because people have moved out of their original household, the new sample in KHDS 2004 consists of over 2,700 households from the baseline 832, which were re-contacted. Much of the success in re-contacting respondents was due to the effort to track people who had moved out of the baseline villages. One-half of all households interviewed were tracking cases, meaning they did not reside in the baseline communities. Of those households tracked, only 38% were located near the baseline community. Overall, 32% of all households were not located near the baseline communities. While tracking is costly, it is an important exercise because migration and dissolution of households are often hypothesized to be important responses to hardship. Excluding these households in the sample raises obvious concerns regarding the selectivity of attrition. In particular, out-migration from the village, dissolving of households, and even marriage, may be responses to adult mortality. At the same time, tracking will provide a unique opportunity to study these coping mechanisms: who uses them, what is the effect, do they get people out of poverty or do they themselves constitute a poverty trap.

KHDS 2004 tracked international migrants to Uganda only. Although the location of those in other countries was known, they were not traced. For those respondents who

[19] One serious problem that is side-stepped by this approach is constructing a definition of what makes a household the same household as 10 years ago, especially if there are individuals who have migrated, split-off or the household has dissolved.

were not re-interviewed, the KHDS 2004 gives some information about their interactions with the re-interviewed respondents.

Community surveys

The community questionnaire was administered in all KHDS baseline communities. There are 49 unique communities; as noted above, the sample has 51 enumeration areas but two pairs are in the same community (areas 44 and 45; areas 46 and 47). In 2004, the community questionnaire was administered in the same manner as in 1991-1994.

4.3 Questionnaires and Information Collected

The KHDS1 and KHDS2 collect detailed information at the individual, household and community level. The household questionnaire is the main instrument used to assess the impact of fatal adult illness. It collects data on individuals and households in the following areas: demographic characteristics; health status, symptoms, health-seeking behaviour and medical expenditures; nutritional status; mortality and related expenditures; human capital, enrolments and education expenditures; fertility and contraceptive use; time use in the labour force, other productive and health-related activities; income levels and sources; assets and durable goods, including housing, farm and business assets; consumption expenditure, by component; savings, debts, transfers and receipt of assistance; characteristics of non-resident parents and children, including their mortality

The objective of the community questionnaire is to elicit community-wide information on demographic characteristics; economy and infrastructure; education; health; agriculture; and culture that are common to all households residing in each community. The questionnaire is administered to community leaders who were also specifically asked about the location, distance and identity of the closest market, primary school, dispensary, health centre, and hospital. In addition, they were asked to name traditional healers within the community. Information from these questions was used to identify the sample of markets, schools, health facilities, and traditional healers for specific questionnaires in the study. It is important to note that these samples are not randomly selected and therefore, are not representative of the markets, health facilities, schools, and traditional healers in Kagera. They are representative of the facilities located near the selected sample of households.

The school questionnaire is aimed at assisting the analysis of demand for schooling of household members. It was completed for every primary school in a cluster. If there was no school in the cluster, a school questionnaire was completed for the nearest primary school to the cluster. There are two parts to the school questionnaire. Part A focused on the characteristics, enrolments and fees for each school and was administered by the interviewer. Part B was left with the headmaster or head teacher of each school so they could refer to school records and inventory to provide information on the number of textbooks (Kiswahili, math, other) available for the students of each grade; and the number of classes, enrolled students, enrolled female students, students who attended last week, and two-parent orphans enrolled for each grade. In 2004, the school questionnaire was administered in the same manner as in 1991-1994. The number of schools per enumeration area ranged from one to three schools per enumeration area. A total of 72 school questionnaires were administered in 49 baseline communities.

The price questionnaire measured prices of key consumption goods throughout the survey area and over time. The price questionnaire contained a list of 30 food items, six pharmaceutical products and 13 non-food items. Three prices were collected for each item from three different traders at different locations in the market. Price data were collected from two types of market: the nearest community market and roadside shops or *dukas* for each cluster in each passage. In 2004, the price questionnaire was administered in the same manner as in 1991-1994. Where possible, two questionnaires were completed per enumeration area. In most enumeration areas one questionnaire was done in shops and one in markets, although some enumeration areas have only one questionnaire and one enumeration area has three questionnaires. A total of 90 price questionnaires were administered, 47 to markets and 43 to shops.

The health facility questionnaire was used to establish changes in the demand for health services and the supply of health services offered at a health facility. It was administered to the health facility closest to each cluster. Data collected in this section was organized in three parts. Part A was administered to the medical person in charge and collected information on characteristics of the facility; personnel; equipment; services; immunizations; family planning; inpatient services; demand; and fee exemption policies. Part B was administered to the pharmacist of the facility and asked about the availability of drugs at the facility. Part C, on inpatient and outpatient consultations, was not administered by an interviewer but was completed by the medical officer in charge. This was not administered in KHDS2

The questionnaire administered to the traditional healer documents the prices, types of facilities, services, and referral practices of traditional healers in the survey area. The questionnaire was administered to two healers per cluster, who were randomly selected from those listed by the community leaders. Administered only in Passage 3 of KHDS1, this survey includes questions on the number and types of patients seen, the types of health problems encountered, and the healer's knowledge of the etiology of AIDS and of other diseases as well as personal background of respondents; consultations in past seven days; facilities and equipment; knowledge and practices; prescription and referrals; income and prices; and childbirth services. This was also not administered in KHDS2.

5. Determinants of Early Childhood Undernutrition: Descriptive Statistics from KHDS

This chapter and the following chapter set up the questions posed by Svedberg (1999) that are important when tackling the problem of undernutrition. What is the extent of undernutrition among very young children in Kagera? Where are they located? Why are they undernourished? We will look into the undernutrition situation in Kagera by descriptively exploring the first and second rounds of the KHDS to answer each of these questions.

5.1 Undernutrition among Children

The 1994 sample of the KHDS consists of 538 children between the ages of 6-60 months of which the majority are boys (51.59%). [20] Children are considered stunted if their height-for-age Z-score is less than – 2, underweight if their weight-for-age Z-score is less than -2 and wasted if their weight-for-height Z-score is less than -2 anthropometric indicators. Table 5.1 presents the prevalence of undernutrition in Kagera in 1994.

Table 5.1: Undernutrition in Kagera among children between 6- 60 months, 1994[21]

	Stunting	Underweight	Wasting
Girls	36.75	13.43	4.24
Boys	44.41	22.04	4.28
Total	40.72	17.89	4.26

Note: All figures are in percentages
Source: KHDS (1994)

In 1994, we see that a larger proportion of boys was undernourished than girls. This is true for stunting, being underweight and wasting. For each indicator of undernutrition, we ran a simple t-test for the difference in means. We found that the

[20] Children under the age of 6 months are excluded from the sample as the I Grow Up Package with STATA is unable to calculate z-scores for these children.
[21] These figures differ to a small extent from those presented by Alderman et al (2005). This is because the authors use data for all waves (1991-94) of KHDS1 and we use only wave 4 of KHDS 1.

difference in the prevalence of stunting and being underweight between boys and girls is statistically significant at the 5 and 1 % levels, respectively. However, the difference in prevalence in wasting among boys and girls was not found to be statistically significant, even at the 10% level. This would suggest that in 1994, there was an acute gender gap in the long-term nutritional status of young children.

The 2004 sample consists of 1489 children between the ages of 6-60 months of which the majority are girls (51.44%). Table 5.2 presents the prevalence of undernutrition among children in Kagera in 2004. In 2004, a higher proportion of boys was undernourished compared to girls. This is true across all indicators of undernutrition. We see that 45.64% of boys were stunted compared to 35.9% of girls; 5.67% of boys were wasted compared to 4.44% of girls; and 16.74% of boys were underweight compared to 16.06% of girls. This is similar to the trend that we saw for 1994 (Table 5.1). While there was no statistically significant difference in the prevalence of being underweight or wasted between boys and girls, we found that there was a statistically significant difference (at the 1% level) in the prevalence of being stunted between boys and girls, suggesting that the acute gender gap in the long-term nutritional status of young children is persistent in Kagera.

Table 5.2: Undernutrition in Kagera among children between 6- 60 months, 2004

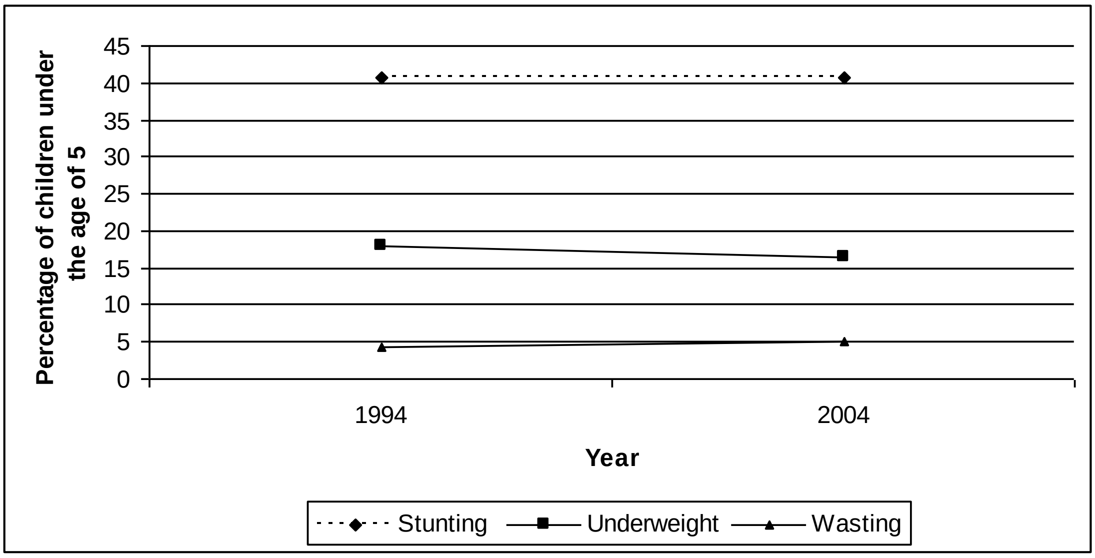
	Stunting	Underweight	Wasting
Girls	35.9	16.06	4.44
Boys	45.71	16.76	5.68
Total	40.66	16.4	5.04

Notes: All figures are in percentages
Source: KHDS (2004)

Over the 10 year period from 1994 to 2004 in Kagera, there have been decreases in the proportions of stunted and underweight children aged between 6 and 60 months (Figure 5.1). However, the decrease is very small, suggesting that the long-term nutritional problem for very young children has not improved very much in Kagera over the last 10 years. Moreover, there has been a slight increase in the proportion of wasted children since 1994.

The slow improvement of the undernutrition among children under the age of five is a matter for concern and it is unlikely that Kagera (and Tanzania) would be able meet the MDG of halving undernutrition among children by 2015. To meet this goal, it is important to understand why these children are undernourished. An understanding of the factors that have an impact on the nutritional status of children would indicate how governments and other institutions can best use their resources to alleviate the problem.

Figure 5.1: Undernutrition among children between 6-60 months, 1994 to 2004, Kagera



Source: KHDS (1994, 2004)

Existing literature distinguishes between various factors that can impact a child's nutrition and categorise them as immediate, underlying and basic determinants that act the level of the child, household and community or country (Smith and Haddad, 2000; UNICEF 1990; Beaudry, 1996). The remainder of this chapter investigates how these determinants affect children's nutrition in Kagera over time.

5.2 Immediate Determinants of Undernutrition

The immediate determinants of a child's nutritional status include dietary intake and health status. In this section we present statistics from Rounds 1 and 2 of the KHDS that will explore the food intake of children in Kagera and their health statuses.

5.2.1 Food or Calorie Intake

Almost all studies that study the determinants of child malnutrition include food available for human consumption as an explanatory variable. The KHDS does not collect any information on calorie intake of respondents; neither does it collect information on the distribution of calorie availability for the household. However, it does collect data on the number of meals that an individual eats in a day for 2004 (but not 1994). Thus, we investigate how many meals are eaten by households on a daily basis. However, we use this information with caution because of the mixed evidence of the impact of this variable as discussed in Chapter 2. In 2004, households in the sample responded that they consumed between one and four meals a day, the average number of meals eaten in one day being 2.08 meals.

Table 5.3: Average number of meals eaten daily by households with undernourished and non undernourished children, 2004

Undernourished	Average number of meals	Not undernourished	Average number of meals	Difference
Stunted	2.08	Not stunted	2.07	NS
Underweight	2.11	Not underweight	2.07	*
Wasted	2.15	Not wasted	2.07	**

Note: * denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (2004)

On an average, households with stunted, underweight and wasted children ate 2.08, 2.11 and 2.15 meals a day, respectively (Table 5.3). On the other hand, households with non-stunted, non-underweight and non-wasted children all ate an average of 2.07 meals every day. There was no statistically significant difference between the average number of meals consumed by households with stunted and non-stunted children at the 10% level. We did find significant differences in the average number of meals eaten daily by households with underweight and non-underweight children; and households with wasted and non-wasted children at the 10 and 5% levels, respectively. However, these were in the wrong direction - households with underweight children ate a larger number of meals everyday than households with non-underweight children and households with wasted children ate a larger number of meals everyday than households with non-wasted children. However, this variable is difficult to interpret – we need to keep in mind that even though some households are eating more meals, these are of inferior quality, which could result in the poor nutritional status of some children.

5.2.2 Quality of Diet

Given the above findings we need to investigate dietary intake further. While we recognise that households may face constraints that force them to eat fewer meals or substitute nutritious food for cheaper nutrient-poor food, we believe that the quality of food people eat is just as important as how much they eat. Studies have documented that better quality of diet is associated with improved birth weight and nutritional status of children as well as reduced mortality. It is also widely recognised that rather than insufficient intake of calories, it is the inferior quality of diet that is the main dietary constraint facing poor populations (Smith and Subandoro, 2007). For these reasons it is important that we take into consideration the quality of food that people are eating when we analyse the determinants of malnutrition.

The KHDS collects detailed information on the variety food items consumed by the household in the last 12 months whether from their own production or from purchases. We choose to use household level information as children are unlikely to be able to make decisions about food consumption by themselves. This household level information does not tell us how food is allocated within the household, nor the quantities of particular food items that are consumed. However, this information could explain how varied a household's diet in our sample is.

Table 5.4: Households' monthly food variety score, 1994 and 2004

	Stunted	Not stunted	Differ ence	Under weight	Not under weight	Differ ence	Wasted	Not wasted	Differ ence
1994	2.51	2.55	NS	2.47	2.54	NS	2.33	2.54	NS
2004	2.99	2.99	NS	2.87	3.02	**	2.93	3.00	NS

Note: All figures are in percentages
* denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (1994, 2004)

Using data for whether the household consumed certain food groups in the last 28 days, we create a food variety score for the household following the concept as explained by Smith and Subbandoro (2007). The food groups included in the food variety score of the household are carbohydrates such as bananas, cassava, potatoes, rice and other cereals, processed foods such as bread, pasta, cake, buns and biscuits; protein such as beans, legumes, nuts and eggs; fruits; vegetables; dairy products; and meats. The household was assigned a score of 0-6 depending on the number of food groups listed above were consumed 28 days prior to the survey, with a score of 6 indicating that the household was consuming food items from all 6 groups and ate a larger variety of foods that may facilitate the consumption of more nutrients. Thus, if the household has consumed only four of the six food groups in 28 days prior to the survey, it was assigned a food variety score of 4.

In Table 5.4, we present the average monthly food variety scores of households that have children who are undernourished and those who are not in 1994 and 2004. In 1994, there were no significant differences in the monthly food variety scores of households with stunted and non-stunted children, underweight and non-underweight children and wasted and non-wasted children. In 2004, we see an improvement in the monthly food variety scores of all households, with the increases being greater for households with children who are not undernourished, either in the short- or long-run. In this year, again, there is no significant difference between the monthly food variety scores of households with stunted and non-stunted children and between households with wasted and non-wasted children. However, households with underweight children eat significantly fewer food groups (on an average) in a month than households, with non-underweight children, suggesting that in the short-term, these children suffer from poor dietary diversity, which can impair their nutritional outcomes.

The food variety score constructed here must be used and results must be interpreted with caution. This indicator can only give us an idea of how diverse household diets can be; it cannot capture information about an individual's food preferences. Another shortcoming of this variable is that it is unable to reflect the socio-cultural norms that dictate intra-household allocation of food (and other resources) as we have discussed in Section 6.5.1. This variable may also suffer from biases that arise from recall errors and telescoping. Despite these limitations, we continue to use this variable as an indicator of the variety of a household diet but bear in mind that this variable can only provide approximate information, at best.

The KHDS survey and Weiss's (1996) ethnography indicate that household diets in Kagera are heavily staple dependent. Data from the KHDS shows that majority of households consume bananas, cassava, maize and potatoes from their own production as well as what they purchase. Very few households tend to supplement this with fruit, vegetables and meat and dairy products. Further, as more households with undernourished children exhibit this pattern, it is very likely that these children are missing out on essential macro and micro nutrients that will affect how they grow and how their body can fight disease (Smith and Subandoro, 2007; Randolph *et al*, 2009)

5.2.3 Child Health

Both rounds of the KHDS provide information on illness of household members in the four weeks prior to the administration of the survey. These figures would give us an idea of the stock of health of healthy and undernourished children. In 1994, more than half the children in the sample had been ill in the last four weeks. Table 5.5 shows that higher proportions of non-stunted and non-underweight children have been ill in the last four weeks than stunted and underweight children, respectively. This is unexpected as literature indicates the reverse. However, these differences are not significant at the 10% level. A much higher proportion of wasted children had been ill in the last four weeks than non-wasted children and this difference was significant at the 10% level

Table 5.5: Proportion of children who have been ill in the last 4 weeks, 1994

Undernourished	Proportion ill in the last 4 weeks	Not undernourished	Proportion ill in the last 4 weeks	Difference
Stunted	54.8	Not stunted	58.86	NS
Underweight	57.06	Not underweight	57.71	NS
Wasted	70.83	Not wasted	56.42	*

Note: * denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (1994)

Table 5.6: Proportion of children who have been ill in the last 4 weeks, 2004

Undernourished	Proportion ill in the last 4 weeks	Not undernourished	Proportion ill in the last 4 weeks	Difference
Stunted	36.4	Not stunted	39.46	NS
Underweight	39.34	Not underweight	38.46	NS
Wasted	37.33	Not wasted	38.67	NS

Note: * denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (2004)

By 2004, fewer children in the sample reported to being ill in the last four weeks. Table 5.6 shows that higher proportions of children who were not undernourished were ill in the last 4 weeks than children who were undernourished. Again, this is not a result that is expected as evidence indicates the reverse. However, these differences in the proportions of children who were ill in the last four weeks were not found to be significant at the 10% level.

Over the 10 year period, there has been a decrease in the proportion of children who were ill in the four weeks before the survey. Further, among all categories of undernourished children, there was a considerable decrease in proportion of children who were ill in the last four weeks, with the decrease being the largest for wasted children. This could be for several reasons – households could have better access to health facilities or amenities either via increased income or state provision of better and more accessible facilities.

These results indicate that we need to look deeper into the underlying determinants of undernutrition – household food security, care for mothers and children and health environments and other services available to households and poverty. The following section discusses the underlying determinants of undernutrition among children in Kagera and present relevant statistics from the KHDS.

5.3 Underlying Determinants of Undernutrition

The immediate determinants of a child's nutritional status are affected by underlying determinants at the household level. These are food security, implying that an individual has enough access to food to lead an active and healthy life; care, as no child can grow without nurturing from other human beings, irrespective of the quantity of food available; and health environment and services, which depend on the availability of safe drinking water, sanitation, health care facilities, housing and other such factors. We examine how food secure households are, the care available to children and factors that could affect this as well as the health and sanitation facilities that are available to households.

5.3.1 Food Security

Share of food in total expenditure

In order to determine whether households are food secure, we look at whether consumption expenditure on food is a large proportion of total household consumption expenditure (Smith and Subandoro, 2007). Households that spend a large proportion of total expenditure on food are vulnerable to food deprivation. This is because irrespective of their current food consumption, if they were to experience a reduction in income, there would also be a reduction in the quantity (and/or quality) of food consumed. Thus, households with children who are undernourished are likely to spend a larger part of their total household expenditure on food.

Table 5.7: Share of food in total expenditure of households, 1994

Undernourished	Proportion of food in total household expenditure	Not undernourished	Proportion of food in total household expenditure	Difference
Stunted	13.62	Not stunted	15.21	NS
Underweight	13.24	Not underweight	14.9	NS
Wasted	15.19	Not wasted	14.51	NS

Note: All figures are in percentages.
* denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (1994)

Table 5.7 presents the share of food in the total annual expenditure of households in 1994. We note that overall, households spend less than 15% of their total annual expenditure. This would imply that households in Kagera were fairly food secure in 1994. Unexpectedly, households with stunted children spend a smaller proportion of their total annual expenditure on food than households with children who are not stunted, suggesting that children who suffer from long-term undernourishment are more likely to live in food secure households. Households with underweight children also spend a smaller proportion of their total annual expenditure on food than households with children who are not underweight, suggesting that underweight children also live in less food insecure households. We do find that households with wasted children spend a larger proportion of their total annual expenditure on food than households with children who are not wasted. However, none of these differences were found to be significant. We need to keep in mind that this measure of food security does not take into account parental preferences for expenditure, particularly for households that are headed by women. While it may be argued that such households may spend more on food in order to promote good nutrition and health of its members, it is likely that these households may prefer to spend on other things, given that they are less well off than others. It is possible that households with undernourished children actually spend a small proportion of total expenditure on food because of different spending priorities.

In 2004, households with stunted, underweight and wasted children significantly spend larger proportions of their total annual expenditure on food than households with children who are not stunted, not underweight and not wasted, respectively (Table 5.8). This finding, corroborated by existing literature suggests that children who are undernourished either in the short- or long-term are more likely to live in households are food insecure.

Table 5.8: Share of food in total annual expenditure of households, 2004

Undernourished	Proportion of food in total household expenditure	Not undernourished	Proportion of food in total household expenditure	Difference
Stunted	68.84	Not stunted	67.41	***
Underweight	69.23	Not underweight	67.71	***
Wasted	70.06	Not wasted	67.82	***

Note: all figures are in percentages.
* denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (2004)

Over the 10 year period, we have seen a dramatic increase in the proportion of total annual expenditure that is spent on food, implying that over time, households in Kagera have become more food insecure. The data for 2004 is consisted with data from the Tanzanian Household Budget Survey of 2007 that indicates that since 2000, households in rural Tanzania have spent over 60% of their total annual expenditure on food. The fact that the decrease in the proportion of undernourished children in Kagera between 1994 and 2004 has been negligible can perhaps be explained by this increase in food insecurity in the region.

However, there has been a dramatic increase in the share of food in total household consumption in the 10 year period. Since the mid-1990s, Tanzania has been faced with adverse weather conditions (floods and drought, resulting in famines) that have played a role in undermining food security.[22] By 2004, the productivity levels of food (as measured by crop production and food production indices) had fallen considerably since 1990. On an average, there has been a linear increase in food production in Tanzania between 1960 and 2000, the increase in the population over the same period has been exponential (Kiratu *et al*, 2011). A combination of these factors is believed to have contributed to an increase in food insecurity in Tanzania since 1990.

Consumption of food grown on own land

Another way in which household food security can be examined is by looking into whether households consume the food that they grow.

Most households in Kagera report that they consume food that they grow and food that they purchase. It is likely that households that are not able to make market purchases and they depend on what they grow. Most households in Kagera grow at least one crop that they consume, the most common being sweet or cooking bananas and cassava (Sections 3.3 and 5.2.2). Thus, but growing their own food, or at least some if it, households that are poor may be able to cope with food insecurity.

Table 5.9: Households consuming food that they grow, 1994 and 2004

	Stunted	Not stunted	Differ ence	Under weight	Not under weight	Differ ence	Wasted	Not wasted	Differ ence
1994	100	100	NS	100	100	NS	100	100	NS
2004	80.24	82.02	**	73.76	82.79	***	79.04	81.53	NS

Note: All figures are in percentages
* denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (1994, 2004)

In 1994, in Kagera, almost all households in the sample (99.81%) reported that they had consumed food items had that been grown or raised by the household in the last 12 months (Table 5.9). Further, all households with stunted children, underweight children and wasted children reported that they had consumed food items had that been grown or raised by the household in the last 12 months and there was no significant difference between households with stunted, underweight and wasted children and households with non-stunted, non-underweight and non-wasted

[22] http://www.profor.info/profor/Documents/pdf/livelihoods/TanzaniaCaseStudy.pdf

children. If owning farmland is an indicator of poverty and if almost all households in the sample consumed food that they grew on their own land, these figures are not surprising.

By 2004, this trend changed and the proportion of households that consumed food items from their own production decreased. Approximately 81.39% of households still reported consuming food items had that been grown or raised by the household in the last 12 months. Smaller proportions of households with stunted, underweight and wasted children consumed food that they had grown or raised in the last 12 months than households with non-stunted, non-underweight and non-wasted children, respectively. This suggests that over the 10 year period, structural changes in the local economy have taken place, resulting in the de-linking of livelihoods (and poverty) from land and farming (Rigg 2006). The shift in the balance of household income from farm to non-farm over the last 10 years could perhaps increase the purchasing power of households and enable access to better food. In the absence of structural changes, it is likely that the differences are indicative of undernourished children living in households that are less food secure than others. The exact direction of the impact of consuming food grown or raised by the household will be determined by the advanced empirical analysis.

5.3.2 Care

In addition to food security, the UNICEF framework of the determinants of child malnutrition treats children's care as a child specific service that is provided by the households, dependent on the time inputs of the mother (UNICEF, 1990). Mothers' time inputs are based on their decision making processes with regard to care and are governed by their schooling and cultural factors that affect care giving practices as well as her status in the household and community relative to that of men.

Parental education

Almost all studies of the determinants of child malnutrition use mother's education as an indicator of care.

Table 5.10: Average years of schooling completed by parents, 1994 and 2004

Parent	Stunted	Not stunted	Difference	Underweight	Not underweight	Difference	Wasted	Not wasted	Difference
1994									
Mothers	2.63	2.91	NS	2.34	2.9	*	1.5	2.86	**
Fathers	4.31	4.43	NS	4.16	4.43	NS	4.08	4.39	NS
2004									
Mothers	5.78	6.37	***	5.66	6.21	***	4.76	6.21	***
Fathers	6.33	6.22	NS	6.13	6.28	NS	6.05	6.27	NS

Note: * denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (1994, 2004)

Table 5.10 presents the average number of years of schooling completed by parents of undernourished and non-undernourished children for 1994 and 2004. Immediately, we see that in both years, fathers have completed more years of education than mothers. This is expected as this is a common occurrence in most developing countries. In 1994, we see that mothers of stunted, underweight and wasted children have completed fewer years of education than mothers of non-stunted, non-underweight and non-wasted children, respectively. The differences marked in Table 5.10 indicates that underweight and wasted children are more likely to have mothers who have completed fewer years of education than children who are not underweight and not wasted, respectively. The difference in mother's education between stunted and non-stunted children was not found to be significant. As seen for the trend in mother's education, we see that fathers of stunted, underweight and wasted children have completed fewer years of education than fathers of children who were not stunted, not underweight and not wasted, respectively. However, these differences were not significant.

By 2004, we see that the average number of years of education completed by parents has increased. Again, mothers of stunted, underweight and wasted children have completed significantly fewer years of education than mothers of non-stunted, non-underweight and non-wasted children, respectively (Table 5.10). For fathers, however, the pattern is slightly different. Fathers of underweight and wasted children have completed fewer years of education than fathers of children who were not underweight and not wasted, respectively but fathers of stunted children have completed slightly more years of education than fathers of children who are not stunted. However, none of these differences in the years of schooling completed by the fathers of children were significant.

These results indicate that parents of undernourished children have completed fewer years of education than those of children who are not undernourished. It is likely that, *ceterus paribus*, if the number of years of education completed by mothers were to increase, the nutrition gap among undernourished and healthy children would decrease. However, it is unlikely that increases in the number of years of education completed by fathers would have the same effect.

It follows that if mother's education can have a positive impact on children's nutrition and improve this in the short- and long-term, it is likely that children will also benefit from the employment of their mothers. However, we need to keep in mind that this relationship may not be linear and could, in fact, influence children's nutrition in a less straightforward way. As a next step, we explore maternal employment and how this can affect children's nutrition outcomes.

Women's employment

The KHDS collects information on whether individuals in the household have been engaged in wage labour and self-employment in the last seven days and in the last 12 months. Working for wages or a salary includes work done for someone who is not a household member, for example, an employer, a firm, the government, or some other person outside the household. Self-employment includes self-farm employment where an individual could have worked in a field or garden belonging to them or to their household or have raised livestock; and self-non-farm employment where an individual worked for themselves or their household, for example, as an independent merchant or fisherman, lawyer, doctor, or other self-employed activity. In this section, we report whether at least one woman in the household has been engaged in either of these activities in the last 12 months. The 12 month period is chosen in order to capture seasonality and labour cycles to some (small) extent.

In 1994, a small proportion of households had at least one woman who had worked for wages/salary (8.69%). Over one quarter of households had at least woman who had worked on land that belonged to someone in their household (26.07%) and

21.79% of households had at least one woman who had worked in non-farm self-employment activities in the last year (Table 5.11).

Table 5.11: Households with at least one employed woman in the last 12 months, 1994 and 2004

Employment	Stunted	Not stunted	Difference	Under weight	Not under weight	Difference	Wasted	Not wasted	Difference
1994									
Wage employment	13.61	5.14	***	18.92	5.96	***	2.17	9.15	**
Self farm employment	32.32	21.57	***	40.54	22.2	***	15.21	26.82	**
Self non-farm employment	26.53	18.38	***	37.16	17.69	***	54.35	19.51	***
2004									
Wage employment	10.56	8.11	***	10.43	8.77	**	12.46	8.82	***
Self farm employment	14.39	17.07	***	18.23	15.68	**	24.93	15.54	***
Self non-farm employment	0	0	-	0	0	-	0	0	-

Note: All figures are in percentages
* denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (1994, 2004)

In 1994, we see that significantly larger proportions of households with stunted children had at least one female member engaged in wage employment, self-farm employment and self-non-farm employment than households with children who are not stunted (Table 5.11). Significantly larger proportions of households with underweight children also had at least one female member engaged in wage employment, self-farm employment and self-non-farm employment than households with children who are not underweight. Further, larger proportions of households with wasted children had at least one female member engaged in self-farm employment and self-non-farm employment than households with children who are not wasted. These figures would suggest that undernourished children are more likely to belong to households where women are employed and this can be damaging to nutrition in the short- and long-term. This may be complicated by the poverty status of the households, for instance, perhaps the poorest of households are the ones that are contracting out women's labour.

Ten years later, a slightly larger proportion of households had at least woman who worked either for wages/salary (9.03%) but a smaller proportion of households has at least one woman who worked on land that belonged to someone in their household

(16.08%). Surprisingly, we found that no households reported that they had any women working in non-farm self-employment activities.

In 2004, we see fairly similar trends to those seen in 1994. Significantly larger proportions of households with stunted children still had at least one female member engaged in wage employment and self-farm employment than households with children who are not stunted (Table 5.11). Again, larger proportions of households with underweight children also had at least one female member engaged in wage employment and self-farm employment than households with children who are not underweight. Further, larger proportions of households with wasted children had at least one female member engaged in self-farm employment than households with children who are not wasted. However, unlike 10 years ago, larger proportions of households with wasted children had at least one female member engaged in wage employment than households with children who are not wasted.

In both years, compared to children who are not undernourished, higher proportions of children live in households where female members are employed either in the household's own economic activities or outside the household. This suggests that there is definitely a trade-off between the benefits for children of mother's income via female employment and the costs of reduced time of the mother in child care as discussed earlier. It is likely that despite the additional income, children's nutrition suffers in the long- and short-term because women may not have control over income or may have very little decision making powers in the household. It is also likely that if the woman who is employed is the primary caregiver, there may be a loss in time she devotes to childcare as well as a loss in the quality of care.

Parental absence

The death of either or both parents and thus, changes in care are likely to affect the nutrition, health and overall well-being of children. This is corroborated by evidence from several studies on the impact of orphanhood, which find that the death of one or both parents can have a negative impact on children's health and nutrition (Ainsworth and Semali, 2000; Beegle *et al*, 2005; Lindblade *et al*, 2003). However, some studies have also found that the nutrition status of orphans is not worse than that of non-orphans (Panpanich *et al*, 1999; He and Ji, 2007).

We distinguish between children who have lost both parents (double orphans), children who have lost only their father (paternal orphans) and children who have lost only their mothers (maternal orphans). In 1994, 22.93% of all children were double orphans, 20.37% were paternal orphans and 15.38% were maternal orphans. This is a very high incidence of parental death, though not very surprising. In other SSA countries, the incidence of orphanhood is fairly high, for example, in Ethiopia, by the time children reach the age of 12, one of five children is like to have lost one or both parents (Camfield and Himaz, 2009). Statistics from UNICEF (2006) indicate that the proportion of orphaned children under the age of 17 in Tanzania has steadily increased from the 1990s until date, largely due to the AIDS pandemic. These statistics also show that in 2005, Tanzania had one of the highest incidences of orphanhood in East Africa – 12% of children had lost one or both parents. This was as high as the average for SSA. In addition, it is likely that that owing to the sampling strategy of the KHDS, a higher incidence of parental death is captured.

Table 5.12: Children between 6-60 months who are orphaned, 1994 and 2004

Orphans	Stunted	Not stunted	Difference	Under weight	Not under weight	Difference	Wasted	Not wasted	Difference
1994									
Double orphan	20.07	25	*	12.84	25.63	***	47.83	21.29	***
Paternal orphan	18.03	22.06	*	15.54	21.66	**	6.52	21.34	***
Maternal orphan	25.17	8.33	***	30.41	11.37	***	8.69	15.85	*
2004									
Double orphan	16.45	15.21	*	16.23	15.57	NS	15.29	15.69	NS
Paternal orphan	15.84	17.45	**	9.69	18.16	***	4.82	17.58	***
Maternal orphan	5.19	6.18	**	2.74	6.37	***	4.25	5.91	*

Note: * denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (1994, 2004)

Given the bulk of evidence that suggests that losing one or both parents has a negative impact on children's health and nutrition, we would expect that there would be a larger proportion of undernourished children who have lost one or both parents. Contrary to this evidence, we see that in 1994, a smaller proportion of stunted children had lost both parents than non-stunted children. A smaller proportion of stunted children had also lost their fathers than non-stunted children. However, a significantly larger proportion of stunted children had lost their mothers than non-stunted children (Table 5.12). From this, we infer that losing both parents or fathers may not have a very strong impact on stunting but that losing mothers can lead to long-term undernourishment among children (see Ainsworth and Semali, 2000 for detailed analysis on how losing one or both parents can have different outcomes for children). This is either because there is a decline in household income or because there is a change in caregivers and care giving behaviour.

In the same year, smaller proportions of underweight children had lost both parents or their fathers than children who were not underweight. Significantly larger proportions of children who were underweight had lost their mothers than children how were not underweight. Again, it is likely that the loss of a parent and the change in caregiver that takes place when the mother dies results in children being undernourished.

The proportion of wasted children who have lost one parent is much smaller than the proportion of non-wasted children, suggesting that losing one parent could not have a substantial impact on children's nutrition. On the other hand, the proportion of wasted children who are double orphans is twice that of children who are not wasted, suggesting that this particularly endangers children's nutrition in the short-term.

In 2004, smaller proportions of all children had lost one or both parents – 15.67% of were double orphans, 16.85% were paternal orphans and 5.81% were maternal orphans. However, the patterns of orphanhood among undernourished children are different from those seen 10 years ago. A slightly larger proportion of stunted children are double orphans than children who are not stunted but smaller proportions of stunted children are maternal and paternal orphans (Table 5.12). We also see that a larger proportion of underweight children are double orphans than children who are not underweight but this difference is not significant. Much smaller proportions of underweight children are maternal and paternal orphans than children who are not underweight. Finally, smaller proportions of wasted children have lost one or both parents than children who are not wasted.

It is not surprising to see that in 1994, a smaller proportion of undernourished children are double orphans. Orphans who have lost both parents often may be placed with well-off family members who have the resources to care for children. Thus, nutritional outcomes of double orphans may not be worse than non-orphans. Children who have lost one parent may have poorer nutrition outcomes for two reasons: (a) children who have lost their mothers may be taken in by other family members and could face discrimination; and (b) children who have lost their fathers are likely to continue to live with their mothers i.e. in female headed households.

5.3.3 Health Environment and Amenities

The third underlying determinant of child malnutrition is the health environment that the child lives and grows up in. The effects of health environments and health services are often captured by using variables such as population per physician, access to clean drinking water, per capita health expenditure. We look into whether households in Kagera have access to improved sources of water, the quality of toilet facilities available, methods of garbage disposal, illness in the household as well as household health expenditures to be able to understand the health environment and any changes that have taken place between 1994 and 2004.

Access to water

We would expect that children who are undernourished live in households that have poor access to clean water. Commonly accepted categories of sources of water are provided by the Joint Monitoring Programme (JMP) for Water Supply and Sanitation of the World Health Organisation and UNICEF. They categorise sources of water as "improved" and "not improved". [23] Improved water sources include household water connections, public standpipes, boreholes, protected dug wells and springs and rainwater collection. Sources that are not considered improved are unprotected dug wells and springs, vendor provided water (including via tankers) and bottled water.

The JMP suggests that an "improved" source is one that is *likely* to provide "safe" water. The JMP cautions that current information on water sources and access to these does not allow us to establish a relationship between access to safe water and access to improved sources. For example, on the one hand, while bottled water is perfectly safe, it is an expensive means of obtaining water. On the other hand, water

[23] http://www.wssinfo.org/en/122_definitions.html

from house connections (indoor plumbing), public standpipes are any other "improved" source can be contaminated due to source pollution, inexistent or inadequate treatment or recontamination in the distribution network. Further, in developing countries, network supply is often intermittent. Despite the shortcomings in this definition, it is used to measure the progress of the MDG to halve the proportion of people without sustainable access to safe drinking water and basic sanitation by 2015.

We draw from the JMP's categorisation of water sources and also distinguish between them on the basis of the likelihood of provision of safe water. However, we recognise that often, the access to services and clean health environments may be determined by how much is invested in health environments and infrastructure. (Haddad *et al*, 2003). We include water sources such as indoor plumbing, indoor standpipes, rainwater, bottled water and vendor bought water in a category of "safe water". Other sources such as neighbouring households, private but outdoor standpipes, public standpipes, wells with or without pumps, rivers, lakes, ponds etc. are categorised as "unsafe water".

Table 5.13: Households' source of water, 1994

Source of water	Stunted	Not stunted	Under weight	Not under weight	Wasted	Not wasted
Safe source:	1.27	0.35	1.9	0.24	0	0.6
Rainwater	1.27	0	1.9	0	0	0.4
Water vendor		0.35	0	0.24	0	0.2
Unsafe source:	98.74	100	98.09	99.76	100	99.39
Public standpipe	5.51	6.99	8.57	5.76	20.83	5.62
Well with pump	12.29	13.29	12.38	12.95	4.17	13.25
Well without pump	7.63	6.99	5.71	7.67	4.17	7.43
River, lake, spring, pond	73.31	72.38	71.43	73.14	70.83	72.89

Notes: All figures are in percentages
Source: KHDS (1994)

Table 5.13[24] presents proportions of households with children who are undernourished and children who are not undernourished that have access to safe and unsafe sources of water. We immediately notice that in 1994 very few households

[24] No statistical differences have been marked in the table as we are only looking for differences in the broader categories of safe and unsafe sources of water between children who are undernourished and those who are not. The relevant differences have been inserted into the text.

have access to safe sources of water via rainwater collection. A higher proportion of households with stunted and underweight children have access to safe water than households with non-stunted and non-underweight children, respectively. These differences were found to be significant at the 10% level. This is surprising because we would have expected fewer households with stunted and underweight children to have access to safe drinking water. However, we note that no households with wasted children had access to safe drinking water compared to 0.6% of households with children who were not wasted but this difference was not significant.

When it comes to unsafe sources of drinking water, we see that slightly smaller proportions of households with stunted and underweight children use these than households with non-stunted and non-underweight children, respectively. These differences were significant at the 5% level. A smaller proportion of households with non-wasted children had access to unsafe water sources than households with wasted children but this difference was not significant at the 10% level. From these results, it would appear that access to clean drinking water may not have any impact on the long run nutritional status of children but in very few cases, could have an impact on the immediate nutritional status of very young children.

Table 5.14[25] shows that in 2004, larger proportions of households had access to safe sources of water. These sources are also more diverse than those seen in 1994 and include indoor plumbing and standpipes inside dwellings. It is possible that over the 10 year period and that indoor plumbing, construction of standpipes inside dwellings and increases in the purchase of water are functions of higher wealth or income. From the table we see that smaller proportions of households with stunted and underweight children have access to safe sources of water than households with children who are not stunted and not underweight, respectively. These differences were found to be significant at the 1 and 10% levels, respectively. A smaller proportion of households with wasted children have access to safe sources of water than households with non-wasted children but this difference was not significant.

We also see that more households with stunted and wasted children have access to sources of unsafe water than households with children who are not stunted and not

[25] No statistical differences have been marked in the table as we are only looking for differences in the broader categories of safe and unsafe sources of water between children who are undernourished and those who are not. The relevant differences have been inserted into the text.

wasted, respectively. These differences were significant at the 1% and 10% levels respectively. In addition, more households with underweight children also had access to unsafe sources of water than households with children who are not underweight but this difference was not significant.

These results are consistent with what we obtained for 1994. Despite the increase in the proportion of households with access to sources of safe water, we see that over time, not having access to safe sources of water can continue to have a negative impact on the long-term nutrition of children. However, health environments and facilities cannot be determined by the access to drinking water alone. Sanitation facilities play an important role in determining the health of children. With this in view, we examine the cleanliness of households by looking at the toilet facilities and methods of garbage disposal.

Table 5.14: Household's source of water , 2004

Source of water	Stunted	Not stunted	Under weight	Not under weight	Wasted	Not wasted
Safe source:	2.72	6.12	2.53	5.41	2.78	5.19
Indoor plumbing	0.51	1.15	0.42	0.98	0	0.94
Inside standpipe	1.02	2.77	0.42	2.38	1.39	2.09
Water vendor	0.85	0.81	1.27	0.74	1.39	0.79
Water truck/tanker service	0.34	0.35	0.42	0.33	0	0.36
Rainwater	0.85	1.04	0.84	0.98	0	1.01
Unsafe source:	96.42	93.88	96.63	94.59	97.22	94.81
Neighbouring household	2.04	1.5	2.53	1.56	0	1.81
Private outside standpipe/tap	4.94	3.7	4.22	4.18	5.56	4.12
Public standpipe	4.6	6.47	5.91	5.66	6.94	5.63
Well with pump	11.07	10.39	9.7	10.82	9.72	10.69
Well without pump	13.63	11.89	12.24	12.62	9.72	12.71
River, lake, spring, pond	60.14	59.93	62.03	59.75	65.28	59.85

Notes: All figures are in percentages
Source: KHDS (2004)

Toilet facilities

How many children have access to toilets? What kind of facilities can they use? Answers to these questions will help us gauge how households dispose of human waste and whether they are at risk to bacteria and infections that would affect their health and nutrition, especially those of their children. We would expect that fewer households with undernourished children would have access to flush toilets, improved pit latrines and that larger proportions of these households have no toilet facilities and resort to using the bush or nearby ponds and rivers.

In 1994, we see that no households with stunted, underweight and wasted children use flush toilets compared to very small proportions of households with non-stunted, non-underweight and non-wasted children, respectively, that use a flush toilet. However, these differences were not significant (Table 5.15). Majority of households in the sample appear to be using pit latrines and we see that significantly higher proportions of households with stunted, underweight and wasted children use these compared to households with non-stunted, non-underweight and non-wasted children, respectively. Surprisingly, smaller proportions of households with stunted, underweight and wasted children have no toilet facility compared to households with non-stunted, non-underweight and non-wasted children.

Table 5.15: Toilet facility used by households, 1994 and 2004

Toilet facility	Stunted	Not stunted	Difference	Under weight	Not under weight	Difference	Wasted	Not wasted	Difference
1994									
Flush toilet	0	0.25	NS	0	0.18	NS	0	0.15	NS
Pit latrine	93.88	88.73	***	95.27	89.71	***	97.83	90.4	**
Pan/ bucket	0.25	0	NS	0	0.18	NS	0	0.15	NS
Other	0.34	0	NS	0	0.18	NS	0	0.15	NS
No toilet	5.78	10.78	***	4.73	9.75	**	2.17	9.15	**
2004									
Flush toilet	4.89	2.71	***	5.58	3.15	***	6.23	3.36	***
Pit latrine	89.44	86.91	***	87.36	87.94	NS	88.1	87.84	NS
No toilet	5.67	10.38	***	7.06	8.9	**	5.67	8.8	**

Note: All figures are in percentages
* denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (1994, 2004)

In 2004, flush toilet usage has a very different pattern than the one seen in 1994. We see that significantly larger proportion of households with stunted, underweight and wasted children use flush toilets compared to households with non-stunted, non-underweight and non-wasted children, respectively (Table 5.15). Majority of households in the sample continue to use pit latrines. Significantly higher proportions of households with stunted children use these than households with non-stunted children, while there are no significant differences in the usage of pit latrines between households with underweight and non-underweight children and between households with wasted and non-wasted children. Again, as seen in 1994, smaller proportions of households with stunted, underweight and wasted children have no toilet facility compared to households with non-stunted, non-underweight and non-wasted children.

The increase in the use of flush toilets over the last 10 years suggests a slight improvement in the sanitation facilities available to households. However, due to the small proportion of households with access to flush toilets, it is likely that this is somehow related to household wealth – wealthier households may be more able to afford constructing a flush toilet. The use of the data on toilet facilities should be used with some caution. The KHDS does not distinguish between a ventilated improved pit latrine and trench pit latrine. Ventilated improved pit latrines have better circulatory systems that expel odours and keep out flies and mosquitoes, reducing the incidence of disease such as malaria. We also do not know how many people share one toilet or whether the use of toilets is limited to household members only or includes others. It follows that the more people that share a toilet, the less hygienic it could be, leading to increased exposure to pathogens. Due to the lack of differentiation between the kinds of pit latrines that households, we lose valuable information on the quality of toilet facility that the households have access to.

Garbage disposal

From the data on toilet facilities, it is not very clear how having improved sanitation facilities such a flush toilet can have an impact on children's nutrition. Further, owing to the lack of differentiation between the kinds of pit latrines available to households and information on the incidence of sharing toilets, no strong inferences can be made. We turn to another manner in which households' access to sanitation facilities can be gauged and to look at how they dispose of garbage.

Households in Kagera dispose of garbage in various ways such as burning it, burying it, dumping it either in open areas or landfills, compositing it or having it collected by garbage trucks. The most common method of garbage disposal in 1994 was composting (Table 5.16). We would expect that households with undernourished children are the less likely to compost garbage and more likely to dispose of garbage by other methods. However, we see that no clear patterns for garbage disposal emerge, except for composting. Unexpectedly, we see that larger proportions of households with stunted, underweight and wasted children compost garbage than households with non-stunted, non-underweight and non-wasted children, respectively. The only significant difference found was between households with wasted children and households with children who are not wasted.

Table 5.16: Methods of garbage disposal by households with, 1994

Method of disposal	Stunted	Not stunted	Difference	Under weight	Not under weight	Difference	Wasted	Not wasted	Difference
Garbage trucks	1.02	0.49	NS	0.68	0.72	NS	0	0.76	NS
Dumped	12.59	10.78	NS	11.47	11.55	NS	8.7	11.74	NS
Burned	0.68	0.74	NS	1.35	0.54	NS	2.17	0.61	NS
Buried	1.02	2.21	NS	1.35	1.81	NS	0	1.83	NS
Compost	83.67	80.64	NS	85.13	81.05	NS	89.13	81.4	*

Note: all figures are in percentages
* denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (1994)

No data on garbage disposal was collected in 2004. However, based on the data for 1994, we see that the manner in which households dispose of their garbage does not have an impact on children's nutrition, either in the short- or long-term. We now turn to investigating household illness to gain more information about the health environments that children are growing up in.

Household illness

How does the illness of a household member affect the nutritional status of children?

As explained in the discussion of the sampling strategy of the KHDS (Section 4.2.1) the KHDS stratifies households according to adult sickness and the extent of it as well as adult mortality. As a result, it is likely that within households, there are adults and children who could be ill for long periods of time. This could affect children in two ways: one, it could reallocate monetary resources to those households member who need it more urgently or two; it could affect caregivers' behaviour. For these reasons, we look into whether a household member has been ill within the last four weeks.

In 1994, all households reported that at least one member that had been ill in the last four weeks. This is a very high level of incidence of illness. This is could either be because of the sampling strategy of the KHDS or because of measurement error. As all households with children who were undernourished and those with children who were not undernourished, no significant differences between the groups were found (Table 5.17).

Table 5.17: Children living in households with ill member, 1994 and 2004

Year	Stunted	Not stunted	Difference	Under weight	Not under weight	Difference	Wasted	Not wasted	Difference
1994	100	100	NS	100	100	NS	100	100	NS
2004	48.29	50.07	*	47.84	49.7	NS	41.92	49.87	***

Note: all figures are in percentages
* denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (1994, 2004)

In 2004, almost half of the surveyed households reported that at least one member had been ill in the last four weeks. Slightly smaller proportions of households with stunted children reported that a household member had been ill in the last four weeks than households with non-stunted children (Table 5.17). Further, significantly smaller proportions of households with wasted children reported that a household member had been ill in the last four weeks than households with non-wasted children.

Since 1994, the proportion of stunted, underweight and wasted children who lived in households with someone ill for at least last four weeks has halved. It is peculiar to see that smaller proportions of households with undernourished children report this than households with children who are not undernourished. This is a counter intuitive pattern we would have expected the opposite due to the reasons that were mentioned above. Perhaps we can learn more about health environments and the role that they play in determining a child's nutritional status by looking at households' annual health expenditure.

Health expenditure

How much does a household spend on health care and health facilities? This may indicate the state of health facilities and how accessible they are to households in Kagera. On the one hand, households with stunted children are more likely to spend more on health care annually. This is because their nutritional status in the long-term has been compromised and they are likely to be more susceptible to disease and infections than healthy or even wasted or undernourished children. On the other hand, we may not see this in the data, owing to the sampling strategy of the dataset.

In 1994, as expected, average annual household health expenditure of stunted and underweight children was significantly higher than that of non-stunted and non-underweight children, respectively. However, the average annual household health expenditure of wasted children was much lower than that of non-wasted children (Table 5.18). While we do expect households with wasted children to have health expenditures that are not as high as those for households with stunted children, it is surprising to find that health expenditure for the former group is so low.

By 2004, the average annual household health expenditure had increased dramatically and we see a reversal of the trend seen 10 years ago (Table 5.18). Surprisingly, we see that the average annual household health expenditure of stunted and wasted children was significantly lower than that of non-stunted and non-wasted children, respectively. We also see that over the 10 year period, the average annual household health expenditure for stunted children has remained the same, suggesting that over time, their ability to pay for health facilities has not increased. The average annual household health expenditure for underweight children has decreased while that for wasted children has increased. The decrease in the former case could mean that fewer underweight children are able to pay for health facilities and healthcare while the increase in the latter case could mean that wasted children are more likely to fall ill and this leads to high health expenditures.

Table 5.18: Average annual household health expenditure, 1994 and 2004

Year	Stunted	Not stunted	Difference	Under weight	Not under weight	Difference	Wasted	Not wasted	Difference
1994	15888	2611	***	28557	2725	***	1185	8662	*
2004	15834	19489	***	14208	18839	***	21059	17942	***

Note: all figures are in Tanzanian shillings
* denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (1994, 2004)

It is possible to express the annual household expenditure on health as a share of total annual household expenditure. This would indicate direct and indirect costs (user fees, medicines, transport etc.) to households. By expressing annual household expenditure on health as a share of total annual household expenditure, we can get a better idea of how much households spend on healthcare in a year.

Table 5.19: Share of health in annual total household expenditure, 1994 and 2004

Year	Stunted	Not stunted	Difference	Under weight	Not under weight	Difference	Wasted	Not wasted	Difference
1994	3.03	1.22	***	4.8	1.22	***	1.03	2.04	*
2004	1.58	1.6	NS	1.49	1.61	**	1.94	1.57	***

Note: all figures are in percentages
* denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (1994, 2004)

In 1994, on an average, households with stunted and underweight children spent a significantly larger proportion of their annual health expenditure on health care than households with children who were not stunted and not underweight, respectively. However, households with wasted children (on an average) spent a significantly larger proportion of their annual health expenditure on health care than households with children who were not wasted (Table 5.19). This trend is reflective of the trend seen for annual health expenditure of households seen in Table 5.18.

In 2004, there was no significant difference in the share of health expenditure in total annual household consumption between households with stunted and non-stunted children. However, on an average, households with wasted children spent significantly larger proportions of total annual household consumption on healthcare; and households with underweight children spent significantly smaller proportions of total annual household consumption on healthcare; again this is consistent with what is seen for annual health expenditure of households in Table 5.18. However, as seen with the health expenditure data, no strong trends emerge and we will rely on regression analysis to see how health expenditure can have an impact on children's nutritional outcomes.

Next, we look at the basic determinants of child undernutrition.

5.4 Basic Determinants of Undernutrition

Poverty is often an important player in determining the nutritional status of children, in the way that it can affect the ability of households to achieve food security, have adequate sources of care and access health resources on a sustainable basis (Smith and Haddad, 2000). Poverty and the underlying determinants of child undernutrition are affected by some basic determinants of malnutrition. These include the resources available to households and countries and include but are not limited to the natural environment, access to technology, quality of human resources and political, economic, cultural and social factors and norms that are prevalent (UNICEF, 1995).

5.4.1 Consumption Expenditure

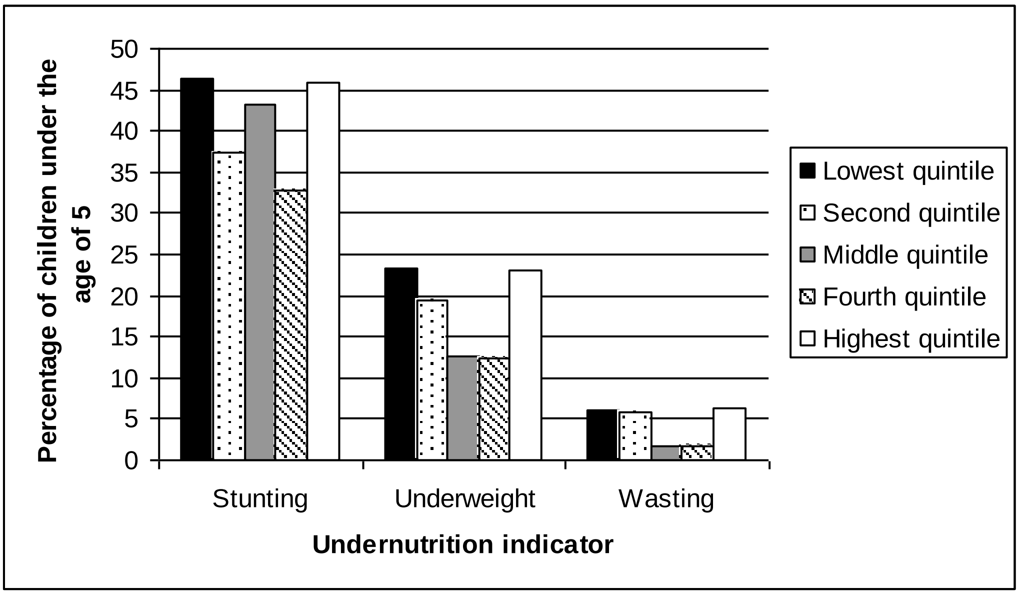
All studies of the determinants of child malnutrition use per capita income as an explanatory variable in order to capture the economic resources that are available to households and countries. Income demonstrates the ability of individuals to purchase essential market and non-market goods and services such as food, access to health and educational facilities.

In 1994, the lowest expenditure quintile has the highest proportion of stunted (46.46%) and underweight (23.23%) children (Fig 5.2). Surprisingly, the highest expenditure quintile also has a very high proportion of stunted (45.87%) and underweight (22.94%) children. This would suggest that income and consumption levels of a household may not have any impact on the nutritional status of children, a result that is corroborated by Haddad *et al* (2003). This will be examined in the subsequent empirical analysis.

What is surprising is that the highest proportion of wasted children belongs to the highest wealth quintile. This would imply that more children in this expenditure category are currently undernourished. One reason for this could be that as levels of expenditure increase, households may spend on and consume more expensive foods, which may not be very nutritious. The lowest wealth quintile has the second highest proportion of wasted children while the middle and fourth quintiles have the least proportion of wasted children (Fig 5.2).

Overall, undernourished children lived in households with lower average total annual household expenditures than households with non-undernourished children but surprisingly, there were no statistically significant differences (at the 10% level) between households with undernourished children and households with children who were not undernourished.

Figure 5.2: Undernutrition among children between 6 – 60 months, by expenditure quintile, 1994



Source: KHDS (1994)

Table 5.20: Undernutrition among children between 6 – 60 months, by gender and expenditure quintile, 1994

Expenditure quintile	Stunting		Underweight		Wasting	
	Boys	Girls	Boys	Girls	Boys	Girls
Lowest quintile	52.83	39.13	28.3	17.39	5.66	6.52
Second quintile	46.84	25	26.58	10	5.06	6.67
Middle quintile	41.3	44.44	13.04	12.5	2.17	1.39
Fourth quintile	39.13	24.53	17.39	5.66	2.9	0
Highest quintile	42.11	50	22.81	23.08	5.26	7.69

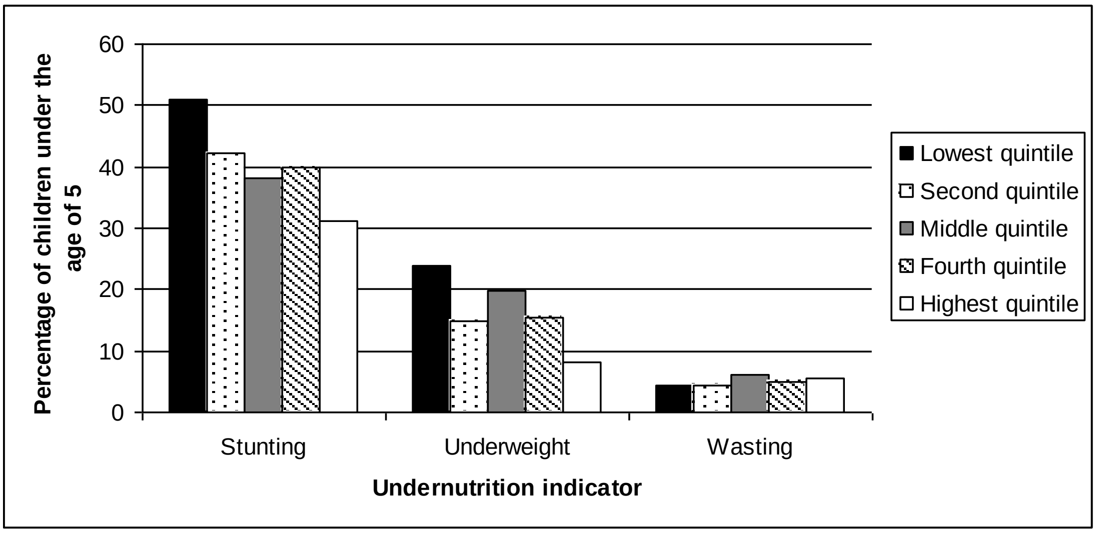
Notes: All figures are in percentages
Source: KHDS (1994)

On disaggregating the distribution of the sample by expenditure quintile across gender, a further complicated situation arises. There are no clear trends in the prevalence of undernutrition across gender. However, within each group, strong trends emerge. For example, across all indicators, the lowest expenditure quintile has the highest proportion of undernourished boys - 52.58% of boys in the lowest expenditure quintile are stunted, 28.3% are underweight and 5.66 % are wasted

(Table 5.20). The lowest proportion of undernourished boys lies in the fourth and middle expenditure quintiles.

The highest proportion of undernourished girls lies in the highest expenditure quintile. Table 5.20 shows that 50% of girls in the top most expenditure quintile is stunted, 23.08% is underweight and 7.69% is wasted. This is definitely higher than that compared to boys in the same quintile. Thus, it seems that girls who live in the richest 20% of households in 1994 were more likely to be undernourished (in 1994 and in the future) than boys. As seen with boys, the lowest proportion of undernourished girls was found in the fourth and middle expenditure quintiles.

Figure 5.3: Undernutrition among children between 6-60 months, by expenditure quintile, 2004



Source: KHDS (2004)

Figure 5.3 presents the prevalence of undernutrition among children by expenditure quintile in 2004. Almost 60% of children in the lowest expenditure quintile are stunted and almost a quarter are underweight. In this year, unlike in 1994, the highest expenditure quintile also has a lower proportion of stunted (29.97%) and underweight (7.09%) children. For wasting, we see that the lowest expenditure quintile has the lowest proportion of wasted children (5.32%) while the higher proportion of wasted children belong to the middle expenditure quintile.

Overall, undernourished children lived in households with lower average total annual household expenditures than households with non-undernourished children with significant difference in the annual household expenditure between stunted and non-stunted children and between underweight and non-underweight children at the at the 1% level.

In Table 5.21, we disaggregate the prevalence of undernutrition by expenditure quintile and gender. As seen with the data for 1994, there are strong nutrition trends for boys and girls for each indicator. Across all indicators, the lowest expenditure quintile has the highest proportion of undernourished boys – 50.78% of boys in the lowest expenditure quintile are stunted, 24.32% are underweight and 6.08% are wasted. The lowest proportion of stunted and underweight boys lies in the top most expenditure quintile and the lowest proportion of wasted boys lies in the second expenditure quintiles.

Table 5.21: Undernutrition among children between 6-60 months, by gender and expenditure quintile, 2004

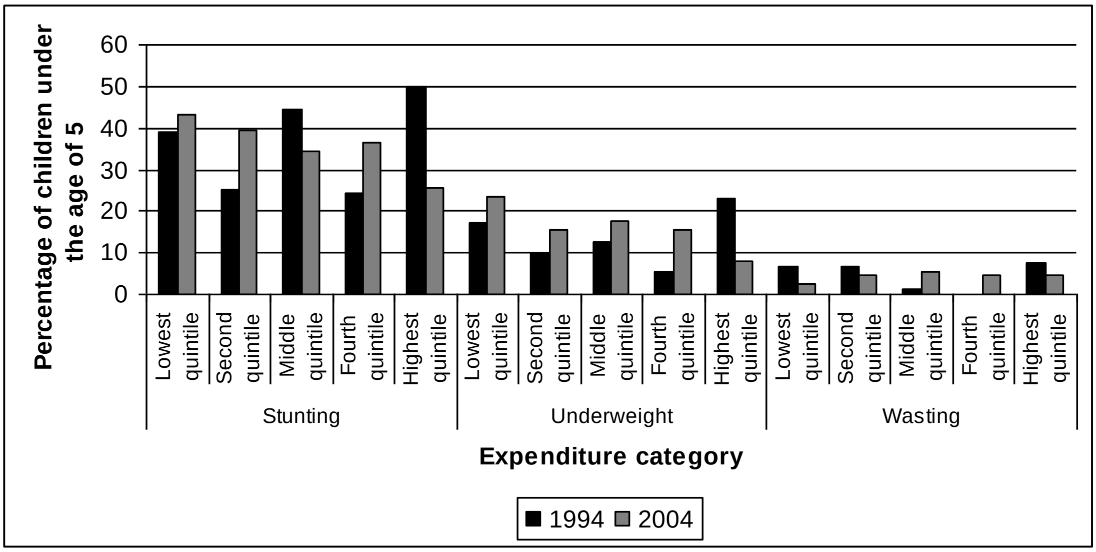
Expenditure quintile	Stunting		Underweight		Wasting	
	Boys	Girls	Boys	Girls	Boys	Girls
Lowest quintile	50.78	43.33	24.32	23.33	6.08	2.67
Second quintile	45.77	39.61	14.08	15.58	4.23	4.55
Middle quintile	42.45	34.59	22.3	17.61	6.47	5.66
Fourth quintile	44.13	36.36	15.17	15.58	5.52	4.55
Highest quintile	37.16	25.5	8.11	8.05	6.08	4.7

Notes: All figures are in percentages
Source: KHDS (2004)

The highest proportion of stunted and underweight girls lie in the lowest expenditure quintile – 43.33% of girls in the lowest expenditure quintile are stunted and 23.33% are underweight (Table 5.21). The highest proportion of wasted girls (5.66%) lies in the middle expenditure quintile. Similarly, we see that the lowest proportion of stunted (25.5%) and underweight (8.05%) girls are in the top most expenditure quintile, while for wasting this was the lowest quintile (2.67%), indicating that the short-term nutritional status of this group of children has improved. These proportions are lower than compared to boys in the same quintiles.

Since 1994, the prevalence of stunting among girls in the bottom two expenditure quintiles has increased while that in the middle and highest expenditure quintile has decreased (Fig 5.4a). A similar trend is seen when it comes to being underweight. Over the 10 year period between the two rounds of the KHDS, the proportion of underweight girls has increased across all expenditure quintiles except the highest wealth quintile, where it has fallen by a considerable extent. The trend for wasting among girls between 1994 and 2004 is different. It shows that over this period, the proportion of wasted girls has decreased for the bottom two and highest expenditure quintiles whereas it has increased for the middle and fourth quintiles.

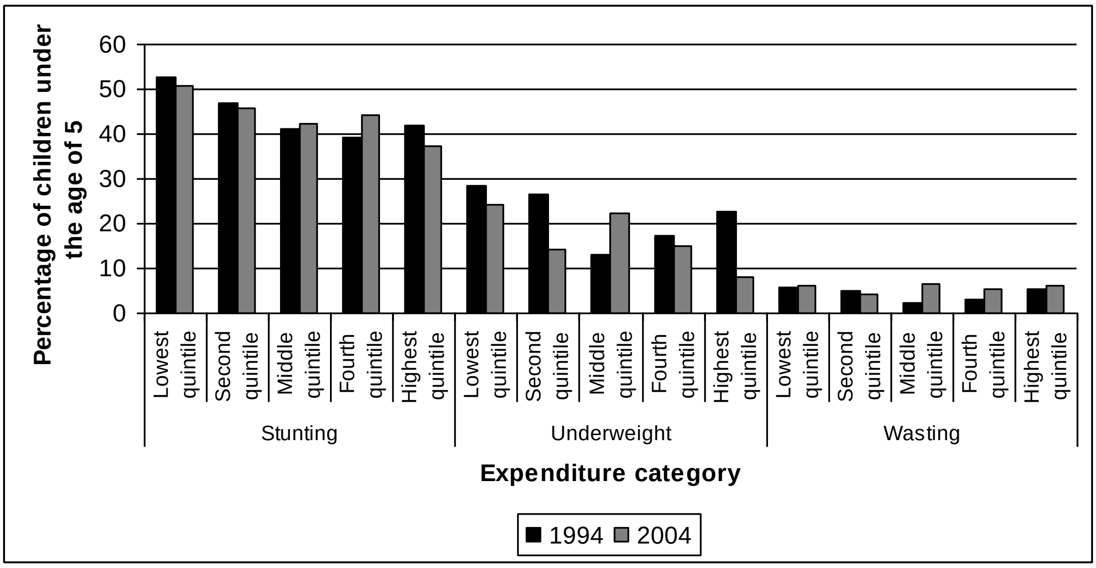
Figure 5.4a: Changes in prevalence of undernutrition across expenditure categories, for girls, 1994 to 2004



Source: KHDS (1994, 2004)

Over time, we see that for boys the prevalence of stunting decreased in the lowest, second and highest expenditure quintile, with the decrease being the largest for the highest expenditure quintile (see Fig 5.4b). There was an increase in the prevalence of stunting in the middle and fourth quintile between 1994 and 2004. A similar trend is seen for being underweight. The proportion of underweight boys in the lowest, second, fourth and highest quintile decreased over time, with the highest quintile showing the most dramatic decrease. However, we see that the proportion of underweight boys in the middle quintile increased over the 10 year period and in 2004 was only 2 percentage points less than the proportion of underweight boys in the lowest expenditure quintiles. The trend seen for wasting over time is of most concern. For all expenditure quintiles, except the second, the proportion of boys who are wasted has increased over time.

Figure 5.4b: Changes in prevalence of undernutrition across expenditure categories, for boys, 1994 to 2004



Source: KHDS (1994, 2004)

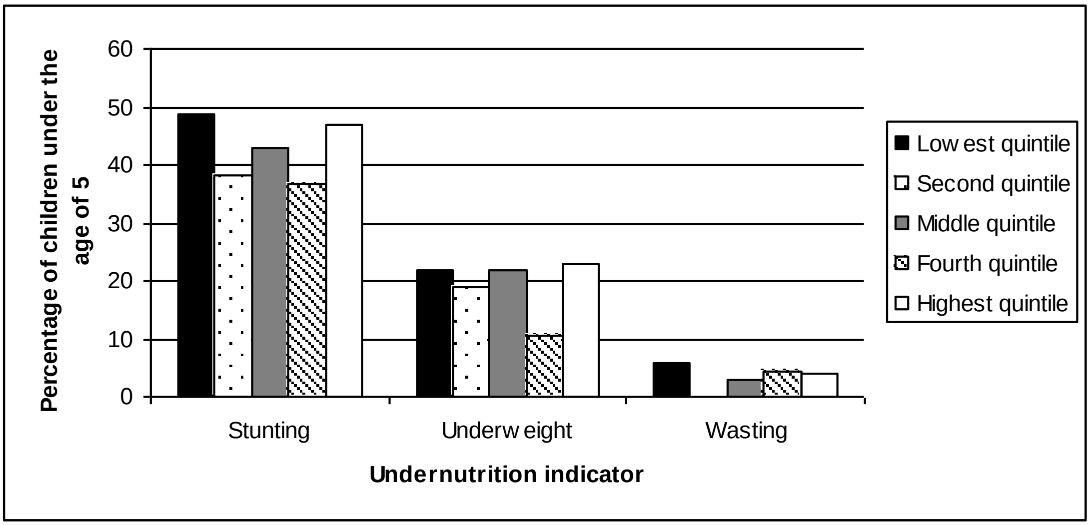
As expected, stark differences in undernutrition (and changes in undernutrition) between the bottom most and top most expenditure quintiles are seen. However, these are counterintuitive. It is expected that with increases in household wealth, the prevalence of undernutrition would decrease; this could be a direct or indirect effect of the increase in household wealth. However, this is not the case as far as the KHDS sample is concerned. What drives these differences between expenditure categories and over time? Why has the nutrition of children in the middle expenditure quintile not improved over time?

5.4.2 Household Assets

Sahn and Stifel (2002) argue that there is a considerable merit in moving poverty measurement away from expenditure based measures towards a more asset based measure for two reasons. One, meaningful poverty alleviation is largely predicated on an individual’s ability to accumulate productive assets; and two, income inequality will be reduced by addressing the unequal distribution of income generating assets. Due to these reasons and the shortcomings of using expenditure and consumption data (discussed in Section 3.2), a non-money-metric approach to defining well-being and poverty – the asset index is included in the descriptive statistics.

This section presents the prevalence of undernutrition by household asset index. Comparing these trends to those seen for undernutrition by expenditure quintile would help confirm whether the expenditure data in the KHDS suffers from measurement or aggregation errors.

Figure 5.5: Undernutrition among children between 6-60 months, by asset index quintile, 1994



Source: KHDS (1994)

Figure 5.5 presents the proportion of stunted, wasted and underweight children in each asset index quintile in 1994. The highest proportion of stunted children (48.77%) belongs to the lowest asset quintile while the lowest proportion of stunted children in the fourth quintile (36.84%). It is expected that the proportion of stunted children would decrease as we move up the distribution of the asset index. Instead, we find that the highest asset quintile has an extremely large proportion of stunted children (47%). These trends in stunting by asset index are similar to those found for stunting by expenditure in 1994 (Fig 5.2).

The trends for being underweight and wasted by asset index are also counter intuitive. Instead of seeing low proportions of underweight children in the top most quintile, we see that the lowest proportions of underweight children (10.53%) are in the fourth asset quintile. As seen in the pattern for being underweight by expenditure in 1994, the highest proportion of underweight children (23%) is also in the top most quintile. We do see an overall decrease in the proportion of wasted children between the lowest (5.91%) and top most quintile (4%) but the spike in the fourth quintile is surprising, especially as overall, there seem to be lower proportions of stunted and underweight children in this quintile than others. This is completely different from the patterns seen for wasting by expenditure in Figure 5.2.

We would expect that households with stunted, underweight and wasted children would not be as well off as households with children who are not undernourished. We find that households with stunted children, on an average, have a lower asset index than households with non-stunted children and this difference is significant at the 10% level. Households with underweight and wasted children also have lower asset indices, on an average, than households with non-underweight and non-wasted children, respectively. However, these differences were not found to be statistically significant (at the 10% level).

Table 5.22: Undernutrition among children between 6-60 months, by gender and asset index quintile, 1994

Asset index	Stunting		Underweight		Wasting	
quintile	Boys	Girls	Boys	Girls	Boys	Girls
Lowest quintile	56.7	41.51	26.8	16.98	6.19	5.66
Second quintile	36.36	40	27.27	10	0	0
Middle quintile	51.02	35.29	30.61	13.73	2.04	3.92
Fourth quintile	34.78	40	10.14	11.11	2.9	6.67
Highest quintile	49.09	44.44	29.09	15.56	5.45	2.22

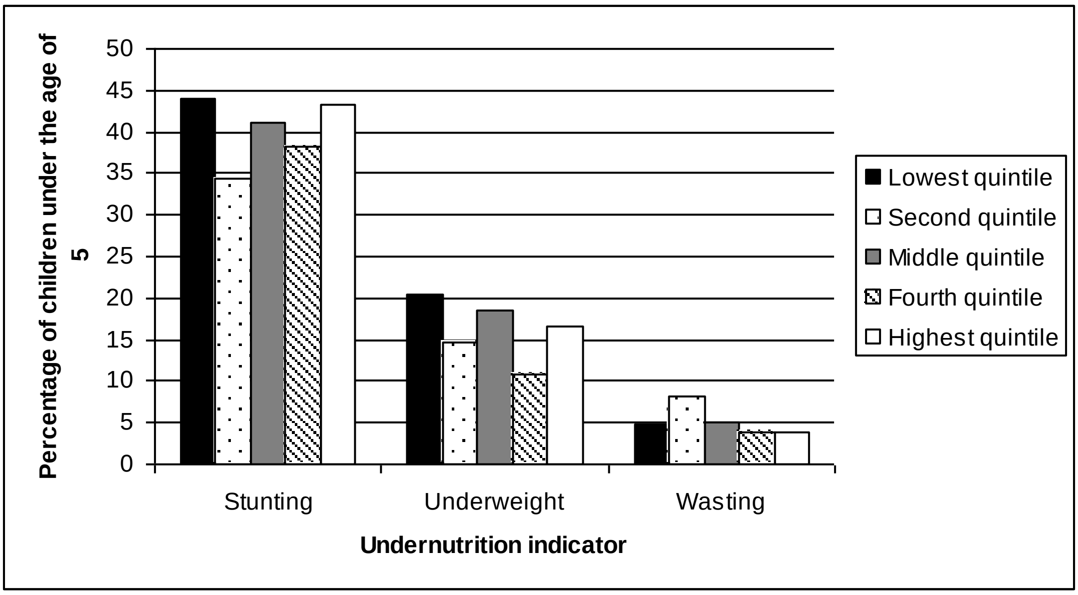
Source: KHDS (1994)

In Table 5.22, we disaggregate the prevalence of undernutrition by asset quintile and gender. The highest proportion of stunted boys (56.67%) is in the lowest quintile. As the asset index increases, the proportion of stunted boys falls but in the top most asset quintile, it increases to 49.09%. The prevalence of stunting among girls is fairly high across all quintiles except the third quintile, where the proportion of stunted girls is the smallest (35.39%). The highest proportion of stunted girls is in the top most asset quintile (44.44%). In each quintile, more boys are stunted than girls, indicating that irrespective of long-term wealth, boys are more likely to be undernourished in the long run.

As seen with the pattern for stunting among boys, the prevalence of being underweight in the lowest asset quintile is quite high (26.8%). As the asset index increases, surprisingly, the proportion of underweight boys increases until the fourth quintile where it is the minimum 10.14% and increases drastically to 29.09% in the top most asset quintile (Table 5.22). For girls, the prevalence of being underweight decreases as we move from the lowest to second quintile, after which it increases slightly in the third quintile. Inthe top most quintile, it increases again to 15.56%. These trends are different from those seen in Table 5.21. However, as seen with stunting, there is a consistent gender disparity, showing that irrespective of long-term poverty, boys are more likely to be underweight than girls.

Overall, as we move from the lowest to the top most asset quintile, there is a decrease in the proportion of wasted boys. The lowest quintile has the highest proportion of wasted boys (6.19%) while the middle and fourth have very much smaller proportions of wasted boys. When it comes to girls, however, the highest prevalence of wasting is seen in the fourth quintile while one of the lowest is in the highest quintile. In poorest and richest households, boys seem more likely to be undernourished than girls while households in the middle and fourth asset quintiles, the reverse is true.

Figure 5.6: Undernutrition among children between 6-60 months, by asset index quintile, 2004



Source: KHDS (2004)

Figure 5.6 presents the prevalence of undernutrition among children by quintiles of the constructed asset index in 2004. The highest proportion of stunted children (43.9%) lies in the lowest asset quintile while the lowest lies in the second quintile (34.33%). The proportion of stunted children in the highest asset quintile (43.37%) is almost as much as that in the lowest quintile, which is surprising, as it is expected that as the wealth of a household increases, the nutritional status of children improves. This would suggest that long term poverty or wealth could have no impact on the long-term undernourishment of children. This pattern is also completely different to the one seen for expenditure categories for the same year (Fig 5.3).

The highest proportion of underweight children (20.33%) lies in the lowest asset quintile while the lowest proportion lies in the fourth quintile. However, the top most quintile has a considerable proportion of underweight children at around 16%. This pattern is very similar to that seen for underweight children in different expenditure quintiles for the same year (Fig 5.3). The prevalence of wasting among all asset quintiles is lower than 5% except for the second and third asset quintiles, where 8.15% and 5.05% of children are wasted, respectively. The fourth and the fifth quintiles have the lowest proportions of wasted children suggesting that perhaps richer households have are less likely to have malnourished children in the short – term. This trend is completely different from the one seen for wasted children in different expenditure quintiles (Fig 5.3).

On an average, stunted children belonged to households with a higher asset index than non-stunted children, with the difference being significant at the 10% level. Underweight children were also found to belong to households with a higher asset index than non-underweight children, on an average. However, wasted children belonged to poorer households than non-wasted children, suggesting that perhaps long-term poverty is more likely to affect the current nutritional status of children than their long-term nutrition, which is counter intuitive. However, the differences in the asset index between households with underweight and non-underweight and households with wasted and non-wasted children was not found to be significant at the 10% level.

In Table 5.23, we disaggregate the prevalence of undernutrition by asset quintile and gender. The highest proportion of stunted boys (51.93%) is in the lowest quintile. As the asset index increases, the proportion of stunted boys falls but in the top most asset quintile, it increases to 48.48%. The prevalence of stunting among girls is fairly high across all asset quintiles except the second, where the proportion of stunted girls is the smallest (27.19%). The highest proportion of stunted girls is in the topmost asset quintile (39.58%). This implies that perhaps long-term wealth has no impact on long-term undernutrition. There is a gender disparity and it seems that boys are more likely to be undernourished in the long-run than girls.

Table 5.23: Undernutrition among children between 6-60 months, by gender and asset index quintile, 2004

Asset index	Stunting		Underweight		Wasting	
quintile	Boys	Girls	Boys	Girls	Boys	Girls
Lowest quintile	51.93	36.17	22.65	18.09	5.52	4.26
Second quintile	41.18	27.19	15.13	14.04	8.4	7.89
Middle quintile	44.29	38.46	12.86	23.72	7.14	3.21
Fourth quintile	40.67	35.98	10.67	10.98	4	3.66
Highest quintile	48.48	39.58	21.21	12.5	3.79	4.17

Source: KHDS (2004)

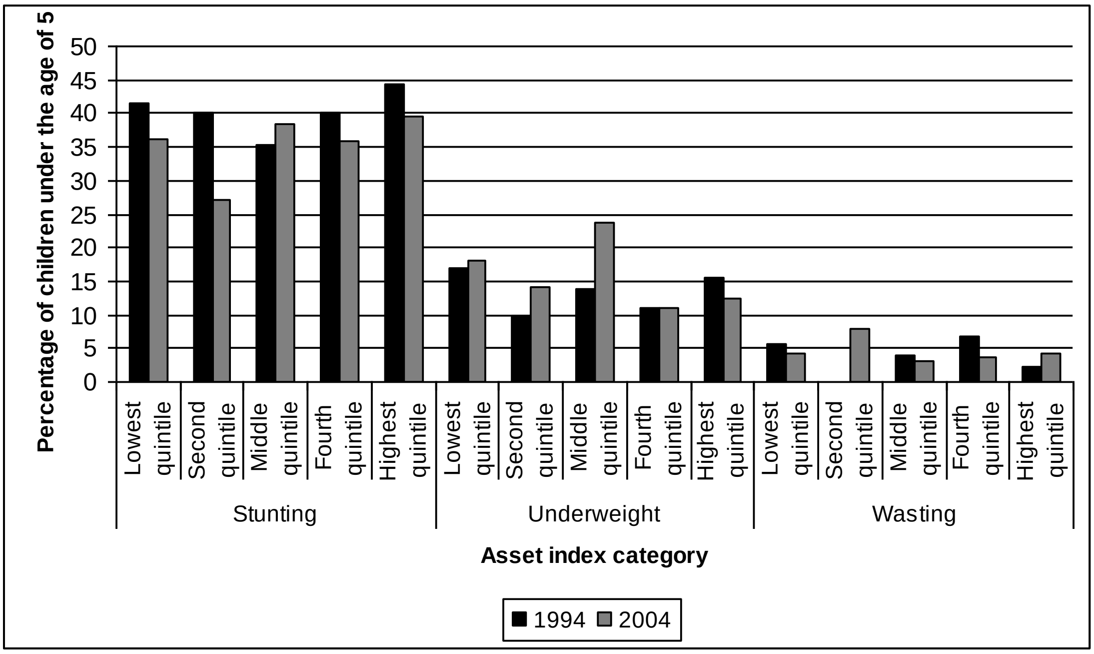
As seen with the pattern for stunting among boys, the prevalence of being underweight is the highest in the lowest asset quintile (22.65%). As the asset index increases, the proportion of underweight boys decreases. However, in the highest asset quintile, it increases to 21.21% (Table 5.23). For girls, the prevalence of being underweight decreases as we move from the lowest to second quintile, after which it almost doubles in the third quintile and then falls by half in the fourth quintile. The highest proportion of underweight girls (23.72%) is in the third quintile while the lowest (10.98%) is in the fourth quintile.

It is very interesting that the highest proportion of wasted boys (8.4%) and girls (7.89%) is in the second quintile (Table 5.14). The lowest proportion of wasted boys is in the top most quintile (3.79%) while the lowest proportion of wasted girls is in the third quintile (3.21%). This would suggest that boys who live in poorer households are at risk of being undernourished in the short-term while girls of poor and well off households are at risk of being undernourished in the short -erm.

Since 1994, the prevalence of stunting among girls in the all asset index quintiles has decreased (except the middle quintile), with the largest decrease being for the second quintile (see Figure 5.7a). Between the two rounds of the KHDS, the proportion of underweight girls has increased across the bottom three asset index quintiles, with the largest increase being for the middle quintile. It has remained almost the same for the fourth quintile fallen slightly in the highest quintile. The trend for wasting among girls between 1994 and 2004 shows that over this period, the proportion of wasted girls has decreased for the bottom most, middle asset index quintiles whereas it has increased significantly for the second and top most quintiles.

Over time, we see that for boys the prevalence of stunting decreased in the lowest, top most asset quintiles while it has increased in the second, third and fourth quintiles (Fig 5.7b). Since 1994, the proportion of underweight boys decreased for all asset quintiles, except the fourth quintile, where there was a small increase. The largest decrease was for the middle quintile. The prevalence of wasting in the lowest and highest quintiles has decreased over time while in the second, third and fourth quintile, it has increased. A similar trend is seen for being underweight. While the proportion of wasted boys has decreased in the lowest quintile and the highest quintile, it is cause for concern that it has increased in the middle quintiles.

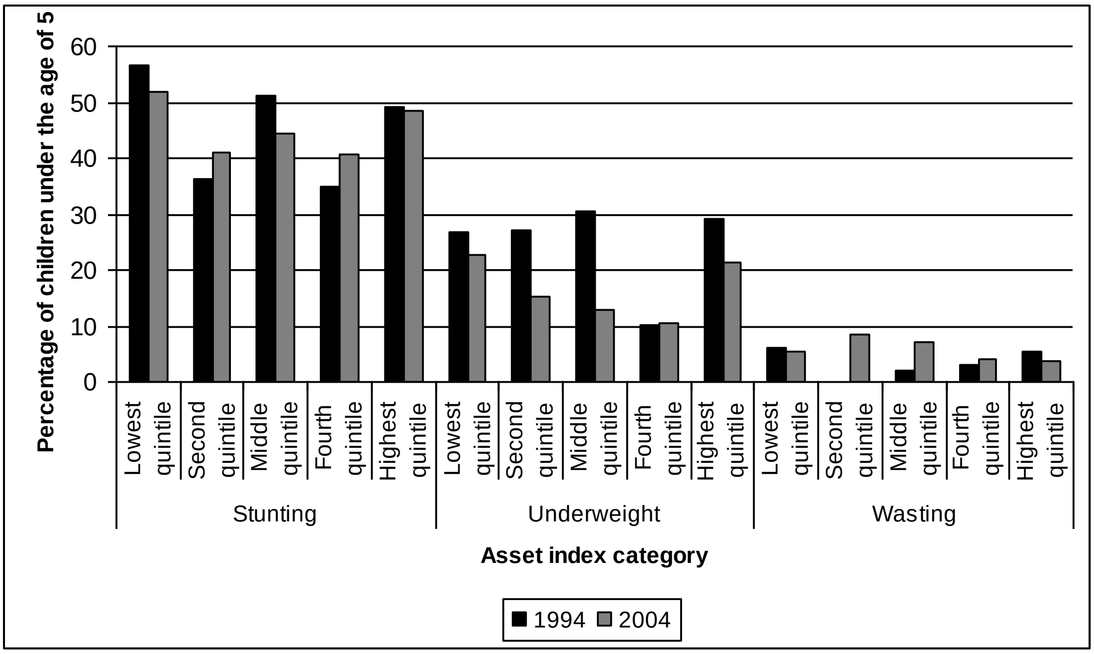
Figure 5.7a: Changes in prevalence of undernutrition across asset index categories, for girls, 1994 to 2004



Source: KHDS (1994, 2004)

By looking into the prevalence of stunting, wasting and being underweight by asset index quintiles, we cannot conclude that the asset index is better indicator of household wealth than consumption expenditure, as both these indicators show different trends for different indicators. We would expect that the asset index data would show a decrease in the prevalence of stunting as we move up the asset index distribution. However, this is not true and it very surprising as both these are long-term indicators of undernutrition and wealth, respectively. However, we do see that the prevalence of wasting decreases as we move up the asset index distribution.

Figure 5.7b: Changes in prevalence of undernutrition across asset index categories, for boys, 1994 to 2004



Source: KHDS (1994, 2004)

There are some shortcomings of using an asset index as an indicator of long-term household wealth. The asset index constructed using factor, principal or multiple correspondence analysis would not be able to capture different household economic strategies that may affect the proportion of income that is spent on consumer durables. As prices are not taken into consideration in the construction of the index, the appropriateness of the asset index may differ between urban and rural areas, and between regions (Howe *et al*, 2008). Further, the KHDS collects information about the same assets from all households and may not be able to capture heterogeneity if all households are not well off. Finally, as the KHDS does not really collect asset data for the construction of an asset index nor is information collected for the same assets over round, using expenditure data for empirical analysis is perhaps a better choice.

5.4.3 Status of Women

This leads us to look into the status of women in Kagera. The better the status of women in the household relative to that of men, the more they are educated and the greater control they have over how household resources are allocated. We can do this by looking at the number of women in the household and at the number of female headed households.

Number of women in the household

We look at the number of women in the household because this would give us an idea of whether households could have alternate care giving arrangements in case the mother of the child is absent. It would also give us an idea of the status of women in the household if we interact this with household wealth. However, we need to keep in mind the likelihood of female dominated households being poorer than others.

Table 5.24: Relative number of women to men in households, 1994 and 2004

Year	Stunted	Not stunted	Difference	Under weight	Not under weight	Difference	Wasted	Not wasted	Difference
1994	1.11	1.2	*	1.11	1.17	NS	1.06	1.17	NS
2004	1.56	1.47	***	1.47	1.51	NS	1.3	1.52	***

Note: * denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (1994, 2004)

We calculate a score of the number of women relative to men for each household by dividing the number of female members by the number of male members in the household. If the score takes a value that is greater than 1, the household has more female members than male members. A value of less than 0 indicates more male members than female members while a value of 1 indicates equal number of female and male household numbers.

In 1994, the average number of women in households that were surveyed in Kagera was 3.76. Table 5.24 presents the number of women relative to men in households with undernourished children and households with non-undernourished children. Households with stunted, underweight and wasted children had a smaller gender score than households with children who are not stunted, not underweight and not wasted, though this difference was only significant in the case of stunted and non-stunted children. This is not surprising, as we expect households with undernourished children to have fewer women than other households.

Ten years later, in 2004, households had an average of 3.35 female members. We see that households with underweight and wasted children have fewer women relative to men than households with non-underweight and non-wasted children, respectively; the only significant difference being between households with wasted and non-wasted children. Very surprisingly, we see that households with stunted children have significantly more women relative to men than households with children who are not stunted (Table 5.24). This seems to suggest that perhaps having more female members has a better impact on the short-term nutritional status of children rather than in the long-term. It is possible that in the long-term, female dominated households are less well off than others, which has a detrimental effect on the long term nutritional outcomes of children who live in female dominated households.

Given these patterns, we are not sure of how the number of women in the household will have an effect on the nutritional status of women. The direction and magnitude of the impact, if any, will be clearer in the following empirical analysis. Next, we look into how many households are headed by women and how this may affect children's nutrition outcomes.

Female headed households

Keeping this in mind we look at female headed households in Kagera. The KHDS does not differentiate between *de jure* and *de facto* female headed households and we are likely to lose the effects of this difference in our results. In 1994, approximately 5% of households were headed by women. As expected, larger proportions of households with stunted and underweight children were headed by women than households with non-stunted and non-underweight children, respectively (Table 5.25). However, the only significant difference found was between households with underweight and non-underweight children. Surprisingly, a much smaller proportion of households with wasted children were headed by women than households with children who were not wasted but this difference was not significant.

Over the 10 year period, the proportion of female headed households (27.31%) increased by around 21 percentage points. This is alarming, especially since it is very possible that the food security and income of these households and in turn the health and nutrition of children and other family members are threatened.[26] In 2004, larger

[26] This could also be an artifact of the data.

proportions of households with stunted, underweight and wasted children were headed by women than households with children who were not stunted, not underweight and not wasted, respectively (Table 5.25). None of these differences were found to be significant, perhaps because the increase in female headed households appears to occur in the entire sample and not just for the sub sample of undernourished children.

Table 5.25: Households headed by women, 1994 and 2004

Year	Stunted	Not stunted	Differ ence	Under weight	Not under weight	Differ ence	Wasted	Not wasted	Differ ence
1994	5.44	4.17	NS	7.4	3.97	**	2.17	4.88	NS
2004	27.44	27.23	NS	28.87	27.02	NS	27.76	27.28	NS

Note: All figures are in percentages
* denotes significance at the 10% level, ** at the 5% level, *** at the 1% level and NS denotes no significance.
Source: KHDS (1994, 2004)

In 1994 and 2004, we see that households with undernourished children have more female household members than others but these differences are not significant and it seems that having more or less female household members does not have an impact on children's nutrition. However, these numbers are averages and it is likely that at the individual level, there are some effects (in either direction) that we cannot see.

6. Determinants of Early Childhood Undernutrition: Empirical Analysis

In Chapter 5 we have discussed in detail the social, economic and cultural factors that play a role in determining children's nutritional outcomes in Kagera. We have laid a special emphasis on the quality of diet in Kagera (Section 3.2.5), as this is something that is often neglected in the economic literature that deals with the causes of undernutrition. In this chapter, we will put forward an estimable equation that is based on the framework of the determinants of child malnutrition (Smith and Haddad, 2000). We present the estimation strategy and results, following which we discuss these results and possible policy implications that they may have.

6.1 Modelling the Determinants of Children's Nutrition

Smith and Haddad (2000) put forward a framework that shows the various pathways through which socio economic factors can have an impact on the nutritional outcomes of children (Section 2.2). We adapt and modify this framework as follows and assert that the nutritional outcomes of children are a result of the impact of immediate, underlying and basic determinants that act at the level of the individual and the household.

Each child has a nutritional status, N_c, which tells us whether the child is undernourished or not. As mentioned above, it is a function of immediate, underlying and basic socio economic factors; some that act at the level of the child and others, at the level of the household:

$$N_c = f(I_c, U_H, B_H) \qquad (1)$$

where I_c is the set of immediate determinants that act at the child level while U_H and B_H are the sets of underlying and basic determinants, respectively, that act at the household level and are further explained below.

I_c comprises the intake of food in terms of quantity as well as quality. It also captures the health stock of the child. Therefore:

$$I_c = g(\Theta_x, \Theta_y, \Omega_c) \qquad (2)$$

where Θ_x denotes the food intake per diem, Θ_y denotes how varied and balanced the diet is and Ω_c captures information about the health stock of the child. These factors are not independent of each other. As previously discussed in Section 2.2, children with poor dietary intake (in terms of quality or quantity) fall prey to disease; disease suppresses the appetite, slows down the absorption of nutrients in food and reduces children's energy levels. Guided by a literature review and the descriptive analysis of the KHDS, relevant indicators for these variables have been chosen. The number of meals usually eaten per day by the household is used to indicate food intake per diem. However, this information is only available at the household level and not for each household member. It also does not take into account meals that children may eat outside the home. The food variety score (Section 5.2.2) is used to indicate the number of food groups that the household consumes in a month. This variable does not provide information for each household member but for the entire household and thus, we lose out on variations that may arise from allocation of food within the household and an individual's own preferences. The data used to construct the food variety score is based on a 28-day recall period and may be subject to a recall bias. Child's health stock is indicated by whether she has been ill in the four weeks prior to the survey (for example, if the child had influenza-like symptoms, diarrhoea, etc).

The immediate determinants are affected by some underlying determinants of undernutrition that act at the level of the household, such as household food security, (π_H), care available to the child (C^c), and the household's health environment (ϖ_H):

$$U_H = j(\pi_H, C^c, \varpi_H) \qquad (3)$$

π_H captures how economically vulnerable the household is to food insecurity; C^c the care available to the child; and ϖ_H the availability of safe drinking water to the household. Food security can be measured by looking at the food expenditure of a household in a given period as a share of the total annual household expenditure for the same period. The higher the share of food in total expenditure, the more economically vulnerable to food insecurity the household is (Smith and Subandoro, 2007). As discussed previously, this indicator is not able to reflect the different expenditure priorities that heads of households may have. It is also unable to capture food insecurity that arises out of seasonality, especially in the context of households that depend on rain-fed agriculture for their livelihood (Devereux, 2009).

$$C^c = k(\varepsilon_M, \varepsilon_F, \varphi_c, \Delta_M) \tag{4}$$

The care available to the child depends on the education levels of the mother (ε_M) and father (ε_F) as this affects their knowledge and beliefs and in turn, caregiving practises. φ_c denotes the orphanhood status of children and we differentiate between children who have lost both parents and children who have lost one parent as literature suggests that the health, education and well-being outcomes of these children can differ (Ainsworth and Semali, 2000). What the KHDS does not collect data on is the age at which children were orphaned. This matters because the effect of losing a parent on children's well-being may be a lagged one and without this information, we may not know the real magnitude of this effect. Δ_M captures maternal employment, which affects her knowledge and beliefs and consequently, caregiving practices. Maternal employment is indicated by using household level data on women's self-employment i.e. women who work on farms owned by the household and women who are engaged in wage labour. However, women tend to under-report self-employment, for instance, women who work on household farms may not perceive of themselves as "being employed" (Bardasi *et al*, 2010).

In turn, the underlying determinants of undernutrition are affected by some basic determinants that act at the level of the household:

$$B_H = m(Cons_{2004}, Cons_{1994}, \Gamma_H, \Phi_H, \varrho_c) \tag{5}$$

where $Cons_{2004}$ denotes the annual household consumption and $Cons_{1994}$ denotes the annual household consumption in 1994 i.e. during Round 1 of the KHDS. ϱ_c denotes the ethnicity of the child, in this case, the ethnic group that the child belongs to. This variable can indicate underlying societal structures and social and/or economic exclusion of particular groups. Also included are factors that give us an idea of the status of women in the household. Γ_H is the number of women relative to men in the household. The higher the number of women relative to men, the better the status of women is said to be and, in turn, the more resources for child care there are in the household. Φ_H indicates female headed households. We expect that in female headed households and female dominated households, children may receive better inputs in terms of food quality and quantity, as well as care. We are also aware that female headed households may be at a disadvantage as they are often poorer than other households and have less access to land, markets and credit than male headed households (Sender and Smith, 1990). KHDS 2 does not distinguish between *de jure* and *de facto* female headed households. We lose out some valuable information because of this lack of information.

The substitution of equations (2) to (5) into equation (1) presents the nutritional outcome of the child in a given year:

$$N_c = f(\Theta_x, \Theta_y, \Omega_c, \pi_H, C^c, \varpi_H, \varepsilon_M, \varepsilon_F, \varphi_c, \Delta_M, Cons_{2004}, Cons_{1994}, Land_H, \Gamma_H, \Phi_H, \varrho_c) \quad (6)$$

6.2 Estimation Strategy

Using KHDS data for 2004, we examine the relationship between socio-economic characteristics of children and their households; and the nutritional status of the child in the short- and long-term, as indicated by anthropometric indicators discussed in Chapter 2. To this end, we use the ordinary least squares (OLS) model to estimate Equation (6). In our estimation, the dependent variable is an anthropometric indicator that presents information about the nutritional status of the child. To understand what may determine the short-term nutritional status of the child, we use the weight-for-age Z-score as a dependent variable. To understand what may determine the long-term nutritional status of the child, we use the height-for-age Z-score as a dependent variable. We are unable to use the weight-for-height Z-scores of children as the number of children with low weight-for-height is very small among those surveyed in the KHDS. As we are using the Z-scores to indicate nutritional status and not creating categorical variables to indicate whether the child is poorly nourished or not, the dependent variable is a continuous one.

The explanatory variables in the estimation will be those in the right hand side of Equation (6). As the KHDS is primarily a rural survey with one urban site, we do not include the urban/rural location of households. We adjust the regression results for the community to take into account any unobserved community level effects that the KHDS was not able to collect. We do this by creating dummy variables for each community and including them as explanatory variables in the estimation to be able to account for the heterogeneity that may exist, for example, in infrastructure such as access to public sanitation services, health facilities, weather shocks, seasonality (to some degree), etc. There is also the case for adjusting for fixed effects to account for any unobserved heterogeneity between households. However, when we controlled for this using dummy variables for each household as explanatory variables, we found that the R-squared term for that was not significantly different from the specification without the household dummies. As a result, ultimately, we do not adjust for household fixed effects and these results are not reported here.

From the literature discussed in Chapter 2 and the adapted UNICEF model, we are aware and understand that some determinants of undernutrition not only have a direct impact on nutrition but can also interact with each other and then affect nutrition. Based on the literature review, we include interaction variables in the specifications. For example, we include interactions between the orphanhood status of the child and household expenditure. Losing both or one parent can have an impact on nutritional outcomes of children because of different caregiving practices after the death or loss of income and resources available to the household due to the death of an earning adult. However, if these children are placed with wealthier households after the loss of a parent(s), they may benefit from access to better calorie intakes, health services and amenities and caregiving practices as richer households have more purchasing power. The interaction between the orphanhood status and wealth of the household would be able to capture this phenomenon that would otherwise be less clear (Ainsworth and Semali, 2000; Lindblade *et al*, 2003).

Evidence suggests that women with higher levels of education are better caregivers. More educated women are also more likely to be employed and thus, are able to provide additional income to the household and be more socially mobile (Sen 1990; Thomas *et al*, 1991). Being more mobile and more educated can mean better abilities to assimilate and act upon healthcare information and utilise health-care institutions more effectively, relative to women with lower levels of education (Borooah, 2002). However, this would be subject to the empowerment of women within a household. If women are not able to make decisions that allow them to act on more information or re-allocate household resources in a different way, nutritional outcomes of children may not be affected or could be negatively affected. There is also a trade-off between employment and care for children. Women who are employed, whether within the household or outside, simply may not have enough time to spend with their children. They may leave their children in the care of others and nutritional outcomes of children could suffer because of this (*Smith* et al, 2003).

How do these interactions have an impact on children's nutritional outcomes and do they differ in the short- and long-term? To be better able to understand these relationships and how they determine children's nutrition, we interact mother's education with two forms of female employment, household expenditure and the status of women.

We only estimate the above equation for the 2004 survey. When this equation was estimated using 1994 data, most of the variables were dropped by STATA and we were not able to obtain any meaningful results. Closer and more careful investigation of the data showed that for several of the children's records, there were missing data. Cleaning the data so have a complete set non-missing values resulted in a loss of 273 observations, reducing the size of the sample by over half. In the analysis for this sample, a further problem arose when trying to distinguish between zero values that were genuinely zero values or because they were coded to 0 as they were missing values. Any inferences made using this data would have not been accurate. As a result, the decision to use data only from 2004 was made. We also present estimation results for the top most expenditure quintile and the bottom most expenditure quintile for 2004 to see how differently these factors have an impact on children's nutrition outcomes depending on the wealth of the child's household. This may give us a better understanding of how relevant poverty alleviation is in the improvement of children's nutrition in Kagera.

A source of bias in our estimates may arise from the fact that the number of meals that a household consumes daily and the dietary diversity of the household are correlated with household food security and expenditure. What our data cannot account for is what happens to these variables in the “hungry” (dry) season (see Section 3.2.5) when banana stocks, which are the staple, are dwindling. Thus, the quality and quality of diet variables are endogenous as seasonality is being captured by the error term. One option to overcome this problem to some degree is to use an instrumental variable approach. Alderman *et al* (2005) use data from the Round 1 KHDS short panel to study the impact of community driven supplementary feeding programmes and crèche based child feeding programmes on children’s nutrition (see Section 2.2.2). In their analysis, they present OLS estimates but owing to the belief that programme placement may be endogenous, they follow with an IV estimation of the model. They use weather shocks, average household consumption and average height of parents as instruments to deal with the endogeneity of programme placement. We follow this approach and use rainfall, and the occurrence of weather shocks (drought or flood) reported by the community to instrument for the quality of diet. In the IV approach, our first stage regression estimates showed that none of the coefficients of the instruments were significantly different from zero, with a very small F-test statistic for joint significance of 1.29 and a p-value of 0.003. This raised concerns over the strength of the instruments. While the post estimation test for exogeneity of quality of diet was rejected at the 10% level, the test for over identifying restrictions revealed that the instruments were not valid. We used the same set of instruments for the quality of diet. The post estimation test for exogeneity could not be rejected; however, after the first stage regression results, we obtained an F-statistic of 7.26 and a p-value of 0.0001. Again because of concern over the weakness of these instruments and the persistent non-significant coefficients and collinearity with other explanatory variables, these two variables were dropped from the model after testing for joint significance in the final specification.

A similar problem arises with our indicator of food security ie the share of food in total annual household expenditure. Food security, again, is correlated with seasonality, which is captured in the error term. In the hungry season, households will spend more on food because prices of staple may be pushed up or they may buy an alternate staple. The indicator used in our analysis will control for this partially. However, what we are unable to account for is whether households are too poor to spend more on food in the hungry season as our indicator is only the average expenditure on food in a year as a proportion of the total annual household expenditure. Thus, this is another potential source of endogeneity that we attempt to overcome with the use of instruments.

As instrumental variables, we use rainfall in each community and the community reports of a weather shock (flood or drought experienced in the last 10 years) as these would be correlated with food security of household but not with the other explanatory variables (recall that we have dropped the quality and quantity of food intake from the analysis). In the IV approach, our first stage regression estimates showed that none of the coefficients of the instruments were significantly different from zero, with a very small F-test statistic of 2.6 and with a p-value of 0.0000. This raised concerns that the instruments chosen for food security are weak. After the second stage regression, we ran post-estimation tests in STATA. The first post-estimation test was for the exogeneity of food security, which we could reject at the 10% level. The second test was to test for over identifying instruments. In this case, we could reject the null hypothesis that the instruments were valid at a p-value of 0.01. Based on these tests, we do not believe that the instruments that we proposed to use for food security of the household were good enough. As a result, we do not report the estimates of the IV approach here.

In the following section, we report the OLS estimates of Equation (6). Our use of dummy variables for communities may control for weather related factors that affect the independent variables to some extent. This is not a fool-proof strategy but may reduce the bias in the estimates.

6.3 Results and Discussion

6.3.1 Determinants of Short-term Undernutrition among Children

The first part of our analysis looks into which factors determine that a child between the ages of 6 and 60 months will be undernourished in the short-run i.e. will be underweight. In this case, the dependent variable is the child’s weight-for-age Z-score. The explanatory variables are those in the right hand side of Equation (6).

Whole Sample

Table 6.1 presents results obtained from the empirical analysis of Equation (6) presented above for factors that affect the weight-for-age Z-score of children between the ages of 6 and 60 months in Kagera in 2004. In Column (1), we present the estimates obtained when regressing a completely exogenous set of explanatory variables. In Column (2), we also control for the other factors that are seen in Equation (6) presented in Section 6.1. In Column (3), we include interaction variables: one set of factors that would interact with mother's education and another that would most likely interact with household expenditure. All estimates are OLS estimates with robust standard errors.

Table 6.1: Factors affecting the weight-for-age Z-score of children aged 6-60 months

Dependent variable is the weight-for-age Z-score of the child	(1)	(2)	(3)
Age of the child in months	-0.016***	-0.016***	-0.016***
	(0.002)	(0.002)	(0.003)
Child is male	-0.197***	-0.195***	-0.191***
	(0.064)	(0.072)	(0.070)
Father's education (in years)	-0.005	-0.007	-0.008
	(0.019)	(0.020)	(0.020)
Mother's education (in years)	0.013**	0.013**	0.064**
	(0.008)	(0.008)	(0.125)
Child is a double orphan	0.232*	0.280*	0.198*
	(0.167)	(0.172)	(2.189)
Child is a maternal orphan	0.082	0.102	4.882
	(0.170)	(0.185)	(5.033)
Child is a paternal orphan	0.020	0.005	-0.198
	(0.139)	(0.134)	(1.940)
Number of women relative to men in the household	-0.041	-0.040	-0.042
	(0.057)	(0.055)	(0.052)
Log of total annual household expenditure	0.344***	0.351***	0.349***
	(0.086)	(0.088)	(0.082)
Child's ethnicity is Haya	-0.140	-0.101	-0.109
	(0.195)	(0.174)	(0.177)
Child's ethnicity is Nyambo	0.289	0.281	0.274
	(0.324)	(0.327)	(0.335)
Child's ethnicity is Hangaza	-0.186	-0.135	-0.103
	(0.369)	(0.400)	(0.403)
Child's ethnicity is Msubi	0.199	0.255*	0.226*
	(0.191)	(0.134)	(0.129)

Child's ethnicity is Kishubi	-0.126	-0.022	-0.038
	(0.226)	(0.221)	(0.237)
Child's ethnicity is Zinza	0.186	0.178	0.185
	(0.238)	(0.302)	(0.322)
Number of meals household usually has per day		-0.068	
		(0.156)	
Food diversity score of the household		0.018	
		(0.022)	
Child has been ill in the last 4 weeks		-0.001	
		(0.132)	
Log of total annual household expenditure 10 years ago		0.013*	0.015**
		(0.007)	(0.006)
Share of food in total annual household expenditure		-0.004**	-0.004**
		(0.004)	(0.005)
Women in the household are engaged in wage labour		0.261*	0.302
		(0.144)	(0.185)
Women in the household work on household farms		-0.178**	-0.152
		(0.084)	(0.119)
Household is headed by a woman		-0.219**	-0.235*
		(0.101)	(0.127)
Household has safe water to drink		-0.442	-0.441
		(0.582)	(0.572)
Interaction variables			
Total annual HH expenditure*child is a double orphan			0.034**
			(0.166)
Total annual HH expenditure*child is a paternal orphan			0.015
			(0.134)
Total annual HH expenditure*child is a maternal orphan			-0.343
			(0.369)
Mother's education*HHs headed by a woman			0.004
			(0.018)
Mother's education*total annual household expenditure			0.006**
			(0.009)
Mother's education*women employed in HH farms			-0.020
			(0.025)
Mother's education*women engaged in wage employment			0.006*
			(0.024)
No of observations	463	463	463
R-squared	0.3952	0.4189	0.4431

Note: *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level

The age of the child has a significant impact on her weight-for-age Z-score, implying that as the child grows older, the more likely it is for her weight-for-age Z-score to decrease even when the immediate, underlying and basic determinants of undernutrition are controlled for in Column (2). This effect is persistent when we include the interaction terms in Columns (3). A shortcoming of the weight-for-age Z-score is that it will not pick up the long-term effect of undernutrition, which is the slowing down of growth. However, it is unlikely that this is happening as the children in our sample are all under the age of five, which is too early for growth spurts. What is more likely is that as children grow older, their food intake is not increasing in congruence with their requirements either due to lack of resources or their inefficient allocation and as a result, their weight-for-age Z-score decreases as they grow older. The gender of the child is closely related to having a poor weight-for-age Z-score. Boys are likely to have lower weight-for-age Z-scores than girls. This result is likely driven by the difference in levels of physical activity between boys and girls – boys tend to be more active and have a higher BMR. As a result, they may burn calories faster than girls due to which they have lower weight-for-age Z-scores.

Next, we look at how the care that children receive affects their nutritional status. Parental education is a standard indicator for care as suggested by several studies (Smith *et al*, 2003; Smith and Haddad, 2000; Borooah, 2002). While father's education does not have a significant impact on children's nutritional status, mother's education does. Further, the interaction of mother's education with household wealth has a strong positive impact in short-term nutrition of children. More educated women, who are likely to marry more educated men, may belong to households with higher incomes; or may be employed, increasing household income, leading to provision of better food, care and health facilities.

We also proxy for the care that a child receives by including variables that capture the death of one or both biological parents. The loss of both parents does have a positive and significant impact on the child's nutritional status, though this is not very strong. Having lost either the mother or father does not have any impact on children's nutrition. Perhaps our results, in the case of the child being a double orphan, are capturing a lagged phenomenon of children being placed with better off households in the event of parental death, where children are benefiting from new (and higher) household income and access to health and infrastructure as well as better care-giving practices. As we do not have information on when children have lost their parents, we cannot estimate the true effect of parental absence.

The status of women, as an indicator of care, has an impact on being undernourished in the short-term - children living in female headed households have lower weight-for-age Z-scores. Such a relationship is likely to exist in two scenarios: (a) if these women's expenditure priorities do not benefit their children either because of choice or compulsion; and (b) if society is patriarchal and female-headed households are likely to have poor access to land (for example, they are likely to have access to fewer and perhaps smaller shambas) and credit markets than men and it is this inherent gender bias that is captured by the significant coefficients.

We include indicators of maternal employment and find that children who live in households where women are engaged in wage labour outside the household have higher weight-for-age Z-scores, which contradicts Abbi *et al* (1991) and Lamontagne *et al* (1998). Typically, women who work outside the home are likely to contribute to household income and have higher bargaining power within the household (relative to women who are not engaged in wage labour). These women are more mobile and their social interactions with other working women lead them to seek, acquire and assimilate knowledge that would help them better care for themselves and their families, despite less time spent on (direct) caregiving activities. The interaction of mother's education with women's engagement in wage labour has a positive and significant impact – more educated women who are working outside the household are indeed able to provide more physical, knowledge or care resources that benefit their children. Having women working in household farms seems to have a negative effect on children's nutrition, possibly because of a lower level of interaction with people outside the family and because of reduced time spent on caregiving activities. When this variable is interacted with mother's education, the direction of the relationship remains the same though it is not statistically significant.

The number of meals eaten per day by the household, food variety score and child illness do not have a significant impact on the weight-for-age Z-score. Our food-related indicators are proxies for food intake and quality and their choice was dictated by what was available in KHDS 2, which is a household level survey and not a nutrition survey of individuals. The variable for the number of meals eaten by the household daily will not take into account any meals or snacks that children eat outside the home, for example at a neighbour or relative's house, in a crèche, at school, supplementary feeds at a health post/clinic or picking fruit from trees. As a result, its impact is difficult to interpret. The food variety score is imperfect because of the recall period used in its construction. It also only provides household level data, does not account for an individual's dietary preferences or the fact that certain household members may receive preferential allocation when it comes to certain food items such as meat (Weiss, 1996). The child's stock of health in the last month is a child-specific variable with an appropriate recall period. However, the prevalence of illness in the KHDS is fairly high (see Section 5.3.3) and the non-significant result is capturing this artefact of the data. These variables presented non-significant results and are a source of endogeneity as discussed earlier. They have been dropped from the final set of estimates presented in Column (3) after testing for joint significance.

Food security of the household affects children's nutrition in the short-term. Our estimates show that the higher the share of expenditure on food as a proportion of the total household expenditure ie the more food insecure a household is, the lower the child's weight-for-age Z-score will be. When we come to the impact the household's health environment and sanitation facilities have on the probability that a child will be underweight, we see that having safe water to drink does not have any significant impact on children's nutrition. It is surprising that sanitation facilities do not have any significant impact on the child's weight-for-age Z-score but this may be because of the lack of variation in facilities that are available to KHDS households (see Chapter 5). Further, a household's access to safe water is closely related to the economic ability to access these sources and it is likely that this is leading to some bias in the estimates.

As discussed in the model, we include poverty in our specification as it may affect the immediate and underlying determinants of undernutrition. We proxy for household poverty by using the log of annual total household consumption. We find that increases in household consumption can increase the weight-for-age Z-score of children. We also see that if the household had been better off 10 years ago, during the first round of the survey in 1994, children's weight-for-age Z-scores in 2004 would have been higher. Again, this result is seen in all three specifications and is almost equal magnitude and significance. We also control for the ethnicity of the children. This is done to be able to account for social and economic marginalisation. Even though in Chapter 3, we see that Tanzania has a less fragmented ethnic identity and a strong uniting, national one, it is possible that there are some small differences between different ethnic groups that contribute to differences in children's outcomes. These differences may be in terms of different physical builds and statures, caregiving practices, distribution of land rights and wealth, etc. Belonging to the Msubi group can have positive effect on short-term nutrition of children, though this is seen only at the 10% level.

It is possible that these impacts differ across households because of the differences in resources that they command. To this end, we examine how differently socio-economic factors can affect the probability that a child will be undernourished in the short run, *if* she belongs to one of the richest or poorest households surveyed.

Lowest quintile

This section presents the coefficients obtained from the estimation of the Equation (6) for the children who live in households in the lowest expenditure quintile (Table 6.2). Unlike the results seen in Table 6.1 for the whole sample, in this sub-sample the age of the child does not have an impact on short-term nutrition. The gender of the child, in this sub-sample too, has a significant impact on the short-term nutrition of children. In the poorest households, boys are more likely to be undernourished in the short-term than girls.

Parental education plays an important role in the nutrition of children among this sub-sample too. Higher paternal education is associated with higher weight-for-age Z-scores of children; this association is seen to be persistent in the three specifications, with the magnitude of the impact of the mother's education being larger than that of the father's.

Table 6.2: Factors affecting the weight-for-age Z-score of children aged 6-60 months, lowest expenditure quintile

Dependent variable is the weight-for-age Z-score of the child	**(1)**	**(2)**	**(3)**
Age of the child in months	-0.004	-0.002	0.007
	(0.010)	(0.007)	(0.013)
Child is male	-0.340	-0.360***	-0.478**
	(0.282)	(0.115)	(0.211)
Father's education (in years)	0.032**	0.063**	0.076**
	(0.048)	(0.028)	(0.037)
Mother's education (in years)	0.009**	0.043**	2.412**
	(0.042)	(0.030)	(1.115)
Child is a double orphan	0.378	0.032	1.427
	(0.370)	(0.388)	(0.648)
Child is a maternal orphan	0.497*	0.956*	0.303*
	(0.381)	(0.653)	(0.039)
Child is a paternal orphan	0.003	-0.013	-1.649
	(0.283)	(0.253)	(1.755)
Number of women relative to men in the household	-0.123	-0.131	-0.132
	(0.112)	(0.142)	(0.175)
Log of total annual household expenditure	0.419*	0.129	0.855**
	(0.242)	(0.176)	(0.362)
Child's ethnicity is Haya	0.364*	0.574**	0.834*
	(0.220)	(0.282)	(1.094)
Child's ethnicity is Nyambo	-0.862	-0.352	-0.926
	(0.694)	(0.847)	(2.151)
Child's ethnicity is Kishubi	-0.517*	-0.128	-0.512
	(0.278)	(0.420)	(0.895)
Number of meals household usually has per day		0.769*	
		(0.434)	
Food diversity score of the household		-0.016	
		(0.073)	
Child has been ill in the last 4 weeks		0.167	
		(0.328)	
Log of total annual household expenditure 10 years ago		0.016**	0.039*
		(0.006)	(0.029)
Share of food in total annual household expenditure		-0.010*	-0.016*
		(0.010)	(0.013)
Women in the household are engaged in wage labour		0.552**	0.745
		(0.238)	(0.597)

Women in the household work on household farms		-0.339	-0.026
		(0.287)	(0.285)
Household is headed by a woman		-0.952*	-1.286***
		(0.520)	(0.327)
Household has safe water to drink		-0.267	0.075
		(0.353)	(0.343)
Interaction variables			
Total annual HH expenditure*child is a double orphan			1.650*
			(2.973)
Total annual HH expenditure*child is a paternal orphan			1.064
			(0.917)
Total annual HH expenditure*child is a maternal orphan			3.658***
			(1.584)
Mother's education*HHs headed by a woman			0.108
			(0.131)
Mother's education*total annual household expenditure			0.191
			(0.242)
Mother's education*women employed in HH farms			-0.080
			(0.113)
Mother's education*women engaged in wage employment			0.153*
			(0.088)
No of observations	88	88	88
R-squared	0.4271	0.4825	0.5775

Note: *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level

The impact of losing one or both parents on being underweight is also not straightforward. Losing both parents or losing the father appears to have no significant impact on the child's nutrition. However, being a maternal orphan can increase the weight-for-age Z-score of the child. On the death of the mother, it is likely that the original household is no longer in a position to be able to provide (good) care for their children. In such an event, maternal orphans may be placed in foster households that are viewed to have more resources available. These children may benefit from placement in foster homes with better caregiving practices and more well-off environments. Again, what we may be seeing is the lagged effect of being placed with a relatively better-off household. Further, the interaction term between household wealth and being a maternal orphan is a highly significant and positive one, suggesting that this could indeed be the case. However, we do not know how long ago children have been orphaned as the stage at which they were orphaned can also have an impact on their nutrition (Camfield and Himaz, 2009).

As seen for the whole sample, for this sub sample too, living in a female headed household have a negative effect on children's nutrition and could lower the Z-score by over 1 point. This is similar to what we have seen for the whole sample, signifying that households headed by women are vulnerable and as a result, the well-being of children and other members of these households may be at risk. However, when we interact this with the mother's education levels, it is not significant. Engagement of women in wage labour has a positive and significant effect on children' short-term nutritional status and this relationship continues to be significant when we interact it with mother's education. A similar result was seen for the whole sample.

The number of meals typically consumed in a day by the household increases the weight-for-age Z-score of the child in the lowest expenditure quintile. While this result is of a fairly high magnitude – it increases the weight-for-age Z-score by almost one point, it is only significant at the 10% level. This significance disappears when we add the interaction variables and we exclude from the final specification in Column (3). The food variety score and the health stock of the child do not have any impact on the weight-for-age Z-score of the child. This is likely for the same reasons discussed earlier – the food variety score not being a very representative indicator of food quality and the high prevalence of illness among KHDS respondents. Again, these variables are dropped from the final specification. As seen for the whole sample, household food insecurity can negatively affect the short-term nutritional status of children, though this effect is not a very large one and is only significant at the 10% level. As seen for the whole sample, in this sub sample too, having safe water to drink does not have a significant impact on children's nutrition.

As seen for the whole sample, current wealth and that 10 years ago has a positive and significant impact on the short-term nutrition of children. Thus, households that are indicative of being wealthy or at least having experienced few income shocks, even if in the lowest expenditure quintile, are associated with better nutritional outcomes of children. The coefficients on these variables are smaller in magnitude than those seen for the whole sample; perhaps because much larger increases in wealth (amongst other factors) for the households in the lowest expenditure quintile are required to bring about improvements in children's nutritional status. In this sub-sample, we see that belonging to the Haya group, which is the largest group in the Kagera region, is positively associated with better nutrition in the short-run.

What about children in the richest 20% of households? Do these factors have similar effects on the probability that these children will be undernourished in the short-run?

Highest quintile

This section presents the coefficients obtained from the estimation of the Equation (6) for the children who live in households that are in the highest expenditure quintile (Table 6.3). As seen for the whole sample, for this sample too, we see that the older the child is, the lower her weight-for-age Z-score will be. This is surprising because the children in this sub-sample live in households that have more resources than others and are in a position to provide growing children with the right quantity and quality of food (even if allocations are not efficient). However, it is still possible that circumstances other than the economic status of the household lead to children consuming few calories than they actually need, which is why they have lower weight-for-age Z-scores. Among the richest expenditure quintile, the gender of the child does not have an impact on children's short-term nutrition

Table 6.3: Factors affecting the weight-for-age Z-score of children aged 6-60 months, highest expenditure quintile

Dependent variable is the weight-for-age Z-score of the child	**(1)**	**(2)**	**(3)**
Age of the child in months	-0.032***	-0.033***	-0.036***
	(0.005)	(0.007)	(0.009)
Child is male	-0.101	-0.016	0.158
	(0.158)	(0.158)	(0.169)
Father's education (in years)	0.008	-0.003	-0.010
	(0.035)	(0.032)	(0.036)
Mother's education (in years)	0.002*	0.021*	1.330*
	(0.030)	(0.037)	(1.046)
Child is a double orphan	0.209	0.376	2.876**
	(0.475)	(0.405)	(1.537)
Child is a maternal orphan	-0.170	-0.182	-1.026
	(0.113)	(0.203)	(1.071)
Child is a paternal orphan	-0.269	-0.425	0.704
	(0.197)	(0.185)	(0.245)

Number of women relative to men in the household	0.015	-0.018	-0.003
	(0.051)	(0.061)	(0.069)
Log of total annual household expenditure	-0.076	0.029	0.080
	(0.143)	(0.180)	(0.387)
Child's ethnicity is Haya	0.046	0.216	0.179
	(0.250)	(0.422)	(0.534)
Child's ethnicity is Nyambo	0.375	0.532	0.540
	(0.454)	(0.568)	(0.779)
Child's ethnicity is Hangaza	1.171***	1.465***	1.574***
	(0.452)	(0.529)	(0.593)
Number of meals household usually has per day		-0.060	
		(0.065)	
Food diversity score of the household		-0.031	
		(0.057)	
Child has been ill in the last 4 weeks		0.354	
		(0.116)	
Log of total annual household expenditure 10 years ago		0.055***	0.065*
		(0.017)	(0.036)
Share of food in total annual household expenditure		-0.001	-0.004
		(0.008)	(0.005)
Women in the household are engaged in wage labour		0.533	0.942
		(0.477)	(0.765)
Women in the household work on household farms		-0.666***	-1.249***
		(0.220)	(0.184)
Household is headed by a woman		-0.026	0.090
		(0.116)	(0.312)
Interaction variables			
Total annual HH expenditure*child is a double orphan			1.661**
			(0.783)
Total annual HH expenditure*child is a paternal orphan			-0.413
			(0.746)
Total annual HH expenditure*child is a maternal orphan			1.498
			(1.227)
Mother's education*HHs headed by a woman			0.003
			(0.081)
Mother's education*total annual household expenditure			0.089**
			(0.070)

Mother's education*women employed in HH farms			-0.093*
			(0.137)
Mother's education*women engaged in wage employment			0.149
			(0.253)
No of observations	96	96	96
R-squared	0.3846	0.4179	0.5262

Note: *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level

As seen with the sub-sample of households in the lowest expenditure quintile, we find that the father's education does not have a significant impact on the short-term nutrition of children. Mother's education does have a positive and significant impact on children's short-term nutrition but this effect, while fairly large, is only significant at the 10% level. However, when mother's education interacts with household expenditure, we see a positive and significant impact on short-term nutrition (at the 5% level); more educated women in richer households are better able to assimilate caregiving information and are better able to access facilities that allow them to act on this information. Being a double orphan has a positive and significant impact on short-term nutrition of children. The positive and significant coefficient on interaction of this effect with household wealth once again leads us to believe that perhaps these children benefit from being placed in a well off household and this effect, which is a lagged one, is what is being captured. Living in household where women work on the household farms can have a negative impact on children's nutrition – households with women working on the household farms are associated with lowered Z-scores of 0.7 to 1 point. This result is also seen when this variable interacts with maternal education suggesting that there is a trade-off between within household employment and children's nutrition. While working on a household farm or in the household business may contribute to household income, women may not be able to spend time on caregiving activities. They may also not be very socially mobile and unable to benefit from the experiences of women outside of their households.

The quantity of food consumed by the household everyday does not have a significant impact on children's nutrition and neither does the diversity of the diet, possibly due to the reasons discussed previously. In addition, the share of food in total annual household expenditure does not have an impact on the child's weight-for-age Z-score

Increases in annual household expenditure do not have a significant impact on children's nutrition. However, the household's level of expenditure 10 years ago has a positive and significant impact on children's nutrition, implying that if households were better off 10 years ago i.e. if households have a history of a large stock of resources, they are likely to have children with higher weight-for-age Z-scores in the future. This may be because households that have been wealthy for very long periods could have better nourished adults, especially mothers. Better nourishment of mothers is linked to better health and nutrition statuses of their children (Victoria *et al*, 2008). Children from the Hangaza group are less likely to be underweight, possibly because this ethnic group, like the Haya, is a dominant one and one of the better off ones in the area.

We have seen how various socio-economic factors can affect a child's nutrition in the short-run and how different these impacts are at different levels of poverty. Do these impacts differ in the long-run?

6.3.2 Determinants of Long-term Undernutrition among Children

The information that household surveys provide can be limiting as they rarely collect data on long-term indicators of socio-economic well-being, which makes it challenging to study the factors that can have an impact on long-term nutrition. Can we use cross sectional data to answer questions about how socio economic characteristics of individuals and the households that they live in affect long-run undernutrition of very young children? If so, can we do this in a satisfactory manner using secondary data?

The second part of our analysis looks into which factors are associated with the long-term nutritional status of a child between the ages of 6 and 60 months. The empirical strategy is described in detail in Section 6.2. The dependent variable is the child's height-for-age Z-score. The explanatory variables are those in the right hand side of Equation (6).

Whole sample

Table 6.4 presents results obtained from the empirical analysis of the model presented above for factors that affect the height-for-age Z-score of children between the ages of 6 and 60 months in Kagera in 2004.

The age of the child has a significant impact on the height-for-age Z-score of the child in all three specifications, implying that even when we control for the interaction terms, as the child grows older, the lower her height-for-age Z-score would be. This may be partly due to measurement error in the age of the child, which is specifically recorded in months in order to calculate the Z-score. These errors are often recall based, especially in developing countries where birth information is not always recorded and many respondents guess ages of household members. This is also true of the weight-for-age Z-score. Previously, we have discussed that if children grow older and their food intake does not increase in accordance with their needs, they will suffer short-term nutrition. Perhaps this coefficient is picking up on the persistence of the short-term relationship between stunting and age. Boys appear to have lower height-for-age Z-scores in the long-run. Evidence shows that this is characteristic of SSA countries, including Tanzania (Smith and Haddad, 2000; Wamani *et al*, 2007).

Parental education, which is fairly stable and unlikely to change over time (except if parents enrol in adult literacy or adult education programmes) has a positive impact on the height-for-age Z-score of children. The significant impact of the parents' education is seen across all three specifications. From the significant and positive interaction between mother's education and household wealth, we infer that, as seen for the short-term, in the long-term too, more educated women from richer households are better able to assimilate caregiving information and are better able to access facilities that allow them to act on this information.

The loss of one or both (biological) parents is time invariant and can be used as a long-term indicator for care. Losing both parents or only one parent has no impact on the height-for-age Z-score of children.

We also find that children who live in households where women work on the household farms have poorer nutrition outcomes in the long-term. While female employment provides and additional source of income to households, there is a trade-off in the time that women spend in caregiving. This is reflected in the negative sign on this coefficient. If women were to spend less time looking after and engaging in bonding with children, it may result in stunting amongst their children. The interaction between this variable and mother's education also has a negative and significant coefficient. This result reinforces the belief that irrespective of how educated mothers are, it is likely that the time that they spend working on household farms detracts from their caregiving function and can adversely affect the long-term nutrition of children. Further, owing to the fact that they work within the "household enterprise", their social interactions are likely to be limited to members from their own households, which could result in a smaller knowledge network that affects caregiving, leading to lower nutritional outcomes for their children in the long-run. As seen to affect short-term nutritional statuses of children, living in a female headed household can also be detrimental for children's nutrition in the long-term. Female headed households tend to be poorer and have lower access to land and credit, which implies that they may not have enough resources to allocate amongst household members. The interaction term between mother's education and female headed households is a positive one, - if female heads of households, were more educated, they may be able to find better jobs and access to credit and land, to be able to provide more resources for their children.

Table 6.4: Factors affecting the height-for-age Z-score of children aged 6-60 months

Dependent variable is the height-for-age Z-score of the child	(1)	(2)	(3)
Age of the child in months	-0.026***	-0.026***	-0.025***
	(0.003)	(0.003)	(0.004)
Child is male	-0.262	-0.273*	-0.278*
	(0.161)	(0.156)	(0.152)
Father's education (in years)	0.021**	0.022**	0.023**
	(0.009)	(0.010)	(0.010)
Mother's education (in years)	0.004*	0.006*	0.376**
	(0.019)	(0.017)	(0.183)
Child is a double orphan	0.223	0.269	3.430
	(0.192)	(0.177)	(2.127)
Child is a maternal orphan	0.192	0.230	6.493
	(0.177)	(0.172)	(5.853)
Child is a paternal orphan	-0.083	-0.103	-3.556
	(0.167)	(0.163)	(3.782)

Number of women relative to men in the household	-0.003	-0.003	-0.008
	(0.040)	(0.039)	(0.039)
Log of total annual household expenditure	0.726***	0.735***	0.686***
	(0.118)	(0.113)	(0.075)
Child's ethnicity is Haya	-0.070	-0.040	-0.082
	(0.180)	(0.187)	(0.184)
Child's ethnicity is Nyambo	0.112	0.091	0.080
	(0.286)	(0.326)	(0.324)
Child's ethnicity is Hangaza	0.186	0.248	0.267
	(0.203)	(0.223)	(0.207)
Child's ethnicity is Msubi	0.151	0.164	0.057
	(0.207)	(0.198)	(0.200)
Child's ethnicity is Kishubi	0.778***	0.853***	0.696***
	(0.250)	(0.213)	(0.193)
Child's ethnicity is Zinza	-0.361**	-0.472***	-0.418***
	(0.147)	(0.167)	(0.146)
Number of meals household usually has per day		0.031	
		(0.105)	
Food diversity score of the household		0.048	
		(0.065)	
Child has been ill in the last 4 weeks		-0.138	
		(0.107)	
Log of total annual household expenditure 10 years ago		0.011	0.014
		(0.016)	(0.014)
Share of food in total annual household expenditure		-0.003*	-0.003*
		(0.005)	(0.005)
Women in the household are engaged in wage labour		0.065	0.128
		(0.179)	(0.324)
Women in the household work on household farms		-0.246**	-0.165*
		(0.099)	(0.089)
Household is headed by a woman		-0.149	-0.324***
		(0.134)	(0.121)
Household has safe water to drink		-0.085	-0.022
		(0.630)	(0.640)
Interaction variables			
Total annual HH expenditure*child is a double orphan			-0.232
			(0.156)
Total annual HH expenditure*child is a paternal orphan			0.253
			(0.280)
Total annual HH expenditure*child is a maternal orphan			-0.451
			(0.419)

Mother's education*HHs headed by a woman			0.074***
			(0.026)
Mother's education*total annual household expenditure			0.026*
			(0.013)
Mother's education*women employed in HH farms			-0.042***
			(0.015)
Mother's education*women engaged in wage employment			0.001
			(0.048)
No of observations	463	463	463
R-squared	0.4571	0.4612	0.4775

Note: *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level

The indicators for quality and quantity of food intake as well as stock of the child's health are found to not have an impact on children's long-term nutritional status. The indicators that we have chosen as proxies for food intake, food quality and the stock of health of the child are all short-term indicators and tend to be variable as they are directly associated with household income, which is very volatile in developing countries. This association may also lead to a bias in these coefficients; and as they are not completely exogenous, we drop them from the final specification after testing for joint significance.

Household food security improves nutritional outcomes in the long-term ie if the share of food in annual total household consumption were to decrease, the child's height-for-age Z-score would increase. While we see this effect in all three specifications, it is not a very large effect and is only significant at the 10% level. The coefficient on household food security should be interpreted with caution - the status of the food security household will change from season to season and from year to year, which is something that this variable does not capture. The community fixed effects too many not be able to capture the long-term trend in this.

We also included households' access to safe drinking water but found that this had no significant impact on the probability of being stunted. Perhaps this is because this is time variant and is correlated with household consumption and as household's become less poor they may be able to afford access to better sources of water. Increases in total annual household expenditure are likely to improve children's height-for-age Z-scores, if other factors were to remain constant. However, the poverty/wealth status of households 10 years ago does not have an impact on children's nutrition. Children's ethnicity is time invariant and as discussed earlier, can also capture aspects such as social and economic exclusion, caregiving practices and behaviour as well as the status of women in society. Children who are Kishubi are less likely to be stunted, while children who are Zinza are more likely to be stunted than children who belong to other groups. This may be something to do with the diet of the Zinza, whose diet mainly consists of plantains and beans along with cassava and millet (Bjerke, 1969). Such a protein deficient diet is likely to thwart growth and result in lower height-for-age Z-scores of Zinza children.

The results in Table 6.4 seem to indicate that a fair number of the determinants of undernutrition are correlated with household consumption. This is not surprising as poverty can affect household's food security, care provision and access to health and sanitation facilities. These relationships are also likely to over or underestimate the true impact of these factors, and hence, we must exercise some caution when interpreting this coefficients. Thus, we examine how differently socio-economic factors can affect children's nutrition in the long run, *if* she belongs to one of the richest or the poorest households.

Lowest quintile

This section presents the coefficients obtained from the estimation of the Equation (6) for the children who live in households that belong to the lowest expenditure quintile (Table 6.5). As seen for the whole sample, in this sub-sample too, the age of the child has a significant impact on the height- for- age- Z-score of the child in all three specifications. Thus, as the child grows older, her height-for-age Z-score decreases. Given that these children belong to the poorest 20% of households surveyed, it is likely that this reflects persistent shortages in food. As seen for the whole sample, in this sub-sample too, boys are more likely to be stunted and this effect of gender is fairly strong. This is corroborated by the 10 SSA country study by Wamani *et al* (2007) that also found that poorer households had more boys who were stunted than girls.

Among these households, surprisingly, unlike our estimates for short-term nutrition, parental education does not have an impact on children's long-term nutrition.

However, as seen in our results of short-term nutrition and the previous set of results for long-term nutrition, we see that there is a positive and significant interaction between mother's education and household wealth.

Table 6.5: Factors affecting the height-for-age Z-score of children aged 6-60 months, lowest expenditure quintile

Dependent variable is the height-for-age Z-score of the child	(1)	(2)	(3)
Age of the child in months	-0.034***	-0.036***	-0.025***
	(0.006)	(0.011)	(0.010)
Child is male	-0.570***	-0.722**	-0.828**
	(0.147)	(0.350)	(0.522)
Father's education (in years)	0.014	0.069	0.064
	(0.039)	(0.043)	(0.036)
Mother's education (in years)	0.051	0.037	2.934
	(0.047)	(0.031)	(1.812)
Child is a double orphan	0.150	0.450	1.201
	(0.530)	(0.685)	(0.516)
Child is a maternal orphan	0.652	0.679*	1.550
	(0.631)	(0.365)	(0.828)
Child is a paternal orphan	0.331	0.413**	0.840***
	(0.231)	(0.160)	(0.401)
Number of women relative to men in the household	0.000	-0.006	-0.039
	(0.049)	(0.044)	(0.096)
Log of total annual household expenditure	0.264	0.183	-0.301
	(0.554)	(1.465)	(1.253)
Child's ethnicity is Haya	-0.088	-0.169	0.017
	(0.314)	(0.381)	(0.933)
Child's ethnicity is Nyambo	-0.758	-0.463	-0.894
	(0.601)	(1.036)	(2.479)
Child's ethnicity is Kishubi	0.400	0.284	0.457
	(0.401)	(0.435)	(1.386)
Number of meals household usually has per day		0.896	
		(1.053)	
Food diversity score of the household		-0.001	
		(0.064)	
Child has been ill in the last 4 weeks		0.074	
		(0.330)	
Log of total annual household expenditure 10 years ago		0.003	-0.015
		(0.047)	(0.078)
Share of food in total annual household expenditure		0.031	0.019
		(0.024)	(0.019)
Women in the household are engaged in wage labour		0.435	0.548

		(0.645)	(1.093)
Women in the household work on household farms		-0.261	-0.095
		(0.202)	(0.368)
Household is headed by a woman		-0.907	-1.578***
		(0.578)	(0.264)
Household has safe water to drink		-0.219	0.370
		(0.651)	(1.134)
Interaction variables			
Total annual HH expenditure*child is a double orphan			-0.448
			(3.608)
Total annual HH expenditure*child is a paternal orphan			2.419***
			(0.524)
Total annual HH expenditure*child is a maternal orphan			1.881
			(0.361)
Mother's education*HHs headed by a woman			0.298***
			(0.116)
Mother's education*total annual household expenditure			0.234*
			(0.139)
Mother's education*women employed in HH farms			-0.019
			(0.105)
Mother's education*women engaged in wage employment			-0.198
			(0.197)
No of observations	88	88	88
R-squared	0.4628	0.4647	0.5954

Note: *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level

We do find that being a maternal and paternal orphan has a positive impact on children's long-term nutrition. It is indeed very likely for this sub-sample that, as previously discussed, children who are orphaned are placed with better off households and that children are benefiting from better facilities, recourses and care in the new household. When we include an interaction between household wealth and being a maternal orphan, this effect, while large in magnitude is no longer significant, suggesting that this is not entirely the case. However, the interaction between household wealth and being a paternal orphan suggests that the long-term nutrition of these children may benefit from the availability of more resources.

The food security status of the household does not appear to have any impact on children's height-for-age Z-score. The same applies for the health environment and sanitation facilities available to the households as well as current and past household wealth. We also found that employment of women in the household does not have an impact on children's long-term nutrition in this sub-sample.

Living in a female headed household leads to poor long-term nutrition of children. This is likely to be more true for the poorest 20% of households surveyed. While living in a female headed household is thought to improve children's health and education outcomes as it is believed that women will prioritise these. However, in situations of extreme poverty, it is possible that women are not able to spend in this manner as the household may have more urgent requirements that call for a different allocation of resources or if women do not have access to jobs or credit. If society has an inherent gender bias, the situation becomes worse for female headed households. However, as seen for the whole sample, we see that among the poorest households surveyed in Kagera, if households were headed by (more) educated women, children's height-for-age Z-scores would improve. This effect is a small one but is significant at the 1% level. If female headed households were more educated this could have a positive impact on the height-for-age Z-score of children. This may be because their higher levels of education allow them to earn higher incomes and thus, command more resources than female heads with lower levels of education. Another reason could be that these women are able to better channel fewer resources and use them more efficiently.

We have seen how various socio economic factors can impact the long term nutrition of children belonging to the poorest 20% of households. Do these factors have similar effects on the long term nutrition of children belonging to the richest 20% of households will also be stunted?

Highest quintile

This section presents the coefficients obtained from the estimation of the Equation (6) for the children who live in households that are in the highest expenditure quintile (Table 6.6). As seen for the whole sample and for the poorest 20% of surveyed, in this sub-sample too, the age of the child has a significant impact on the long-term undernutrition of children. Given that these children belong to the richest 20% of households surveyed, it is less likely that this reflects persistent shortages in food in Kagera and may just be more due to measurement error of age as discussed previously. Among this sub-sample however, the gender of the child has no impact on the height-for-age Z-score of children, implying that among the richest 20% of households, there is a negligible gender gap as far as the long-term nutrition of children is concerned.

Table 6.6: Factors affecting the height-for-age Z-score of children aged 6-60 months, highest expenditure quintile

Dependent variable is the height-for-age Z-score of the child	(1)	(2)	(3)
Age of the child in months	-0.034***	-0.037***	-0.041***
	(0.007)	(0.010)	(0.008)
Child is male	-0.044	0.180	0.230
	(0.533)	(0.499)	(0.524)
Father's education (in years)	0.043**	0.060***	0.063***
	(0.019)	(0.019)	(0.020)
Mother's education (in years)	0.036	0.052**	1.824*
	(0.044)	(0.021)	(2.803)
Child is a double orphan	-0.135	0.036	-1.850
	(0.402)	(0.403)	(0.751)
Child is a maternal orphan	-0.256*	-0.145	-1.652***
	(0.154)	(0.226)	(0.776)
Child is a paternal orphan	0.237	0.147	1.073
	(0.672)	(0.751)	(0.943)
Number of women relative to men in the household	0.127	0.061	0.012
	(0.104)	(0.056)	(0.050)
Log of total annual household expenditure	0.033	0.177	0.238
	(0.344)	(0.224)	(1.011)
Child's ethnicity is Haya	1.150***	1.434***	1.576***
	(0.159)	(0.240)	(0.227)
Child's ethnicity is Nyambo	1.160***	1.591***	1.778***
	(0.150)	(0.225)	(0.307)
Child's ethnicity is Hangaza	2.092***	1.123***	2.098***
	(0.469)	(0.284)	(1.080)
Number of meals household usually has per day		-0.492	
		(0.210)	
Food diversity score of the household		-0.127	
		(0.101)	
Child has been ill in the last 4 weeks		-0.197	
		(0.256)	

Log of total annual household expenditure 10 years ago		0.093***	0.120***
		(0.017)	(0.027)
Share of food in total annual household expenditure		0.008	0.004
		(0.009)	(0.010)
Women in the household are engaged in wage labour		-1.378**	-1.664**
		(0.573)	(0.683)
Women in the household work on household farms		-0.958	-1.151***
		(0.687)	(0.288)
Household is headed by a woman		0.121	0.026
		(0.469)	(0.542)
Interaction variables			
Total annual HH expenditure*child is a double orphan			0.265
			(1.268)
Total annual HH expenditure*child is a paternal orphan			0.622
			(0.773)
Total annual HH expenditure*child is a maternal orphan			3.718***
			(1.402)
Mother's education*HHs headed by a woman			0.085***
			(0.019)
Mother's education*total annual household expenditure			0.122
			(0.189)
Mother's education*women employed in HH farms			0.002
			(0.107)
Mother's education*women engaged in wage employment			-0.129
			(0.154)
No of observations	96	96	96
R-squared	0.4136	0.4217	0.4675

Note: *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level

Higher parental education has a positive impact on children's long term nutrition. Parents who have completed more years of schooling may be better able to provide their children with more and better quality food and create an amenable environment that is proving to be beneficial in terms of children's nutritional outcomes. Being a maternal orphan lowers the height-for-age Z-score of the child. Children's nutritional (and in fact, other) outcomes may suffer as a result of this because of the loss of the primary caregiver. If the child is placed in a better off foster household, as seen on the estimated coefficient of the interaction between household expenditure and being a maternal orphan, the child may in face have a better nutritional status in the long term. However, not knowing how long ago the child lost her mother is a deterrent in the understanding of the real magnitude of this impact. Being a paternal orphan or a double orphan does not have an impact on children's long term undernutrition

For this sub-sample, children who live in households where women are engaged in wage labour or where women who work on household farms are likely to have poor long term nutrition are likely to have lower height-for-age Z-scores. This is probably because of less interaction between children and their mothers and changes in caregiving practices as another household member may now be the primary caregiver. While the impact of living in a female headed household is not significant, the interaction between mother's education and living in a female headed household is significant and can lead to better long-term nutrition of children. As discussed previously, this may be because higher levels of education allow them to earn higher incomes, command more resources and channel these resources efficiently to the benefit of their children and other household members.

While the current wealth of the household does not have a significant impact on children's height-for-age Z-score, the wealth of the household 10 years ago does. Again, this is indicative households that have been wealthy in the long-term can provide steady access to healthy, caring and food secure environments that positively affect the long-term nutrition of their children. As seen in the previous sets of estimates, quality and quantity of diet, child's stock of health, household food security and household's consumption do not have an impact on the height-for-age Z-score of children who are in this sub sample. Finally, children who belong to the Haya, Nyambo and Hangaza groups have better long term nutritional outcomes than children who belong to other groups. This may be due to the fact that these ethnic groups are traditionally the dominant ones that have better access to resources and facilities improve well-being.

In this section, we have seen how various socio-economic factors can affect a child's nutrition in the long-run and how different these impacts are at different levels of poverty. But have we been able to address the question of what determines children's nutrition in the short-run and the long-run by using household survey data in a satisfactory manner?

6.4 Concluding Remarks: Regression Analysis

The KHDS is a rich and detailed household survey that collects a vast amount of data for the surveyed households and individuals in Kagera. Despite the nuanced information it can provide on the behaviour of these households and its members over time, it does have a limit on to what degree it can explain the child undernutrition situation. Nutrition surveys are expensive and time consuming to administer and can prove to be a constraint to researchers. Household surveys, especially those such as the Living Standard Measurement Surveys (LSMS), can help overcome this problem because of the wide range of characteristics that they collect data on. However, the regression analysis in this chapter indicates that such surveys are unable to provide distinct information for indicators that may be required when studying nutrition and health related questions. This will be discussed in more detail in Chapter 8.

With a combination of individual and household level information, we used an OLS model to estimate the impact of various factors on the child's nutritional status in the short and long-run. We include interactions terms to take into account some relevant inter-relationships that exist between these various factors. In the short-run, children's age and being male increases the likelihood of being undernourished. The older the children are, the higher their energy needs are. This is especially true for boys who live in the poorest households in our sample, pointing to the fact that the calorie needs of very young children are not being met, putting their health and well-being at risk. These findings are similar to those of Alderman *et al* (2005) who, in a study evaluating the impact of nutrition programmes, using data from Round 1 of the KHDS, find that age and (male) gender are negatively associated with the weight-for-age Z-score of children.

We find mixed evidence on the impact of the care that children receive on their nutrition. Like the bulk of the literature on the determinants of malnutrition among children, we find that education of the parents has a positive and significant impact on the short –term nutrition of children. Higher levels of mother's education, more than that of the fathers, were found to have a significant and positive impact on children's weight-for-age Z-score. Again, Alderman *et al* (2005) find this to be true as do several other studies, for example, Horton (1986), Behrman and Wolfe (1987), Borooah (2002). Even if mothers have the knowledge to change or improve their caregiving behaviour, they may not be able to act on this knowledge if there are economic restrictions on the household. For example, ante natal and early childhood parenting classes would give parents the right kind of information to help improve caregiving behaviour, health environments and parental attitudes. However, if this approach is to be followed, it cannot be done without ensuring that parents have the economic and physical abilities to access this information and implement it. Our estimates of interactions between mother's education and household expenditure show that these factors may act cohesively rather than separately to positively affect children's nutrition in the short-term.

The death of one or both parents may not always prove to be detrimental to a child's nutritional outcomes. We expected that the loss of a parent would be negatively associated with weight-for-age Z-scores of children because of loss of income and/or different caregiving behaviour resulting from the death of one or both adults. Children placed with extended families in these situations may also bear the brunt of favouritism as the needs of biological children may be prioritised in these foster or adoptive homes. However, in the short-term, we see that parental loss is positively associated with weight-for-age Z-scores of children, a result different from what Alderman *et al* (2005) find. The data do not tell us how long before the survey was administered the deaths occurred. We may be seeing is a lagged result of being placed with a better off household that can afford to look after orphaned children. Indeed, the coefficients on the interactions between annual total household expenditure and orphanhood appear to indicate this.

Women being engaged in wage labour can improve children's nutrition in the short-run. These women contribute to household income and are likely to have more bargaining power in the household that enables them to participate in the allocation of resources amongst household members, thus contributing to better nutritional outcomes and overall well-being of children and other household members. This is also evident from the significant coefficient seen for the interaction term between mother's education and female employment. More educated women are more likely to be in a position to affirm their engagement in wage labour and thus, have more decision making power in the household in patriarchal societies, while such a scenario is less likely for less educated women (Smith *et al*, 2003). Employment of women working on household farms, on the other hand, has a negative impact on children's short-term nutrition. There are several possible reasons for this. One, women may not actually receive an income for this. Any extra income that their labour generates is likely to still be controlled by the male head of the household. Thus, the additional income earned may not translate into increased decision making or bargaining power of women and they may still be unable to participate in intra-household resource allocation. These women may leave an older child or elderly person in charge of younger children while they are at work and these individuals may not exhibit optimal caregiving behaviour. Women engaged in wage labour too need to make alternate childcare arrangement but have the benefit of access to better services such as a community crèche or day care. Women engaged in wage labour outside the house also have more social interactions with other working women and can assimilate more knowledge from them (Lamontagne *et al*, 1998; Sen, 1990). Women engaged in household enterprises may not have these opportunities. Thus, while both forms of women's employment contribute to household income, they have different effects on children's nutrition. Not just any form of employment can improve women's status and children's nutrition as seen in our sample.

This analysis adds to the literature that finds that food security of a household is important for children's nutrition and that improvement in the food security of households improves children's nutritional outcomes in the short-term, particularly for children who belong to the poorest households. This justifies the need for intervention programmes that strengthen the links between household's economic abilities to buy food and provision mechanisms either through fair price shops, food for work programmes or at children's schools; for example, take home rations or school meals as seen from Alderman et *al*'s (2005) results that show that participation in food supplementation programmes can improve children's weight-for-age.

A very strong result was that improvements in the wealth of households or reduction of poverty has a positive and strong impact on the nutritional outcomes of children in the short-term for the whole sample, and particularly for the poorest households in our sample. This result is corroborated by several studies (for example, Anand and Ravallion; 1993; Smith and Haddad, 2000; Haddad *et al*, 2003). We also studied the impact of household wealth 10 years ago. Having been richer 10 years ago, which could signal long-term wealth or being less vulnerable to income shocks, is also positively associated with children's weight-for-age Z-score. However, increases in household wealth along may not always lead to desired levels of improvement in children's nutrition as households must be able to channel these resources effectively. Large increases in income whether generated by households themselves, received as transfers or as a windfall could only be effective if they were accompanied by investment in public infrastructure, dissemination of caregiving practises, and increasing access to health and food-related facilities.

Overall, the high status of women can have a positive impact on children's nutrition, though this is not a very straightforward impact. At very high levels of poverty, living in a female headed household proves to be detrimental to children's nutrition in the short- term. This acts in combination with low purchasing power, poor health environments and low levels of education among women to negatively affect children's nutrition. Our coefficients on the interaction between living in a female headed household and higher women's education show that even for the poorest households, if women are more educated and have the means to provide better environments for their children, children are less likely to be underweight.

Turning to our results showing what affects children's nutrition in the long-term, we find that as seen in the short-run, in the long-term too, children's age and male gender are associated with stunting. These results are similar to the ones found by several studies (including Smith and Haddad, 2000; Alderman *et al*, 2005; Wamani et al, 2007). A limitation of the height-for-age Z-score as an indicator of long-term undernourishment is that it does not pick up growth spurts that are likely to take place during adolescence and does not pick up on the fact that some children are short for their age, not because of a nutritional deficit but because of a genetic predisposition (Falkner 1986; Jeliffe, 1966; Habicht *et al*, 1974). Parental education – mother's education more than the father's- is also positively associated with long-term nutrition, in addition to being associated with short-term nutrition. Alderman *et al* (2005) also find that parent's education is positively associated with children's height-for-age Z-scores but unlike in our case, they find that the father's education has a stronger positive impact.

Unlike in the short-term, losing both parents had no significant impact on children's height-for-age Z-score. Losing the mother, however, was positively associated with better height-for-age Z-scores. As seen in the short-term, the interaction between maternal orphanhood and household wealth is a positive one in the long-term too, suggesting that children who are living in wealthy households after the demise of their mother may not be necessarily stunted. In the long-term, losing the father was found to not be detrimental but only for children in the poorest households. In this case too, the interaction between paternal orphanhood and household wealth is a positive one. This result, however, is the opposite of what some studies have found; that the loss of the father results in a deficit in long-term nutrition of children (Alderman *et al*, 2005). Unlike what we have seen for short-term nutritional outcomes of children, we found that in the long-term, women's employment, whether in wage labour or on household farms, is detrimental to the long-term nutritional outcomes of children. Working women do tend to spend less time playing, interacting and engaging with their children, which is associated with stunting.

Food security of the household as measured by the share of food in total annual household expenditure is not significantly associated with children's nutrition in the long-run as it was seen to be in the short-run. This is perhaps because this indicator is time variant and cannot capture any information about the long-term potential of food security of households. We found that (like Alderman *et al*, 2005), in the long-term too, wealth of the household was positively associated with higher height-for-age Z-scores of children. However, we did not see this association for the richest or poorest households as we did in the short-term. In the long-term, living in a female headed household is associated with stunting. Our coefficients on the interaction between living in a female headed household and higher women's education show that in the long-term too, even for the poorest households, if women are more educated and have the means to provide better environments for their children, children are less likely to be stunted.

Finally, certain ethnic groups such as the Msubi, Haya, Nyambo and Hangaza may have better weight-for-age and height-for-age Z-scores because they are the majority groups in the area and have better access to economic and infrastructure resources. This may also be a reflection of particular physiological characteristics of these tribes. We need to bear this in mind while making inferences because of the methodological concerns pertaining to choosing reference populations (as discussed in Chapter 2).

It is surprising that the health and sanitation environments were not found to be significant in any of the specifications, both in the short- and long-term. Perhaps this is because there is very little variation in these facilities between households (see Chapter 5).

This analysis has its limitations. The first is that we were not able to find suitable instruments to account for the endogeneity posed by the quantity of food intake, quality of food intake and food insecurity variables. To some extent, this endogeneity of food security caused by seasonality has been dealt with by the inclusion of community fixed effects. The second is that, the OLS estimates of the quantity and quality of food intake were persistently non-significant and were dropped from the final specification. As a result, this analysis lacks important information on what do people eat and how much of it. Recall that these variables were problematic to begin with; the KHDS is not a survey of individual's health and nutrition, these indicators did not provide information at the individual level. These indicators have been constructed using household level data and do not have reflected how food is allocated between household members and whether there are gender- or age-based preferences when it comes to food distribution within a household. There is also no information on when children suffered the loss of a parent as the timing of orphanhood has different effects on short- and long-term undernutrition. Finally, there is no information on whether female headed households are headed by women *de facto* or *de jure*. If women are acting as heads of households because their husbands work in a different area, they might have high household incomes and better access to land and credit than women who have become household heads after the death of their husband or other male head.

Throughout this section (6.4) we have compared our findings, primarily, to those of Alderman *et al's* (2005) study that evaluates the joint contribution of income growth and nutrition interventions towards the reduction of malnutrition. This is because their study is similar in scope and uses data from the KHDS. They use data from the 1991-1994 short-panel and focus on the evaluation of the impact of two specific programmes on children's nutritional outcomes. Some of our results, though for a different sample of children at a different point in time, are similar to those of Alderman's study, while some show a different relationship, for example, the relationship between father's education and undernutrition, as discussed earlier in this section. One shortcoming of Alderman's study is that they do not take into account the fact that some of the determinants of undernutrition may interact with each other and have an impact on children's nutrition in the short- and long-term. They also do not account for household food security in their evaluation of the impact of the nutritional programmes. The impact of these programmes on children who live in food secure households may be different from that on children who live in food insecure households.

We have seen that there are many ways in which the immediate, underlying and immediate determinants can have an impact on a child's nutrition. For example, households with low incomes are likely to have less educated parents, orphanhood status, household wealth which interact with each other to determine whether a child will be wasted or stunted or properly nourished. When tackling the problem of undernutrition in Kagera (and elsewhere in the world), any approach that is taken needs to be an integrated one. For example, if health workers disseminate information to young mothers about top up feeds to supplement breastfeeding, these women should have access to markets/ clinics where such formula is sold at affordable prices. Interventions also have to be targeted to ensure that the children who are at the highest risk of being undernourished, for example, children who belong to very poor households or minority ethnic groups such as the Zinza and more are vulnerable to health and consumption shocks are receiving the resources that they need. At the same time, it is important that those children who are less at risk, for example, those who belong to slightly well off households, majority ethnic groups and have working mothers do not go unnoticed.

7. Impact of Child Undernutrition on Schooling

In this chapter, we explore the educational trajectories of children who were aged between 6 and 60 months during Round 1 of the KHDS in 1994. Specifically, we look into individual and household level characteristics of these children 10 years later i.e. during Round 2 of the KHDS conducted in 2004. We also look at characteristics of the schools that children went to and communities that they lived in during this time. By looking at these socio-economic characteristics of this group of children, we will be able to determine how their schooling efficiency or educational outcomes differ and whether they may be associated with their past nutritional statuses. This will also set up the background for the statistical analysis by identifying factors other than early childhood nutrition that affect children's educational outcomes.

As previously discussed, the longitudinal dimension of the KHDS allows us to track households and individuals in Kagera over a 10-year period. Thus, for the children aged 6-60 months in 1994, we are able to source individual, household, school and community level data in 2004. In 2004, the children are aged between nine and 15 years. There has been a decrease in the sample size since 1994; it has reduced from 538 to 450 children (approximately 16.4%). This is quite small compared to attrition in some other surveys. The Michigan Panel Study on Income Dynamics experienced a sample loss of approximately 50% from cumulative attrition between 1968 and 1989 (Fitzgerald *et al*, 1998). Despite this large loss of respondents, the authors found no strong evidence that the representativeness of the survey was distorted through 1989. Bolivian Pre-School Program Evaluation Household Survey data collected in 1995 and 1998 has an attrition rate of 35% between rounds (Alderman *et al*, 2001). The Kenyan Ideational Change Survey was administered in 1994/1995 to a sample of ever-married women and their husbands. A follow-up survey was conducted in 1996/1997. The attrition rates between the two surveys were found to be 33% for men, 28% for women, and 41% for couples (*ibid*). Investigating the impact that attrition can have on analyses that use longitudinal data, Alderman *et al* (2001) find that for the Bolivian and Kenyan longitudinal surveys, the means for several important outcome and family background variables differed significantly between those who were lost to follow-up and those who were re-interviewed. In addition, a number of family background variables were significant predictors of attrition, for example, poverty. However, for many estimates the coefficients on standard variables in equations remained unaffected by attrition. They conclude, like Fitzgerald *et al* (1981) that for their samples high attrition rates are not always a problem for obtaining consistent estimates.

This loss of sample size in the KHDS between 1994 and 2004 is a likely result of attrition resulting from death of survey respondents, refusal to participate in the current round or out migration that did not make it possible to track these children or the households they belong to. The exact details of all sources of the attrition could not be found for all children. However, the tracking file for the KHDS1 survey respondents shows records indicating that of the 88 children between the ages of nine and 15 years that were lost between 1994 and 2004, three children did not have adequate information to be tracked. Another two children who were believed to be living in Kagera were not found. It is likely that the remaining children died between rounds, were untraceable because of out-migration or refused to participate in further rounds. Further, we recognise that poor childhood nutrition is correlated with poor child, adolescent and adult health outcomes and in situations of extreme poverty, poor child health and nutrition may be correlated with mortality (Caulfield *et al*, 2004; Black *et al*, 2004). However, since the attrition between the 1994 and 2004 rounds of the KHDS is much smaller than other longitudinal surveys, this bias is not of very great concern (World Bank, 2004).

Approximately half of our sample of 450 children is aged between nine and 15 years is boys (50.44%) and the remaining is girls (49.56%). The next section will present summary statistics of the individual, household and school characteristics of the children in the sample.

7.1 Summary Statistics

The official age for starting primary school in Tanzania is seven years. However, there is plenty of evidence to suggest delayed enrolment of children (not only in

Tanzania but also in other developing countries). For example, Burke and Beegle (2004) find that the parents of majority of children in Tanzania between the ages of seven and nine years felt that their children were too young to go to school. A social sector review of Tanzania by the World Bank (1999) also found evidence of delayed enrolment – over 60% of parents of children aged between 10 and 12 years felt that their children were too young to go to school. Guided by this evidence, we restrict the sample to children aged between 10 and 15 years. There was only one nine-year-old child in the sample, so dropping her reduces the sample size to 449. The average age of the children in our sample is approximately 12 years and majority of the sample is male (see Table 7.1). Majority of the children in the sample belong to the Haya tribe and the most commonly practised religion is Catholicism.

Table 7.1: Summary statistics, children aged between 10 and 15 years, 2004

Variable	Obs	Mean	Std dev	Min	Max
Child characteristics					
Age of the child	413	12.896	1.686	10	15
Child is male	413	0.513	0.500	0	1
Child has been ill in the last 4 weeks	413	0.334	0.472	0	1
Child has a longterm illness	413	0.109	0.312	0	1
Child was stunded in R1	413	0.433	0.496	0	1
Child is thin for her age	413	0.107	0.309	0	1
Child belongs to the Haya tribe	413	0.584	0.494	0	1
Child belongs to the Nyambo tribe	413	0.157	0.365	0	1
Child belongs to the Hangaza tribe	413	0.143	0.350	0	1
Child belongs to Mshubi tribe	413	0.036	0.187	0	1
Child belong to Kishubi tribe	413	0.005	0.070	0	1
Child belongs to another tribe	413	0.068	0.252	0	1
Child is Muslim	413	0.138	0.345	0	1
Child is Catholic	413	0.574	0.495	0	1
Child is Protestant	413	0.179	0.384	0	1
Child belongs to another Christian faith	413	0.094	0.293	0	1
Child belongs to traditional religious group	413	0.002	0.049	0	1
Child belongs to another religious group	413	0.012	0.109	0	1
Household characteristics					
Education of the father (years)	413	2.72	3.72	0	18
Education of the mother (years)	413	1.86	3.15	0	12
Number of boys in the HH	413	1.66	1.30	0	6
Number of girls in the HH	413	1.64	1.29	0	7
Log of total annual HH expenditure	413	13.75	0.61	11.96	15.624
Log of per capita total annual expenditure	413	11.88	0.59	10.03	13.692

Share of schooling in annual HH expenditure	413	3.83	5.67	0	61.125
Child's schooling-related characteristics					
Child has been enrolled in school at some point in her life	413	0.947	0.225	0	1
Child is currently enrolled in school	413	0.893	0.309	0	1
Current grade the child is in	413	3.097	1.847	0	9
Child can read a newspaper	413	0.777	0.417	0	1
Child can write a letter	413	0.755	0.430	0	1
Distance of school from home	413	2.561	12.648	0	250
Time spent at school in one week (hours)	413	23.787	14.880	0	66
Child is enrolled in a public school	413	0.879	0.327	0	1
Child is enrolled in a private school	413	0.027	0.161	0	1
Characteristics of the school					
Availability of a primary school in the community	413	1	0	1	1
Number of primary schools in the community	413	1.407	0.630	0	3
Teacher-student ratio	413	0.019	0.006	0.008	0.0344
Swahili Textbook-student ratio	413	0.260	0.177	0.051	1.0531
Math textbook-student ratio	413	0.239	0.204	0.002	1.4879

Note: The sample size has reduced from to 413 after dropping missing observations and outliers
Source: KHDS (2004)

On an average, a third of the children in the sample have been ill in the week before the survey and a very small proportion of them suffer from a long-term illness. The proportion of children who were stunted in Round 1 is quite high (about 43%); however, a much smaller proportion of children are currently undernourished ie thin (low BMI) for their age.

The number of years of schooling completed by the parents in our sample is fairly low. On an average, fathers have completed approximately three years of schooling and mothers two years. The range, however, shows that some fathers have completed or incomplete tertiary levels of education, while mothers only secondary. Household sizes are fairly large and on an average there may be two male and two female children in each household, though these numbers may be as high as six and seven.

Almost all children have been enrolled in school at some point in their lives and almost 90% were enrolled in school in 2004 at the time of the survey. Over three-fourths of the children in the sample can read the newspaper and write a letter in

Swahili. On an average, children are in Grade 3. This would suggest that there is indeed some delay in enrolment of children into primary school as discussed at the beginning of this section. As the official age of entry into primary school in Tanzania is seven, we would have expected 12-year-old children to be in Grade 5 or 6 in 2004.

Approximately 80% of children are enrolled in a public school. Enrolment in private school is low in comparison, likely due to lack of access to private school facilities in rural areas. There is at least one primary school in each community and on an average, children spend 24 minutes traveling to school. We were able to compute some ratios that may indicate school quality. In the schools that were surveyed, teacher-student ratios range from approximately 1 teacher for 125 children to 1 teacher for 10 children, with a mean teacher-student ratio of 1:50. The Swahili textbook-student ratios range from approximately 1 Swahili textbook for 20 children to 1 textbook for 1 child, with a mean Swahili textbook-student ratio of 1:4. The math textbook-student ratios range from approximately 1 math textbook for 30 children to 1 textbook for 2 children, with a mean math textbook-student ratio of 1:4.

The next section will investigate the magnitudes and exact directions of the impacts socio-economic and school related factors have on school attendance and achievements of children in Kagera.

7.2 Impact of Undernutrition on Schooling Achievements

7.2.1 School Attendance

One of the few studies in Economics that evaluate the factors that affect children's school attendance in developing countries is one by Burke and Beegle (2004). The authors investigate why children in north western Tanzania are not attending school. Their analytical framework is based on a household's demand for schooling and the supply of the same. However, the study overlooks the relationship between children's health and their school attendance when they look at reasons for poor school attendance. Given that the KHDS collects information for the same group of individual for two points in time, it allows us to adapt and modify this framework postulated by the authors and to examine the impact that poor health and nutritional status of children can have on their school attendance.

The attendance of each child ($Attend^i$) captures the number of hours that they have spent in school in the week prior to the survey. A household's decision to enrol children in school is one that is made at the beginning of the year. This decision may depend on whether the household has physical and economic access to the school, parents' assessment of the child's ability to do well at school as well as the opportunity costs of schooling (Burke and Beegle, 2004; Lloyd and Hewett, 2009). The decision to attend school, once enrolled, is one that is made throughout the year. Children may not attend school or attend school irregularly due to multiple reasons, the most common is being unwell (Weitzman, 1986; Neuzil *et al* 2002). The link between poor health and nutrition has already been well established (Section 2.2) and thus, this reason for not attending school is not surprising. However, this is something that should be interpreted with caution as households may cite illness as the reason for non-attendance compared to other reasons as it is a more "acceptable" one. At the same time, it would be also be simplistic to assume that children do not attend school solely as a result of being undernourished or unwell. Some other reasons for not attending school at all or irregularly include being required at home to take care of younger siblings, older or sick family members; being engaged in paid or unpaid work activities within or outside the household; as an ex-post coping mechanism, etc, (Krutikova, 2009; Bhalotra, 2007). For these reasons, we choose to focus on children's school attendance rather than enrolment, believing that school attendance is also driven by the same factors as enrolment and can act as a fairly good proxy (Burke and Beegle, 2004). Children's school attendance will depend on a number of characteristics at the child, household, school and community level.

$$Attend_i = f(C_i, HH_i, School_i, Comm_i) \qquad (1)$$

where C_i is a set of child characteristics, HH_i is a set of household characteristics, $School_i$ is a set of characteristics of the school that the child attends and $Comm_i$, is a set of characteristics of the community that the child lives in.

C_i is a set of child characteristics that comprises the child's age (Age_i) and gender (Sex_i). In addition, it captures health and nutritional status of the child (Ω_i). Therefore:

$$C_i = g(Age_i, Sex_i, \Omega_i) \qquad (2)$$

Ω_i captures information about the child's stock of health and nutrition as follows:

$$\Omega_i = h(N^i_{1994}, N^i_{2004}, \pi_i, \varpi_i) \qquad (3)$$

Here, N^i_{1994} is the child's nutritional (stunting) status in 1994, N^i_{2004} is the child's current nutritional (thinness) status ie in 2004, π_i captures whether the child has been ill in the recent past and ϖ_i captures whether the child has a long-term health problem. It is well known that stunting that occurs in early childhood is irreversible and its effects are persistent though adolescence and adulthood. These effects may range from poor health to mortality and include poor cognitive development, educational outcomes and even a lower income earning potential of individuals (Jukes, 2005; Pollitt, 1990; Appleton *et al*, 1996). Owing to this, we use individual level anthropometric data from the 1994 round of the KHDS to control for the early childhood nutritional status of children. However, while this indicator of early childhood undernutrition is able to capture an individual's long-term nutritional status, it is not able to account for hunger that children may be presently experiencing. To be able to capture hunger or at least proxy for it, we include information on the child's current nutritional status as measured by the BMI-for-age Z-score, which captures whether a child's calorie intake is adequate for her requirements ie whether she is thin for her age or not.

Individuals who are afflicted by short- and long-term health problems are likely to have weakened immune systems. They are also more susceptible to other frequent bouts of illness. Children are particularly vulnerable owing to their still developing immune systems. In such a scenario, these individuals require atypical amounts of energy to combat the disease. If the energy input does not match the energy requirement, it can have adverse effects on their nutritional status (Svedberg, 2000). Thus, we use individual level information on recent (π_i) and chronic (ϖ_i) health problems of individuals which include conditions such as heart diseases, respiratory disorders, HIV/Aids status, etc. that is available. We are aware that the health stock of the child can affect school attendance in two ways. The first is a direct one where children are too ill to go to school. The second is less straightforward. Children who are stunted in early childhood are likely to have persistently poor health and nutritional statuses later on in life, which may prevent regular school attendance owing to recurrent illnesses; implying some degree of reverse causality between the two.

HH_i is a set of household characteristics that may affect children's school attendance

$$HH_i = k(Cons_H, \eta_H, B_{H,} G_H, \xi_M, \delta_H) \qquad (4)$$

Where $Cons_H$ denotes annual household consumption expenditure. η_H, G_H and B_H denote the size and composition of the household. The household roster of the KHDS is able to give us information about the size of the household as well as about composition. From this information on household composition, we are able to pull out data on the number of girls and boys between the ages of five and 17 years that children in our sample live with. Literature suggests that there is a positive relationship between the education of parents and that of their children (Leibowitz, 1977; Stafford and Hill, 1974). We have already established that there is a positive relationship between mother's education and children's nutrition in our previous analysis (Chapter 6). Thus, it would follow that better educated parents are indeed better able to provide better care for their children as well as have adequate economic and social resources as well as knowledge to be able to ensure better health, educational and labour outcomes for children. ξ_M captures the education of the mother (in years). We exclude father's education from the model as father's education is positively correlated with that of the mother's (see Appendix 3 for correlation matrices). The KHDS collects data on the highest level/grade of education completed by mothers and fathers and we use this to indicate mother's education. δ_H denotes the ethnicity of the child, in this case, the ethnic group that the child belongs to, for which the KHDS collects data. This variable is used to capture underlying societal structures and social and/or economic exclusion of particular groups (Boo, 2009).

$School_i$ comprises information about the access to school as well as school quality as these would affect a household's demand for schooling:

$$School_i = j(\mathrm{P}_i, \Psi_i, \kappa_i,) \qquad (5)$$

We distinguish between the types of school that the child attends (P_i) ie whether it is a public or private school as it is believed that private schools are of better quality than public schools (Glewwe, 2002). The school component of the KHDS collects data on the type of school that children go to and this is used to capture the ownership of the school as well as to proxy for the quality of the schools that children go to. However, we do not distinguish between private religious and non-religious schools, even though this information is available as there are a very small number of private schools in the survey – only 8 out of 53. Ψ_i denotes the distance the child has to travel to school and can help us gauge whether households have physical access to schools and how easy it is to access these schools. If schools are too far away from households or if the transports costs incurred in sending children to school are too high, parents may be deterred from sending children to school frequently, especially in very poor households. κ_i is a set of factors that denote school quality and are indicated by the teacher-student ratio, Swahili-student textbook ratio and Math-student textbook ratio. Other indicators of school quality that can be used are teacher's qualifications and length of work experience, funding and sources of the same available to the school, etc. However, the school component of the KHDS does not collect this information and as such, our indicators of school quality are limited to the type of ownership of schools and the teacher-student and textbook-student ratios.

Comm$_i$ captures where there are any primary schools close by that children may be enrolled in.

The final empirical model will take the form:

$$Attend_i = F(Age_i, Sex_i, N^i_{1994}, N^i_{2004}, \pi_i, \varpi_i, Cons_{H,}\eta_H, G_H, B_{H,}\delta_H, \xi_M, P_i, \Psi_i, \kappa_i, Comm_i) \qquad (6)$$

Results and Discussion

Using KHDS data for 1994 and 2004, we examine whether children's past nutritional status is associated with their school attendance in 2004, while controlling for their socio-economic and school characteristics. We use an OLS model to estimate equation (6) to gauge how being undernourished in early childhood and current socio economic circumstances can affect the time that children spend in school every week. We will look at one indicator of school attendance: the number of hours that the child spent in school in the week before the survey. The dependent variable is thus continuous and ranges from 0 – 66 hours.

The explanatory variables in the estimation will be those represented in the right hand side of Equation (6) above. As before (see estimation strategy used in Chapter 6), we do not include the urban/rural location of households as the KHDS is primarily a rural survey. In our analysis, we include specifications with fixed effects for the different households and communities that children live in and the different schools that they attend. We do this by creating dummy variables for each household (community, school) and include these dummies in the regression. The coefficients for the dummy variables for households, communities and schools are not reported here. By doing this, we are able to control for unobserved heterogeneity when this heterogeneity is constant over time and correlated with the independent variables that may cause an omitted variable bias. This will help us control for variables that may be linked to the political influence of certain village leaders that enable these villages to have better infrastructure, etc. at the community level; school-related factors such as some schools having better qualified teachers than others, more sources of funding than others, etc. at the school level; and unobserved heterogeneity at the household level, for example beliefs of households of the returns to education of their children or the different utilities that they derive in investing in different children.

Earlier, we mentioned that we exclude father's education from our models as this is positively correlated with mother's education. A few of the other explanatory variables in our models are likely to be correlated with each other, for example, children's nutritional status and health; and household size and composition. Correlation matrices for these are presented in Appendix 3.

Table 7.2 presents the estimates from the regression analysis that investigates the impact that children's early childhood nutrition can have on their school attendance, without instrumentation. In column (1) we present the OLS estimates with household fixed effects. In columns (2) and (3), we present estimates with community and school fixed effects, respectively. These estimates have robust standard errors.

The inclusion of the household fixed effects in Column (1) helps us overcome any omitted variable bias that is caused by unobserved variables, for example, the value that parents place on sending children to school or any aspirations that parents may have for their children that affect the decision to send them to school. Using the fixed effects at the household level would then require us to drop the variables that control for socio-economic characteristics of the household; in this case – mother's education, household expenditure, household size and composition. However, we are concerned that when we exclude these variables from our estimation, the omitted variable bias could creep in. The disadvantage of including these variables is that they present the problem of multicollinearity as some of the household characteristics will undoubtedly be correlated with the household dummy variable. This is (arguably) a less severe error than the omitted variable bias. Hence, we do not exclude the household characteristics or the household fixed effects as this is a lesser evil. We are aware that as a result of the multicollinearity, the estimates in Column (1) are less precise than they would be if there was no multicollinearlity.

Table 7.2: Factors that affect children's school attendance in Kagera, 2004

Dependent variable is time child has spent in school in the week before the survey	(1) Household fixed effects	(2) Community fixed effects	(3) School fixed effects
Child is male	0.957*	2.974**	2.241**
	(1.245)	(1.407)	(1.102)
Child's age (years)	0.832	0.050	0.176
	(0.850)	(0.360)	(0.470)
Child was stunted in 1994	-1.940**	-0.766**	-0.049**
	(1.869)	(0.846)	(1.170)
Child has low BMI for her age in 2004	-2.517	-0.538	-0.421
	(1.130)	(1.880)	(0.295)
Child has been ill in the past 4 weeks	-1.722**	-1.826**	-1.426***
	(1.708)	(1.125)	(0.227)
Child has a longterm illness	-4.882	-8.271***	-5.094***
	(1.005)	(2.061)	(0.150)
Log of annual total HH expenditure	1.381*	1.038*	1.366*
	(1.439)	(2.550)	(1.052)
Mother's education (years)	-0.170	-0.135	-0.226
	(0.540)	(0.157)	(0.347)
Size of the HH	-5.525	0.385	0.461***
	(1.864)	(0.581)	(0.112)
No of girls in the HH	1.880	-0.034	0.165
	(2.864)	(1.449)	(0.332)
No of boys in the HH	0.821	-0.266	-0.574
	(2.408)	(0.797)	(0.853)
Head of the HH is Catholic	1.945	4.391***	2.647**
	(1.677)	(0.850)	(1.831)
Head of the HH is of another religion	-1.866	0.876	-1.188
(non-Christian and non-Muslim)	(0.507)	(0.687)	(0.903)

Head of the HH is Haya	4.151	5.243**	1.735*
	(2.518)	(2.328)	(0.889)
Head of the HH is from another tribe	0.785*	0.434	2.188
	(2.440)	(1.912)	(1.892)
Child goes to a private school	-0.516	2.448	
	(1.852)	(4.586)	
Distance from school (km)	0.047	0.064***	
	(0.521)	(0.021)	
Teacher-student ratio	1.973	1.084**	
	(0.649)	(2.684)	
Swahili textbook-student ratio	1.996	3.815	
	(2.817)	(1.983)	
Math textbook-student ratio	3.473	4.899*	
	(0.521)	(3.403)	
No of obs	413	413	413
R-squared	0.7315	0.7188	0.7267

Note: *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level

The coefficients that are presented in Table 7.2 indicate that stunting in early childhood is negatively associated with school attendance in the current period and this effect was found to be significant in all our specifications. The prevalence or patterns of stunting in a community are likely to be similar over households and over time, given that these households in a community share the same potential resources that determine the long term nutritional status of children. This may also be true at the school level as the stunted stature of the child may signal to parents that the child is not "old enough" for school or has poor health due to which she has not attended school. Present undernutrition, which we also use to capture whether children are hungry or not, though negatively associated with school attendance is not significant in either specification.

Illness in the recent past is associated with a reduction in time spent at school in the week prior to the survey. Children who had been ill in the four weeks before the survey were likely to have attended school for approximately one and a half hours less than others in the week before the survey, on average. Given that the burden of disease in Tanzania is largely attributable to communicable diseases such as malaria, tuberculosis and HIV/Aids (MOH, 2003), it plausible that children who live in rural areas are more likely to fall prey to such diseases owing to poor and health facilities. And owing to the fairly long recovery periods for malaria, tuberculosis and even influenza could be fairly long, causing children to miss school. In addition, having a long-term or chronic health problem is also associated with a decrease in the number of hours the child spends in school every week by between 6-7 hours per week. Conditions such as respirators disorders and having a positive HIV status that results in frequent illnesses would also mean that children would miss school frequently. This result is fairly intuitive - children who have chronic health problems such as respiratory disorders, HIV positive status, congenital heart defects, etc. are likely to fall ill frequently, have compromised nutritional outcomes and as a result, attend school less regularly than others. These patterns of illness are also more likely to be seen in our sample owing to the sampling design of the KHDS (Chapter 4 and Appendix 1).

The gender of the child does have an impact on time that she spends in school every week. Being male is positively related to school attendance and boys can spend between 2.9 to 3.2 more hours every week in school than girls. This result is consistent across all specifications but has stronger statistical significance in the community and school fixed effects models. This result is characteristic of many developing countries (Deolalikar, 1993; Connelly and Zheng, 2003) and is likely for two reasons: one, native ethnic groups in Kagera are patriarchal and this creates a gender gap that is seen in children's school attendance. The second reason, which is not entirely unrelated to the first is that parents may choose to send their male children to school than female children as they expect that the returns to boys' education would be higher. The child's age was not found to have a significant impact on children's school attendance.

Living in a household that is wealthy is positively associated with school attendance. This result is also an intuitive one. Richer households can afford to contribute more towards children's schooling costs. In the event that they experience a shock, they are more able to cope with its effects and may not resort to pulling children out of school as a coping mechanism. Richer households are also believed to have better access to health facilities and information that is likely to facilitate better and timely use of these facilities in addition to improved means of care if children are to fall ill.

Children who live in larger households appear to be more likely to spend more time in school per week but this association is not a very clear one as the sign on the coefficient changes between the specifications. The significant result is only seen in the specification with the school fixed effects. This result is contrary to what literature suggests - that large households tend to be poorer than smaller ones and thus, larger households maybe be less able to contribute towards schooling expenditure and more likely to make a non-attendance decision over the school year. In our sample, we find that household size and consumption expenditure are positively correlated, implying that larger households are actually richer, though the correlation coefficient is not very large (0.32). Perhaps part of this is a reflection of the fact that consumption expenditure is not a very sensitive measure of poverty. Second, it is likely that in large households, parents may have to choose which of their children they will send to school based on their preference for the child or the perceived intelligence and abilities their children. Our result could also be a reflection of this effect, which we tried to explore by looking into the number of girls and boys that there are in the household. However, these variables were not found to have a significant impact on the time that a child spent in school per week.

Children who live in households where the head of the household is Catholic are more likely to spend more time in school. We see a similar positive and significant relationship between school attendance of the child and the head of the household being Haya. From Weiss's ethnography of the Haya (Weiss, 1996), we have understood that the Haya are the majority group in Kagera and are better off than other groups. Owing to this, it is possible that the Haya have more physical and economic access to schools. It is also likely that in accordance with government policy children from the minority groups (that are not the majority ethnic groups in the region) are benefiting from the quota system introduced in the post-independence period. The aim of this system was to equalise access and educational attainment (Weber, 2010).

So far, we have looked at children's characteristics and the socio-economic circumstances that they are growing up in. Next we look at different aspects related to primary schools in the communities in which children live. From the school data available, we see that there is at least one primary school. However, the presence of a primary school in the vicinity is not all that is relevant for a household to decide whether to send children to school. If schools are too far away, this may negatively impact children's attendance for two reasons: one, schools that are far away from villages mean higher transport costs; and two, in rural areas, there are significant risks to travelling long distances, especially for girls (Connelly and Zheng, 2003; Tafere and Camfield, 2009). However, the coefficient on the distance to school on the probability that the child will regularly attend school is a confusing one. Though very small in magnitude, it is highly significant at the community level and suggests that the further away the school, the more likely children are to spend in school every week!

Next, we look at some school quality characteristics that may have an impact on a household's demand for schooling. The first of these is whether the child attends a private school and the estimates in Table 7.3 indicate that going to a private school is not associated with school attendance. This result may be attributed to the fact that of the 52 schools that the children in the KHDS reported to attend, only eight are private schools, so a very large number of households may not have physical access to private schools, which are generally perceived to be of better quality than public schools (Glewwe, 2002). Even if households do have private schools in the community, they may not be able to send their children to these schools as the costs associated with private schools are fairly high. We also see the coefficients for the other indicators of school quality ie teacher-student and textbook-student ratios are positive and significant. Schools that have high quality indicators may appear attractive to parents leading to higher school attendance.

A potential source of endogeneity is the childhood nutritional status, which could generate a correlation between nutritional status and the error component, arising from unobservable household preferences which influence both schooling and health investments. Households with a higher propensity for investments in children may feed them better as well as enrol them in school (Alderman *et al*, 2009). Further parents may invest in their children different because they feel that some children are more intelligent or more competent than others, which is not something that the data will be able to show us. If children who show are "valued more" are also better fed by parents, as suggested by Glewwe and Jacoby (1995), the effect of nutrition would be overestimated. To overcome this problem the height of the mother was used to instrument early childhood nutritional status as also done by Sanchez (2009) and Le Thuc (2009). Maternal height may be used as an instrumental variable based on the assumption that it does not affect directly affect school attendance but can have an effect on early childhood stunting, even before children are born. Medical evidence suggests that a possible channel of transmission between maternal height and child growth is owing to the manner in which maternal height affects the placental weight, which, in turn imposes a restriction on child size. In addition, evidence from twin studies suggests a causal link between birth weight and child growth (Falkner, Holzgreve and Schloo, 1994; Falkner and Matheny, 1995). Further, Thomas *et al* (1991) suggest that parental height has a large positive impact on child height after controlling for all other observable characteristics. Hernandez-Dias *et al* (1999) also find evidence to support the relationship between maternal height and early childhood stunting- controlling for potential environmental confounders, mothers with short stature were significantly more likely to have stunted children. Thus, maternal height is likely to have a causal effect on child's height-for-age. However, using just one instrument for the endogenous nutrition variable will only just identify the model. We also use reported weather related shocks such as the experience of a drought or household reported crop loss. These shocks are likely to affect children's nutrition as households' coping strategies could alter the resource allocation (Hoddinott and Kinsey, 2001). Similar instruments have also been used by Alderman *et al* (2009) and Alderman *et al* (2006) to instrument for the endogeneity of childhood nutrition.

We run a two-stage least squares regression using mother's height, reported drought or flood and crop loss as instruments for early childhood stunting. Generally, the rule of thumb is that the F-test statistic for joint significance of the instruments in the first-stage should exceed 10 (Staiger and Stock, 1997). The results of the first stage regression had an F-test statistic value of 12.37 and we conclude that the instruments are valid. After the second stage regression, we tested for the exogeneity of early childhood nutrition and rejected the null hypothesis of exogeneity of early childhood nutrition at the 1% level. We also test for overidentifying restrictions and the null hypothesis that the instruments are valid cannot be rejected as the p-value is larger than 0.10 (p=0.36)

Table 7.3 below presents the IV results of the estimation of equation (6) with mother's height, crop loss and drought used as instruments for childhood undernutrition. We find that for these new IV estimates, the male gender of the child continues to be positively associated with higher school attendance but these estimates are smaller in magnitude than seen in the OLS estimates. Past undernutrition is negatively associated with school attendance but the magnitude of the impact is higher than that seen in Table 7.2 suggesting that those estimates underestimated the effect of past nutrition of children on school attendance. Hunger is negatively associated with school attendance and this is quite a large effect. This finding has some relevance for policy and suggests if children are continued to be provided with adequate nutrition that is in congruence with their energy needs as they grow older, it could alleviate hunger and improve short-term nutrition of children. The implementation of school feeding programmes could thus improve school attendance not only because children will be healthy enough to attend school regularly but it also acts as an incentive for parents to ensure that their children will attend school. This may benefit poorer households, especially those who are prone to seasonal, economic and environmental shocks that interrupt their patterns of food consumption.

Table 7.3: Factors that affect children's school attendance in Kagera, 2004, with instrumentation

Dependent variable is time child has spent in school in the week before the survey	(1) Household fixed effects	(2) Community fixed effects	(3) School fixed effects
Child is male	1.642	2.047**	2.369***
	(0.108)	(0.601)	(0.287)
Child's age (years)	0.032	0.549	0.689*
	(0.473)	(0.616)	(0.341)
Child was stunted in 1994	-1.021*	-1.729**	-1.993**
	(0.886)	(0.974)	(1.161)
Child has low BMI for her age in 2004	-2.905	2.519	-2.854***
	(1.114)	(0.643)	(0.438)
Child has been ill in the past 4 weeks	-2.161**	-0.904**	-1.693**
	(0.683)	(0.406)	(0.702)
Child has a longterm illness	-4.438*	-4.992***	-6.217***
	(1.681)	(2.591)	(1.462)
Log of annual total HH expenditure	4.598	2.622	1.253
	(1.506)	(1.483)	(1.736)
Mother's education (years)	0.553	-0.200	-0.085
	(0.682)	(0.134)	(0.107)
Size of the HH	-1.137	0.885	0.643
	(0.832)	(0.653)	(0.389)
No of girls in the HH	-0.769	-0.451	-0.572***
	(0.429)	(0.606)	(0.083)

No of boys in the HH	-0.850	-1.093	-0.740***
	(0.615)	(0.458)	(0.414)
Head of the HH is Catholic	4.296	3.944**	3.483***
	(1.112)	(1.903)	(0.158)
Head of the HH is of another religion	-2.928	-1.837	-2.029
(non-Christian and non-Muslim)	(1.091)	(1.429)	(1.044)
Head of the HH is Haya	3.832	3.196*	2.911***
	(1.624)	(1.362)	(0.420)
Head of the HH is from another tribe	0.873	0.595	1.209
	(0.138)	(0.094)	(0.116)
Child goes to a private school	6.048	5.638***	
	(2.465)	(2.092)	
Distance from school (km)	-0.029	0.047**	0.103
	(0.499)	(0.120)	(0.081)
Teacher-student ratio		1.447**	
		(0.845)	
Swahili textbook-student ratio	3.936	3.771***	
	(1.431)	(1.352)	
Math textbook-student ratio	2.497	2.713***	
	(0.628)	(1.906)	
No of obs	379	379	379
R-squared	0.745	0.728	0.786

Note: *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level

The IV estimates show the negative association between illness (recent and long-term) and school attendance as seen in the OLS specifications though the IV estimates show a slightly larger effect for the illness variables. Household wealth, however, is no longer significantly related to school attendance; nor is the size of the household. However, we see that the IV estimates suggest that a higher number of girls and boys in the house are related to a decrease in school attendance. Further, there is a change in the size of the effect of the head of the household being Catholic and the head of the household being Haya; these are smaller than those seen in Table 7.2. Finally, we turn to the school quality related variables. The IV estimates for these variables continue to be positive and significant but with some change in magnitude. Further, they are significant in fewer of the fixed effect specifications, suggesting that they were previously overestimated.

These IV estimates still suffer from some amount of bias because of the reverse causality between children's illness and past and current nutrition outcomes but less so than the OLS estimates seen in Table 7.2. There is a case for dropping these variables from our analysis. We are reluctant to do so, however, because of bulk of the evidence that links illness to school absenteeism (discussed in Section 2.3.2). Further, they are jointly significant with the other explanatory variables. Proxying or instrumenting for these variables is also problematic as the instruments would also be correlated with the nutrition outcomes and school attendance children. Generally, in our IV estimates, the directions of the significant associations remain unchanged though in some cases the magnitudes or strength of the associations can change.

Next we look at whether children's schooling achievement is related to early childhood undernutrition.

7.2.2 Grade Achievement

The model

A study very similar to ours has been conducted by Alderman *et al* (2009) who use the KHDS to investigate the impact of early childhood undernutrition on the delay in school enrolment and grade achievement (please see Section 2.3.2). As this study is attempting to do things that are similar to theirs, we will refer to their methodology and contrast this with ours where appropriate.

A first point of difference is that the range of ages of children in the Alderman *et al* (2009) sample is not the same as ours. The authors investigate outcomes of children who were aged under 10 years in 1994 while the children in our sample were aged under five years in 1994. As a result of this, we are only able to investigate the factors that are associated with the number of years of schooling children had been able to complete until 2004 (henceforth referred to as current grade completion). We are aware that different factors may be associated with their "final" grade completion. Additionally, the authors do not take into account hunger in the classroom that may inhibit learning processes and prove to be an impediment to successful grade achievement.

The number of grades completed by each child ($Grade_i$) captures the highest grade completed at the time of the survey. Like school attendance, children's grade achievement is determined by a set of socio-economic factors that act at the level of the child, household and school:

$$Grade_i = f(C_i, HH_i, School_i) \tag{7}$$

Where C_i is a set of child characteristics, HH_i is a set of household characteristics, $School_i$ is a set of characteristics of the school that the child attends. C_i is a set of child characteristics that comprises the child's age (Age_i) and gender (Sex_i). In addition, it captures health and nutritional status of the child (Ω_i).

$$C_i = g(Age_i, Sex_i, \Omega_i) \tag{8}$$

Ω_i captures information about the child's current and past nutritional status , recent illness of the child as well as any long-term health problems the child may have as follows:

$$\Omega_i = h(N_{1994}^i, N_{2004}^i, \pi_i, \varpi_i) \tag{9}$$

where, N_{1994}^i is the child's nutritional (stunting) status in 1994, N_{2004}^i is the child's current nutritional (thinness) status ie in 2004, π_i captures whether the child has been ill in the recent past and ϖ_i captures whether the child has a long-term health problem. These indicators of children's nutrition will capture the child's nutritional status in early childhood and in the current period i.e. in 1994 and 2004, respectively, both of which will affect the child's cognitive development and labour market-related outcomes as discussed in the previous model. The short- and long-term indicators of health capture information about health stock that could grade achievement via the pathway of poor cognitive development.

HH_i is a set of household characteristics that will affect children's grade achievement. This set comprises of factors as set out below:

$$HH_i = k(Cons_H, \eta_H, B_{H,} G_H, \xi_M, \delta_H) \tag{10}$$

where household consumption is denoted by $Cons_H$ and captures the wealth of households. As seen in the previous section, maternal education is denoted by ξ_M that will capture information on years of schooling completed by the mother and also to some extent, time and effort that parents may be able to put in to help children with school work. Ethnicity of the child may be able to indicate underlying societal structures and social and/or economic exclusion of particular groups and is denoted by δ_H.

$School_i$ consists of a set of variables that capture the type of (ownership of) school children attend (P_i) and school quality(κ_i):

$$School_i = f(\mathrm{P}_i, \kappa_i) \tag{11}$$

A limitation of the KHDS is that it does not collect information on home environments or an individual's subjective well-being. As such, we are unable to account for factors such as whether children's home environment is conducive to study or their aspiration, sense of efficacy or self-agency that may affect their grade achievement (Batura and Dercon, 2012). We are also unable to account for other factors that may influence grade achievement such as diligence regarding school work.

The final estimable equation will take the form:

$$Grade_i = v(Age_i, Sex_i, N^i_{1994}, N^i_{2004}, \pi_i, \varpi_i Cons_H, \xi_M, \delta_{H,} P_i, \kappa_i) \tag{12}$$

Results and Discussion

This part of our analysis looks into the effect that a child's past nutritional status can have on the number of years that she had finished at the time of the survey in 2004. The dependent variable is a continuous one and captures the number of grades that the child had completed at the time of the survey. The explanatory variables are those presented in the right hand side of Equation (12) and we use an OLS model to estimate this equation.

As before we do not include the urban/rural location of households as the KHDS is primarily a rural survey. In our analysis, we include specifications with fixed effects for the different households and communities that children live in and the different schools that they attend. We do this by creating dummy variables for each household (community, school) and include these dummies in the regression but do not report them. By doing this, we are able to control for unobserved heterogeneity when this heterogeneity is constant over time and correlated with the independent variables that may cause an omitted variable bias. For example, we mentioned that we do not have data on factors such as whether children's home environment is conducive to study or their aspiration, sense of efficacy or self-agency that may affect their grade achievement. Using household fixed effects may be able to account for some of these types of unobserved characteristics of households, communities and schools. Alderman *et al* (2009) too use community fixed effects in their model but do not model household and school fixed effects, and as such, do not account for some of these variables at the household and school levels.

Table 7.4 presents the estimates from the regression analysis that investigates the impact that children's early childhood nutrition can have on their school attendance, without instrumentation. In column (1) we present the OLS estimates with household fixed effects. In columns (2) and (3), we present estimates with community and school fixed effects, respectively. These estimates have robust standard errors.

As in Section 7.2.1, we do not drop the household characteristics in the specification with the household fixed effects. This is to ensure that our estimates do not have an omitted variable bias. However, since these variables are undoubtedly correlated with the household dummy variables, there is some degree of multicollinearity and the estimates in Column (1) are less precise than they would be if there was no multicollinearlity. Our belief is that this is the lesser evil of the two.

Table 7.4 Factors that affect children's years of schooling in Kagera, 2004

Dependent variable is years of schooling child has completed at time of survey	**(1)** **Household fixed effects**	**(2)** **Community fixed effects**	**(3)** **School fixed effects**
Child is male	-0.282	0.038	0.133
	(0.533)	(0.170)	(0.083)
Child's age (years)	0.543***	0.567***	0.739**
	(0.190)	(0.063)	(0.082)
Child was stunted in 1994	-0.124**	-0.201**	-0.316***
	(0.556)	(0.160)	(0.084)
Child has low BMI for her age in 2004	0.041	0.049	0.055
	(0.626)	(0.290)	(0.201)
Child has been ill in the past 4 weeks	-0.334*	-0.130*	-0.102*
	(0.498)	(0.189)	(0.063)
Child has a longterm illness	-0.262***	-0.309***	-0.381***
	(1.004)	(0.327)	(0.111)
Log of annual total HH expenditure	0.690*	0.437**	0.639***
	(0.814)	(0.222)	(0.031)
Mother's education (years)	0.038	0.005	0.033**
	(0.094)	(0.023)	(0.016)
Size of the HH	-0.655	-0.034	-0.074**
	(0.504)	(0.050)	(0.044)

No of girls in the HH	-1.078	-0.177*	-0.207***
	(0.780)	(0.102)	(0.054)
No of boys in the HH	-1.690	-0.022	0.113
	(0.603)	(0.091)	(0.074)
Head of the HH is Catholic	0.760	0.107	0.127
	(1.967)	(0.184)	(0.092)
Head of the HH is of another religion	1.288	1.067	1.363
(non-Christian and non-Muslim)	(0.256)	(0.541)	(0.084)
Head of the HH is Haya	3.476	0.912**	0.681***
	(2.904)	(0.414)	(0.069)
Head of the HH is from another tribe	1.355**	0.945*	0.327***
	(1.943)	(0.552)	(0.081)
Child goes to a private school	1.300	1.055	
	(1.366)	(0.922)	
Teacher-student ratio	2.787**	2.387**	
	(1.771)	(1.798)	
Swahili textbook-student ratio	1.742	0.957***	
	(1.809)	(0.386)	
Math textbook-student ratio	1.793	2.090**	
	(1.986)	(1.725)	
No of obs	413	413	413
R-squared	0.876	0.792	0.752

Note: *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level

The past nutritional status of the child is negatively associated with the number of years of schooling the child has completed until 2004. This effect though highly significant is not of very high magnitude in our three specifications. However, it is in line with evidence that also finds that poor early childhood nutritional status has a negative impact on children's cognitive ability (Grantham-Mc Gregor, 1995; Glewwe and King, 2001).

Poor nutrition in the current period stems from inadequate quantity or quality of food. It is well documented in literature that this inadequate nutrition can adversely affect children's cognitive development (Yaqub, 2002). In our model, we use current nutritional status to be able to capture, to some extent, whether children are going hungry or if their current energy needs are not being met. Children's current nutritional status, however, does not appear to affect current children's grade achievement (Table 7.4). We cannot discount the fact that early childhood undernutrition is persistent in later life. Even though our variable for current nutritional status is not significant, it is still possible that the early childhood stunting variable is partly capturing this effect. These results reinforce our earlier suggestion of the implementation of school feeding programmes. As discussed in the previous section of this chapter, not only will such programmes act as incentives for regular school attendance but also decrease hunger, improve children's nutrition in the current period and help achieve better school and cognitive outcomes for children.

Our estimates in Table 7.4 also show that there is a negative relationship between children's poor health and their current grade achievement. The negative impact of recent illness i.e. being ill in the four weeks before the survey is seen in all the specifications. This is not every surprising for several reasons. Missing school frequently implies that children would fall behind at school. Our previous estimation has established a negative link between recent illnesses and regular school attendance. Thus, if children fall ill frequently, they would be missing school more often and fall behind their relatively healthier counterparts who are less prone to disease. Keep in mind also the reverse causality that we have already mentioned as well as what the KHDS data tells about the high prevalence of childhood undernutrition that poor nutrition results in poor health and vice versa. Having a chronic illness too has a negative impact on the years of schooling attained. Children, who fall ill frequently, are likely to have a poor stock of health and indeed, nutrition, which keeps them out of school frequently or for long periods and thus, the number of years of schooling completed until now/by the current period suffers.

While the gender of the child does not seem to be associated with the number of years of schooling completed by 2004, the age of the child is positively associated with it. Our estimates suggest an increase in years of schooling by almost half a year if the child is one year older. Household consumption is positively associated with the number of years of schooling that children had been able to complete by 2004, with the effect being highly significant at the school level. Recall from our estimates in Section 7.2.1 (non-IV estimates) the highly significant and positive impact that household wealth had on the time that children spend in school every week. Thus, it follows that if household wealth is instrumental in ensuring regular school attendance, then children from richer households are more likely to attend school regularly and have completed more years of schooling. This is not only because of the relationship between household wealth and school attendance. Parents from more well off households are more educated and able to provide them with adequate opportunities and inputs for higher educational attainments. This is supported by our estimates that show that mother's education is positively associated with the number of years of schooling that the children have completed thus far. More educated mothers are more likely to ensure that the home environment is conducive to children's study. However, the KHDS does not collect data on the home environment and we are unable to directly estimate the impact that the mother's education can have on children's grade achievement in a "learner context".

Belonging to the Haya and smaller ethnic groups is positively related to current grade achievement of children. In light of the positive marginal effect of belonging to the other ethnic groups had on school attendance, this result is not surprising.

Next, we look at the relationship between various indicators of school quality and the years of schooling completed by children. The coefficient for attending private school is not significant at the household or community level. However, the coefficients for the teacher-student ratio as well as the Sawhili and Math textbook ratios show that school any improvements in these ratios are associated with fairly significant increases in schooling years (approximately one year). Thus, these results as well as our results from the previous estimations of factors affecting school attendance indicate that improvements in school quality could increase attendance and achievement as parents may feel that is is indeed worthwhile to send their children to school.

In their uninstrumented model, Alderman *et al* (2009) find that better nutrition of children is positively associated with higher completed levels of schooling. Household wealth, the cumulative schooling of household members and better school quality, indicated by the number of blackboards per class, are also associated with higher completed levels of children's schooling. However, the age of the child and any shocks to income household can have a negative effect on the level of schooling. Some of our findings are similar: we find that being stunted in early childhood is associated with fewer years of schooling, as is having a long-term health problem. While we do not see any significant relationship between household wealth and schooling achievement, we do see a positive significant relationship between belonging to the Haya group and higher completed years of schooling. Recall that the Haya are the majority group in Kagera and that this variable is likely to be capturing the fact that they are economically or politically better-off than the other ethnic groups in the region. We also find a positive effect of school quality, but in our case the indicator is the Swahili textbook-student ratio, implying that schools that have more resources available to students, are likely to have students completing more grades. Contrary to Alderman *et al* (2009), our estimates show that age is positively associated with the number of completed years. Thus, the older the child is, the more grades she is likely to have completed. This is plausible as the children in our sample are still enrolled in school, assuming that they are not likely to drop out in the next few years.

Again, a potential source of endogeneity is the childhood nutritional status. Alderman *et al* (2009) use data on shocks experienced by the household, specifically drought/flood (as reported by the community) and crop loss in 2004. We also use these instruments and additionally, mother's height to instrument for early childhood nutritional status (Sanchez, 2009). The motivation for using these variables as instruments has been discussed earlier in Section 7.2.1. As with the IV approach for school attendance, we run a two-stage least squares regression using mother's height, reported drought or flood between 1994 and 2004 and crop loss in 2004 as instruments for early childhood stunting. The results of the first stage regression had an F-test statistic value of 17.11 and we conclude from this that the instruments are valid (Staiger and Stock, 1997). After the second stage regression, we ran standard post estimation tests in STATA. On testing for the exogeneity of early childhood nutrition, we rejected the null hypothesis of exogeneity of early childhood nutrition at the 1% level. Testing for overidentifying restrictions revealed a p-value larger than 0.10 (p-value= 0.226) and hence, the null hypothesis that the instruments are valid cannot be rejected.

Table 7.5 presents the IV results of the estimation of equation (12) with mother's height, crop loss and drought used as instruments for childhood undernutrition. In the IV estimates, the age of the child continues to be positively associated with a higher number of years of schooling completed until now but this effect is only significant at the household and school level. Neither recent illness not current nutritional status are significant, suggesting that hunger in the classroom is not associated with poor grade achievement. However, early childhood undernutrition and long-term illnesses are associated with completing fewer years of schooling.

Both these effects are only significant at the community and school levels and the magnitude of the coefficients is slightly larger than seen in the OLS estimates in Table 7.4.

Table 7.5: Factors that affect children's years of schooling completed in Kagera, 2004, with instrumentation

Dependent variable is years of schooling child has completed at time of survey	(1) Household fixed effects	(2) Community fixed effects	(3) School fixed effects
Child is male	-0.216	-0.284	-0.185
	(0.604)	(0.573)	(0.273)
Child's age (years)	0.533**	0.427	0.542***
	(0.311)	(0.265)	(0.083)
Child was stunted in 1994	-0.966	3.261*	1.496*
	(0.882)	(1.555)	(1.259)
Child has low BMI for her age in 2004	0.127	-0.336	-0.105
	(0.939)	(0.795)	(0.136)
Child has been ill in the past 4 weeks	0.243	-0.085	0.027
	(0.618)	(0.593)	(0.153)
Child has a longterm illness	0.016	-0.426*	-0.393***
	(1.048)	(0.395)	(0.097)
Log of annual total HH expenditure	1.115	0.748	0.868***
	(0.794)	(0.430)	(0.446)
Mother's education (years)	-0.077	0.056	0.063***
	(0.280)	(0.148)	(0.027)
Size of the HH	-0.213	-0.094	-0.105
	(0.017)	(0.172)	(0.092)
No of girls in the HH	-1.442	0.286*	-0.214**
	(0.534)	(0.343)	(0.254)
No of boys in the HH	0.271	-0.037	-0.064
	(0.489)	(0.138)	(0.257)
Head of the HH is Catholic	2.043	-0.432	0.313***
	(1.225)	(0.793)	(0.062)
Head of the HH is of another religion	-0.067	0.355	0.225
(non-Christian and non-Muslim)	(0.068)	(1.117)	(0.024)
Head of the HH is Haya	1.932	0.448	0.796***
	(0.749)	(1.032)	(0.038)
Head of the HH is from another tribe	1.120	0.186	0.437
	(1.005)	(0.972)	(0.222)
Child goes to a private school	0.867*	1.341***	
	(1.371)	(1.074)	
Teacher-student ratio	1.730*	1.193	
	(0.287)	(0.935)	
Swahili textbook-student ratio	2.273*	3.460**	
	(1.291)	(1.603)	

Math textbook-student ratio	1.214*	2.001**	
	(0.549)	(1.038)	
No of obs	388	388	388
R- Squared	0.738	0.804	0.852

Note: *** indicates significance at the 1%evel, ** at the 5% level and * at the 10% level

Household wealth, however, is no longer significantly related to the years of schooling completed current at the household or community level but is highly significant at the school level. It also has a bigger coefficient than seen in the non – IV estimates. Mother's education continues to have a positive impact on schooling attainment in 2004 but this impact is slightly larger than seen in Table 7.4. The IV estimates suggest that higher levels of education completed by the mother are significantly associated with higher schooling attainment. A higher number of girls in the household are also with a lower schooling attainment in 2004. Again, the magnitude of the effect as seen in the IV estimates is slightly bigger than that seen in Table 7.4. However, the effect is less statistically significant at the school level. Belonging to ethnic groups that are not Haya is not significant for schooling attainment as seen in the previous set of estimates. However, belonging to the majority Haya group, and being Catholic is positively related to a higher number of years of schooling children have been able to attain so far. Finally, we turn to the school quality related variables. The IV estimates for these variables continue to be positive and significant but with some change in magnitude. Further, they are significant in more of the fixed effects specifications, suggesting that they were previously underestimated.

In their instrumented model, Alderman *et al* (2009) find that poor nutrition in early childhood is negatively associated with ultimate grade achievement. They also find that household wealth, maximum years of schooling in the household and school quality are positively associated with completed years of schooling. Compared to their uninstrumented model, these significant coefficients have larger magnitudes. While shocks to household income have a positive impact on schooling, this effect is less significant in the instrumented model. Some of our results are similar to these: we find that early childhood undernutrition is associated with few years of schooling completed by 2004. Like Alderman *et al's* IV estimates, this effect is larger when instrumented for; however, the level of significance in our IV estimates reduces, unlike in Alderman *et al* (2009). Household wealth is associated with having completed more years of schooling by 2004; belonging to the Haya group, which also indicates better (relative) economic and social circumstances of households, is associated with having completed more years of schooling by 2004. School quality, too, is significantly and positively associated with the number of years completed in 2004. As seen with Alderman *et al's* IV estimates, our IV estimates for these variables are larger than those in our uninstrumented model. Unlike Alderman et al, we find that the mother's education continues to remain significant, and the magnitude of its effect increases slightly.

As seen in the IV estimation in Section 7.2.1, these IV estimates too suffer from some amount of bias because of the reverse causality between children's illness and past and current nutrition outcomes but less so than the OLS estimates seen in Table 7.2. Again, we do not drop these owing to the evidence that links illness to poor grade achievement (discussed in Section 2.3.2) and because these explanatory variables are jointly significant with the others. Proxying or instrumenting for these variables is also problematic as the instruments would also be correlated with the nutrition outcomes of the children. Generally, in our IV estimates, the directions of the significant associations remain unchanged though in some cases the magnitudes or strength of the associations can change.

7.3 Concluding Remarks: Regression Analysis

With a combination of individual, household and school level information for the Kagera region in Tanzania, we investigate whether children's past nutritional outcomes are associated with their current schooling efficiency outcomes. In the first part of our analysis, we used an OLS model to estimate the relationship between children's short- and long-term nutrition on their school attendance. In the second part, we used an OLS model to look into the relationship between children's nutrition and current cognitive development, indicated by their grade achievement at the time of the survey. For both models, we used crop loss in 2004, flood or drought experienced in the last 10 years and mother's height to instrument for the endogeneity of children's nutrition as also used by Alderman *et al* (2009). In both models, we have three specifications, where we control for household fixed effects, community fixed effects and school fixed effects. Household fixed effects will control some unobserved factors such as parent's aspiration for children; the value they place on their children's education; whether the home environment is conducive to studying at home, etc. Community fixed effects control for unobserved factors such as access to health facilities, transport infrastructure etc., data for which was not collected in KHDS2 (see Chapter 4). School fixed effects control for factors related to teachers' experience, motivation, etc. While the IV and fixed effects approach will be able to control for some of the endogeneity posed by omitted variable bias, this is not a fool-proof method. Our estimates suffer from a bias caused by reverse causality between some of the explanatory variables – children's nutrition and health. This section summarises the IV results only as these results are less biased than the OLS estimates.

The equation that we estimate to gauge whether there is a link between early childhood nutrition and school attendance is an adaptation of the model set up by Burke and Beegle (2004). The results from the estimation of Equation (6), add to a larger body of literature that explore reasons for school absenteeism that we have reviewed and discussed in Chapter 2. To our knowledge, these studies investigate overall reasons for school absenteeism and choose to focus on the child's health as the main explanatory variables (of course, controlling for household and school characteristics). A handful of experimental studies (for example, Miguel and Kremer (2004)) investigate whether alleviating micro nutrient deficiency would improve school absenteeism. In our analysis, along with the child's health, household and school characteristics, we include the child's current and long-term nutritional outcomes as explanatory variables.

In our IV regression estimates in Table 7.3 we see that current undernutrition as well as early childhood undernutrition are associated with fewer hours spent in school ever week. Our estimates of this model also indicated that poor health in the short- and long-term can reduce school attendance. These results are corroborated by those of the Miguel and Kremer (2004) study. The authors find that improving current nutrition and health statuses can lead to lower levels of school absenteeism. As noted earlier, the negative relationship between poor health and nutrition has been well-established although the direction of causality is less easy to pin down- poor health can lead to poor nutritional outcomes and vice versa. Thus, if a child was stunted in 1994, it is likely that this undernutrition persists later on in her life. Her poor nutritional status 10 years later makes her more susceptible to disease and she misses school frequently. Even if a child was not stunted in 1994 or undernourished in 2004, given the nature of the burden of disease in Tanzania, she may fall prey to malaria, tuberculosis or other diseases. Recovering from these diseases not only takes time but can also adversely result in worsened nutrition in the current period because of which the child may take longer to recover and thus, frequently miss school! This reverse causality is like to have provided some bias in our estimates and as a result they are, perhaps, only indicative of the direction of the relationship between school attendance and child nutrition and health. As the degree of the bias is unknown, we do not say whether our IV estimates are over or under-estimates.

There is a gender gap in school attendance - our estimates show that being male is associated with spending up to two additional hours in school ever week suggesting that perhaps parents prefer to send male children to school as they believe that the returns to their education will be higher compared to that of girls. This is not implausible as Lloyd and Hewett (2009) find that in circumstances of extreme poverty is it not impossible for the gender gap in schooling achievement to reduce in countries such as Tanzania.

Household characteristics that were expected to be positively related to school attendance such as household wealth and mother's education were not found to be significantly associated with children' school attendance. This contradicts Burke and Beegle's (2004) results in the study of school attendance among children in north western Tanzania. However, the inclusion of our variable on ethnicity may be able to pick up information on a household's social and economic circumstances. Belonging to the Haya group, which is the majority ethnic group in Kagera, was found to be positively associated with higher school attendance. It is likely that this is a reflection of the Haya's better access to resources, perhaps because of political strength, that can improve children's school attendance, which household wealth is less able to capture. The authors also find that the age of the child has an impact on school attendance – the older the child is, the more hours she will spend at school during the week. However, we do not find that this relationship is statistically significant. It is more likely that older children are kept out of school to care for younger children in the household or form a part of the household's labour supply, and thus, are more likely to attend school less regularly (Burke and Beegle, 2004).

The school component of the KHDS collects information on indicators such as the type of ownership if school as well as some physical resources available to schools, which are typically used as indicators of school quality. Information on the number of teachers and textbooks available allows us to calculate teacher-student ratios and textbook-student ratios that we were able to include in our analysis. Our results also contradict the evidence that Burke and Beegle (2004) present for the impact school quality on school attendance. While their estimates were not significant (even at the 10% level), our estimates suggest that "good" school quality can be effective in increasing children's school attendance. If parents know that the local school is of good quality, they may be more likely to send children to school and having more resources per child is likely to improve attendance and current grade achievement.

Next, we investigated whether there is a link between early childhood nutrition and years of schooling completed in 2004. This analysis is similar to the one conducted by Alderman *et al* (2009) as it uses data from the same survey to answer the same question. We follow the authors' IV approach in where they use households reported crop loss in 2004 and weather shocks experiences in the last 10 years and to that we add mother's height as an instrument for early childhood nutrition. In addition to a set of similar controls for household and school characteristics, we use children's health as explanatory variables as missing school for long periods or very frequently because of poor health can have adverse consequences for children's schooling achievement. However, in Alderman *et al's* (2009) study sample, the children were aged upto 10 years in 1994 and would be aged upto 20 years in 2004. However, we restricted our sample to children who were aged under five to be able to study the effects on current and not ultimate levels of schooling. Further, while Alderman *et al* (2009) use community fixed effects in the IV approach, they do not explore the use of household or school fixed effects that would control for some unobserved variables as noted at the beginning of this section.

The results from the estimation of Equation (12), add to a larger body of literature that explore reasons for low levels of school achievement that we have reviewed and discussed in Chapter 2. Early childhood undernutrition and long-term illness are associated with lower grade achievement in 2004 (Table 7.5). This inference should be interpreted with some caution due to the reverse causality between health and nutrition that we have discussed at the beginning of this section. Our estimates also show that as children grow older, they are more likely to attend school more regularly and to have higher grade achievement. The positive relationship between age and grade achievement is an intuitive one. Alderman *et al* (2009) also find similar results.

Of course, current completed years of schooling would depend upon a host of other factors, one of which is household wealth. We find that it is significantly and positively associated with current completed years of schooling. Richer households are in a position to bear the burden of school costs; they are more stable and less likely to pull children out of school to cope with the effects of a shock; they tend to place a higher value on children's education. Mother's education is positively associated with children's current completed years of schooling and this is significant. More educated parents place a higher value on education and thus would be able to invest more in children's education in the form of school fees, books, uniforms etc. as well as in the form of time spent helping children with homework. If such a pattern were to be sustained for the duration of the child's schooling, ultimate grade achievement and potential earnings as adults would be much higher, as found by Alderman *et al* (2009). As seen for school attendance, belonging to specific ethnic groups can improve schooling outcomes. Belonging to the majority ethnic group in Kagera i.e. Haya is positively associated with school attendance and current grade achievement. Further, being Catholic is also positively associated with having higher current grade achievement. As discussed in Chapter 3.3, some of the minority ethnic and religious groups are benefiting from the quotas in education and we see this in the positive and significant coefficient on belonging to a minority religion and its association with current completed years of schooling.

Our analysis also looked into school quality to see whether the quality of schools affected a household's demand for schooling. Schools with better quality (as indicated by teacher-student rations and Swahili and mathematics textbook-student ratios) are positively associated with school attendance and current grade achievement. The results are similar to those found by Alderman *et al* (2009).

The factors that affect the two school efficiency outcomes of interest are similar as seen in our estimates. Our results suggest that early childhood undernutrition is linked to poor education related outcomes and that those who live in resource poor household are more vulnerable. Our results cannot establish direct causality and are only indicative of this relationship. This is because, despite the use of instruments for early childhood undernutrition and fixed effects, the results still suffer from some bias. This is because of the reverse causality of health and nutrition that we have not been able to instrument for (as these would be correlated with nutritional outcomes of children). They could not be dropped from the analysis as they are jointly significant with the other explanatory variables. Further, particularly in low income settings, mother's height itself may be endogenous. Taller mothers who are likely to have been better nourished when they children, have accumulated more human capital when compared to women who have been stunted in their childhood. Taller mothers may place more value on schooling and have higher aspirations for their children. This would imply that instead of being an instrument for the child's early nutrition status, the mother's height should be a direct determinant of schooling achievement! However in using this instrument, we are assuming that this is not the case (Sanchez, 2009).

8. Conclusion

Although poor nutrition is a problem for individuals of all ages, it particularly affects the well-being of young children. More than 4.5 million children under the age of five die each year due to undernutrition, and millions more are permanently disabled by the physical and mental effects of a poor dietary intake in the earliest months of life (UNICEF, 2007). By the time children are two years old, they could suffer physical and cognitive damage that cannot be reversed, thus, adversely affecting their future health and well-being if they are undernourished. The consequences of insufficient nourishment continue into adulthood and are passed on to the next generation as undernourished girls and women have children of their own (Horton, 2008).

While globally, there is progress being made in the reduction of child undernutrition, the story in Africa is not so. The last 25 years have seen a less than four percentage point decrease in the prevalence of child undernutrition in the continent. Within Africa, there is some variation in the degree of reduction of child undernutrition with SSA countries making the least progress (World Bank, 2006). In Tanzania, in 2008, 54% of children under the age of five were found to be undernourished (SCUK, 2009). Previous discussions in this thesis have shown that the situation in Tanzania is indeed very dire. While Tanzania has had higher growth rates than its neighbours, it has a higher prevalence of child undernutrition and poor schooling efficiency and consistently performs poorly on other indicators of well-being, despite focussed health and education policies and initiatives. Why do children in Tanzania, particularly Kagera, continue to remain undernourished? How is this linked to their future well-being and human capital formation?

The review of relevant literature in Chapter 2 indicated the progress that has been made in answering some of these questions. Studies in economics as well as nutrition, epidemiology, child health and other social sciences have identified several determinants of good health and nutrition. These studies find that individual food intake and health stock; household food security, health environments, wealth and care provisions; socio-cultural factors such as ethnicity, status of women relative to that of men and potential resources available to households are important determinants of children's nutritional outcomes. The literature review also identifies the various impacts that poor childhood nutrition can have. Studies associate poor early childhood nutrition with morbidity and low stocks of physical and mental health that can harm children's physical and cognitive development. A consequence of this is that children so affected do poorly at school and have poor educational outcomes that lead to poor labour outcomes and overall quality of life. Even if children's cognitive development is not harmed, children's low stock of health due to undernutrition may adversely affect their performance at school in the forms of non-attendance and low grade achievement. Again, this can again harm their participation in the labour market and potential future income, leading to a low standard of living.

The review in Chapter 2 indicates that there are some gaps in this field of research. Analyses of the determinants of undernutrition tend to overlook how these factors interact with each other in particular contexts in the short- and long-term. Further, these studies do not look at how early childhood undernutrition is related to the schooling efficiency of children enrolled in primary school; most focus on the relationship between poor nutrition and cognitive development as measured by child vocabulary or comprehension tests such as the Cloze Test, Raven's Test or Peabody Picture Vocabulary Test, among others. Based on these gaps we listed key questions that needed to be answered.

The first of these questions (Chapter 2, pp. 53-54) was which factors are associated with children being undernourished in the short- and long-term? To answer this question, we first need to understand how different factors at the individual and household level are associated with the nutritional outcomes of children. To this end, this study looks into the determinants of short- and long- run child undernutrition in the Kagera region of north-western Tanzania. We used a combination of individual and household level information from the second round of the KHDS that was conducted in 2004. With the help of an OLS model, we estimated the impact of various socio-economic factors on children's nutritional status in the short and long-run, including some interaction variables in our specifications. To our knowledge, this analysis is the first of its kind as it looks into the determinants of childhood undernutrition in a very specific regional context and also attempts to account for the interactions between certain key determinants. Recall from Section 6.2 that we were unable to find valid instruments for food security, which is endogenous. As a result, our estimates are biased to some degree and can only be indicative of the relationships found.

We found that in the short-run, the age and gender of the child, parental absence, maternal employment, household food security, household wealth - in the previous period (1994) and in the current period (2004) – along with female headed households were significantly associated with the short-term nutritional outcomes of the children in our sample. For the children who lived in households in the bottom most expenditure quintile, we also found that the gender of the child, parental education, household food security, household wealth in 1994 and 2004, and women's were significantly associated with their short-term nutritional outcomes. For children living in the highest expenditure quintile, we found that age, mother's education, maternal employment and household wealth in 1994 are associated with their nutritional outcomes in the short-term. Further, for the whole sample and for households in the lowest and highest expenditure quintiles, losing a parent and being placed in better off foster or adoptive households can have a positive impact on children's short-term nutrition as seen from the coefficients on the relevant interaction variables. The interactions between mother's education and employment of women in wage labour suggest a positive associated with the short-term nutrition of children.

In the long-term, the age, gender of the child, parental education, household food security, current household expenditure, maternal employment on household farms and living in a female headed household are associated with children's long-term nutritional outcomes. For children in the bottom most expenditure quintile, the age and gender of the child, the death of the father, and living in a household headed by a woman is associated with the long- term nutritional outcomes of children. For children living in the highest expenditure quintile, we found that the age of the child, parental education, death of the mother, maternal employment and household wealth in 1994 are significantly associated with their long term nutritional outcomes. Further, for the whole sample as well as for the bottom most and top most expenditure quintiles, living in a female headed household with higher levels of household wealth is positively associated with better long-term nutritional outcomes, suggesting that the availability of more resources of female headed households (that may be systematically denied access to land and credit resources) can improve children's nutrition. As seen for the interactions in the long-term, losing a parent and being placed in better off foster or adoptive households can have a positive impact on children's nutrition. However, despite high levels of education maternal employment on household farms is negatively associated with children's long-term nutrition, suggesting that while this sort of maternal employment can contribute to household income, women may be spending less time on care giving activities and engaging with their children. Overall, in the short- and long-term, mother's education and household wealth interact with each other to have a positive impact on children's nutrition outcomes.

In answering this question as well as questions 2, 3 and 4 listed at the end of Chapter 2, our analysis adds to the literature that finds that household food security, wealth and the better status of women are positively associated with children's nutrition in the short- and long-term periods. Such findings add to the motivation for the implementation of intervention programmes that strengthen the links between household's economic abilities to buy adequate food (quantity and quality) and provision mechanisms either through fair price shops, food for work programmes or at children's schools, for example, take home rations or school meals. Similar interventions can also help households cope with shocks that affect household consumption. For example, as seen in Alderman *et al* (2005), nutrition intervention programmes in combination with income growth can improve nutritional outcomes of children.

The effect of the status of women in the households relative to that of men on children's nutrition is not a straightforward result to interpret. At very low levels of household consumption, living in a female headed household proves to be detrimental to children's nutrition. This combined with low purchasing power, poor health environments and low levels of education among women to increase the likelihood of children being undernourished in the short- and long-run as seen from our estimates of the interaction terms. At low levels of poverty, when purchasing power is higher, women are more educated and have the means to provide better environments for their children, children are less likely to be underweight or stunted. Thus, providing an impetus to women's education at the primary, secondary and tertiary levels of education, as well as adult learning, could lead to an improvement in caregiving behaviour as seen in several experimental studies in public health (for example, see Rosato *et al*, 2004). In addition to this, the care that women provide may benefit from education via means of better employment opportunities, higher incomes and more resources to put towards the care of their children. However, as we have seen for our sample, different kinds of employment that they are engaged in have different impacts on nutritional statuses of their children. Being employed in outside enterprises that are not household enterprises, provides additional income and facilitates engaging with a larger social network, other than the (extended) family network. It is then the case that these women are involved in information exchanges with other women who have similar socio-economic circumstances and can assimilate and act upon caregiving, resource allocation strategies that may be more appropriate to their context.

As discussed in Chapter 6, there are many ways in which the immediate, underlying and immediate determinants can have an impact on children's nutrition. For example, households with low incomes are likely to have less educated parents, poorer health environments and lower food security. These factors interact with each other to determine whether children will be wasted, stunted or properly nourished. As a result of this it is not accurate for us to claim that only improving only food security or maternal education and health-related knowledge can improve children's nutrition. When tackling the problem of undernutrition in Kagera (and elsewhere in the world), any approach taken to alleviate this problem needs to be an integrated one. For example, if health workers disseminate information to young mothers about top-up feeds to supplement breastfeeding to ensure that new born babies and infants are receiving adequate nutrition during this crucial period, these women should have access to markets/ clinics where such formula is sold at affordable prices. Interventions also have to be targeted to ensure that the children who are at the highest risk of being undernourished, for example, children who belong to very poor households or minority ethnic groups such as the Zinza and more are vulnerable to health and consumption shocks are receiving the resources that they need. At the same time, it is important that those children who are less at risk, for example, those who belong to slightly better off households, majority ethnic groups and have working mothers do not slip between the cracks. However, we again need to take into account the fact that such interventions or policy measures may have impacts that will be different due to those anticipated (Du Pas, 2011).

The effects of early childhood undernutrition are not only persistent in adulthood but can also be transmitted into future generations, with a mother's nutritional status affecting the health of her future children and even grandchildren (Walker *et al*, 2012). Children who are undernourished in early childhood have been shown to suffer in the development of cognition and earn less income as adults, hindering their growth and economic potential as well that of nations. Lower income, poor health, and reduced access to proper nutrition and health environments continue to affect the next generation, establishing a repetitive cycle or a poverty-nutrition-trap. In Tanzania, the increase in primary school enrolment, despite the initiatives taken to improve the same by the government, have been less than encouraging when compared to the progress made by her east African neighbours. What are the reasons for children's poor schooling efficiency outcomes (questions 5 and 6 listed on pp. 54)? Does poverty prevent children from accessing educational opportunities? Does poor education quality affect a household's demand for schooling? Or is this in fact, as the literature suggests a function of children's poor nutritional status?

The second broad question that we asked in this thesis is whether poor early childhood nutrition is associated with children's schooling efficiency. This is a two part question. The first part of this question investigated whether poor early childhood nutrition has a negative effect on the school attendance of primary school-going children. The framework for the model was adapted from a study by Burke and Beegle (2004) that explored reasons for school absenteeism. Our analysis extends their model to include children's stock of health and nutrition as explanatory variables, using mother's height, crop loss reported by the household and weather shocks such as a flood or drought experienced over the last 10 years to instrument for children's undernutrition. We also used fixed effects for households and communities that children live in as well as for the schools that they go to. Using individual, household and school level information from both rounds of the KHDS, we implemented an OLS model to examine the relationship between children's long-term and short-term nutrition on their school attendance.

Our estimates showed that children's past and current nutritional statuses are associated with school attendance. Children who are stunted in early childhood and have low BMI-for-age Z-scores in the current period spend less time in school. Children who have been ill in the recent pass or have a long-term illness also spend less time in school. This result is similar to the one found in the experimental study by Miguel and Kremer (2004) and adds to literature that suggests that improvements in nutrition, which in their case was deworming, improves school attendance. Living in a household with a larger number of children was found to increase absenteeism. This is because parents may make schooling decisions based on expected returns to education or perceived abilities of children, and choose amongst them. Parents may also require older children to take care of younger siblings and the elderly, do household chores or be employed elsewhere– the opportunity cost of schooling could be high for these household, especially for poor households. However, we did not find the age of the child to be negatively associated with school attendance and it is likely that the latter scenario is not taking place amongst households in our sample. This is similar to the result found by Burke and Beegle (2004). We also looked into whether the quality of local schools played a role in determining school attendance and found that private schools as well as schools better teacher-student and textbook-student ratios are positively associated with school attendance.

The second part of this question investigated whether poor early childhood nutrition is negatively associated with current grade achievement of primary school-going children. Most studies using longitudinal data only look at the impact of poor early childhood nutrition on cognitive outcomes at the age of five, with the exception of Alderman *et al* (2009). The framework for the model was adapted from the study by Alderman *et al* (2009). We follow the author's IV approach and use crop loss reported by the household and weather shocks such as a flood or drought experienced over the last 10 years to instrument for children's undernutrition. In addition, we also use mother's height as an instrument for children's undernutrition. In our estimation, we include fixed effects for households and communities that children live in as well as for the schools that they go to. As noted earlier, Alderman *et al* (2009) only use community level fixed effects. Using individual, household and school level information from both rounds of the KHDS, we implemented an OLS model to examine the relationship between children's long-term and short-term nutrition on their school attendance.

Early childhood undernutrition and long-term illness were found to have negative impacts on children's current levels of completed school years. While this result is similar to that found by Alderman *et al* (2009), it contradicts Miguel and Kremer's (2004) finding that improvements in children's nutrition do not have an impact on their test scores. Chronic illnesses are positively related to early childhood stunting and that this significant result as seen in Table 7.5 also captures to some degree the reverse causality between health and nutrition; we are unable to estimate the magnitude of this impact with accuracy. Additionally, children's age, mother's education and household wealth significantly affect children's grade achievement. As far as school quality is concerned, our estimated showed that better math textbook-student ratios also have a positive impact on children's current levels of completed school years. Further, a better teacher-student ratio can also improve current grade achievement, suggesting that the quality of school can play a positive role in children's cognitive development. Again, these results are similar to those found by Alderman *et al* (2009). Our findings suggest the need for programmes such as ensuring early childhood vaccinations that prevent incidence polio, whooping cough etc.; school feeding or take home ration programmes that can alleviate hunger as well as act as an incentive for households to send their children to school.

Despite the use of instruments for early childhood undernutrition and fixed effects, the estimation of the school attendance and current completed years of schooling equations still suffer from some bias. This is because of the reverse causality of health and nutrition that we have not been able to instrument for. At best, our results are only indicative of the relationships that have been discussed. Further, as we do not know the extent of the bias caused by the reverse causality, we cannot ascertain whether our results in Tables 7.3 and 7.5 are over or underestimated.

The KHDS is a rich and detailed household survey that collects a vast amount of data for households in Kagera. Despite the nuanced information it can provide on the behaviour of households and its members over time, it does have a limit on to what degree it can explain the child undernutrition situation. Our analysis is a limited one as we rely on household level information to draw conclusions about how different socio-economic factors affect (individual) children's nutrition in the short- and long-run. For example, we attempted to gauge the impact of dietary diversity on nutritional outcomes by constructing a food variety index as we learnt that diets in Tanzania and Kagera are highly staple dependent and this lack of diversity in diets leads to micro nutrient deficiency. As the data on food consumption are collected for households rather than individuals, this index is unable to capture intra-household variation in food consumption and allocation patterns, so in our analysis it can only be indicative rather than representative. Another limitation of using household level information as gathered by the LSMS and HBS is that they are unable to capture seasonal variations in consumption and supply (of food and other resources), which leads to an inaccurate picture of consumption patterns and inaccurate inferences about nutrition related outcomes (Devereux, 2009; Hawkesworth *et al*, 2010). Further, despite the advantages of using panel data for such analyses, they too are not able to capture the full extent of the effects of seasonality. These problems may be overcome with the help of direct estimates of individual food consumption for a population derived from surveys conducted on nationally representative samples. Hawkesworth *et al* (2010) suggest that such information surveys can often be sub-divided by age and sex categories and used to investigate regional and socio-economic variations if conducted properly. Thus, the limitations of our analysis and indeed of other analyses investigating similar issues could diminish by conducting an individual nutrition survey that collects information on each respondents anthropometry, food intake, dietary diversity, intra-household allocation of food (and other resources) and socio-economic characteristics. However, nutritional surveys are not easy to administer as they are time consuming and because of the heavy cost involved in their administration. They are also subject to a fair amount of measurement errors and respondent bias, especially as far as food intake is concerned. Problems of recall and telescoping combined with the fact that most individuals are not willing to admit that they are hungry or overstating their lack of food if they believe that they will benefit from doing so, will lead to errors in our inferences. Thus, household surveys that collect anthropometric data may be an alternative route for empirical analysis of the undernutrition equation. If household surveys could consistently collect some long-term well-being information on the long-term stock of health of household members, ante natal care given to newborn babies, infants and their mothers, we would be able to say more about what impacts long-term nutrition.

The use of secondary household survey data is limiting in another way. It is not collected to other researchers' requirements, who are often forced to use proxy indicators that may not be robust. For example, the use the 2004 KHDS survey can only a snapshot view of socio-economic dynamics and interactions at work, which enable us to study the determinants of short-term undernutrition but are not suitable for the study of long-term undernutrition. While some factors such as the child's gender and parental education are time invariant, the others vary with time and are not ideal for the purpose of our study. This may underestimate or overestimate the true impact that these socio-economic factors have on long-term undernutrition of children. However, there is some debate around this issue and a contradicting point of view is that whether socio-economic characteristics of the household vary or not, they are still robust predictors of long-term undernutrition as long-term undernutrition is caused by deprivation in early childhood, which is the duration of a child's life that we are studying.

Our results also raise issues about the appropriateness of indicators for school quality or in the bigger picture, of the quality of education, especially in low income countries. The quality of education that children receive does not solely depend on an enabling school environment; it also depends on enabling home and policy environments (Tikly, 2010). The school context tends to be covered in more detail than the other two, especially in household level surveys, though still limiting. For example, in the school context instrument in the KHDS (and other LSMS) information is typically collected on students' achievement and progress such as grade progression and cognitive achievement or vocabulary tests; school's infrastructure such as the physical condition of the building and the availability of learning materials. However, what we also need to have information on to be able to assess the school context is barriers to students' achievement such as bullying, indiscipline in class; teacher preparedness and motivation that may be gauged via the observation of lesson plans and process of school evaluation, etc. Additionally, information is also required on the availability of books or libraries in the community; availability of desks and adequate lighting in homes; prevalence of child labour within the household and the community; prevalence and levels of domestic violence or abuse; and children's and parents' aspirations, self-esteem and self-efficacy to be able to have a more complete picture of the learner context. At the policy level, there is almost no information available to be able to gauge whether it is conducive to initiate interventions or programmes that would improve the quality of education as the ones discussed earlier in this section. Researchers would be better equipped to answer questions about the quality of education and on the feasibility of initiating changes if they were to be informed of regional and national governments' skill development priorities; availability of budgets and had some evidence of effective service delivery and good governance (*ibid*).

9.Appendices

Appendix 1: Research design, sampling strategy and content of the KHDS.

KHDS1

The KHDS interviewed more than 800 households from nearly 50 communities in all five districts of Kagera. Households, community leaders, health facilities, schools, and market vendors were queried in six-seven month intervals for up to four survey periods. Traditional healers were also interviewed once. The aim of the second round conducted in 2004 (KHDS2) was to track members of the KHDS1 households. Although the KHDS questionnaires are adapted from the World Bank's LSMS questionnaires, the KHDS is unique as it is wholly longitudinal. This feature gives us the opportunity to measure changes in household consumption and assets between interviews and thus, over time and we may be able to study issues such as household saving or dissaving that key household-level coping mechanisms amongst others.

Research Design

The research design called for a longitudinal survey of a sample of households, some of which would have experienced an adult death (or were likely to do so) and some of which had not. Some of these households were to be drawn from communities with high adult mortality rates, and others from low-mortality communities. The sampling frame for the survey was based on the 1988 Tanzania Census. The census also provided information on adult death rates by ward within the Kagera region.

The census data helped determine which communities had relatively high and low adult death rates. However, there were a couple of problems that led to the decision for a stratified sample of households based on multiple criteria: first, despite the high rates of HIV infection in Kagera and the large number of deaths over time due to Aids, the death of a prime-age adult is still a relatively rare event over a short time period. In order to ensure for the survey to interview enough families suffering or about to suffer the death of a prime-age adult, a very large sample would have to be selected.

Second, HIV prevalence and adult mortality rates in Kagera were found to be geographically concentrated. This meant that they were also strongly correlated with different climates and cropping patterns. The highest rural HIV infection rates were in the northeast (10% in Bukoba Rural and Muleba districts and 24% in the town of Bukoba), where tree crops such as bananas and coffee were predominant. The lowest rates were in the south and west (0.4% in Ngara and Biharamulo districts), where perennial crops and livestock are more common. A survey design stratified only on mortality rates might confound the effects of high mortality with different agricultural, soil, and rainfall patterns (World Bank, 2004).

Sampling design

The KHDS used a random sample that was stratified geographically and according to several measures of adult mortality risk. This strategy allowed the team to overcome the problems mentioned above. The household sample was drawn in two stages. In the first stage, stratification was based on geography and mortality risk in both stages. Communities and clusters were selected in the first stage and households in the second.

Selecting communities: The 550 primary sampling units (PSUs) in Kagera were classified according to eight strata defined over four agronomic zones and, within each zone, the level of adult mortality (high and low).[27] Clusters of households were drawn randomly from the PSUs in each stratum, with a probability of selection proportional to the size of the PSU.

The four agronomic[28] zones are:

- Tree Crop Zone: Low fertility soils in areas of high rainfall, where the main crops are bananas, coffee, and tea. This zone is in the northern part of Kagera with communities in Bukoba Rural and Muleba Districts.

[27] A PSU is a geographical area delineated by the 1988 Tanzanian Census that usually corresponds to a community or, in the case of a town, to a neighbourhood.
[28] The source for the classification of zones was the Tanzania Atlas published by the government of Tanzania in 1967.

- Riverine Zone: Alluvial and colluvial soils of considerable potential, but requiring flood control, where the cropping pattern is mixed and includes cereals, sugarcane, rice, and legumes, as well as tree crops. This zone is in the middle of the region; most of its communities are in Karagwe and Bukoba Rural Districts and a few in Muleba District.
- Annual Crop Zone: Soils of low to medium fertility with moderate potential and lower rainfall, where the cropping pattern is mixed and includes groundnuts, cassava, beans, cotton as well as some cereals (maize, sorghum) and pasture, but few tree crops. This is in the southern part of Kagera in Biharamulo and Ngara Districts.
- Urban Zone: The town of Bukoba, the region's capital, plus an additional 27 communities in Muleba, Karagwe, Ngara, and Biharamulo Districts that were designated as urban by the 1988 census.

The zone labels were chosen for simplicity. They suggest the characteristic agricultural pattern for regions, which are not exclusive patterns.

Within each agronomic zone, PSUs were classified according to the level of adult mortality. The 1988 Tanzanian census asked a 15% sample of households about recent adult deaths. Those answers were aggregated at the level of the "ward", an administrative area that is smaller than a district. The adult mortality rate (15-50) was calculated for each ward and each PSU was assigned its ward’s adult mortality rate.

Table A1.1: Distribution of communities, households and population, KHDS1

Zone	Adult mortality rate, 1988		
	Low	High	Total
Tree crop	74,952	6,685	81,637
Riverine	87,414	8,923	96,337
Annual crop	56,207	8,673	64,878
Urban	21,138	3,745	24,833
Total	239,709	28,026	267,735

Note: The threshold for the stratum with “high” adult mortality was 29/1000 in the Tree Crop zone, 17/1000 in the Riverine Zone, 8/1000 in the Annual Crop Zone, and 20/1000 in the Urban Zone.
Source: Beegle *et al* (2006)

Owing to the fact that adult mortality rates were much higher in some zones than others and the distribution was quite different within zones, “high” and “low” mortality PSUs were defined relative to other PSUs within the same zone. A PSU was classified as in the “high” mortality category if its ward adult mortality rate was at the 90th percentile or higher of the ward adult mortality rates within a given agronomic zone. Table 4.1 shows the distribution of households across the strata.

Selecting clusters: Having classified all of the PSUs in Kagera into the eight strata, the KHDS interviewed households within PSUs in clusters of 16 households each. Based on experience with other LSMS surveys, this is the number of households that could reasonably be interviewed by a field team of one supervisor, two interviewers, and an anthropometrist in a week. The probability that a PSU was selected within each stratum was proportional to its size (the number of households), according to the following formula: [29]

$$\text{Probability of selecting this PSU} = \frac{\text{Number of clusters in this stratum x Number of households in this PSU}}{\text{Number of households in this stratum}}$$

The research design and the budget called for surveying 50 clusters of 16 households each, for a total sample of 800 households. Divided across the eight strata, this would imply the need to enumerate roughly six PSUs in each of six strata and seven PSUs in two strata (see the first figure in each column of Table 2). However, to guard against attrition of entire communities and the possibility that actual mortality rates would be found to be quite different from those observed in the census, more PSUs were enumerated than would be needed for the survey. A total of 62 PSUs were selected from the 549 in the region to be enumerated- eight PSUs were selected at random from each of seven strata and all six PSUs in the high-mortality urban stratum were selected.

However, the field teams successfully enumerated only 52 PSUs, from which 54 clusters could be drawn. Ten PSUs were not enumerated, generally because they were inaccessible or the teams ran out of time. Of the 52 PSUs that were enumerated, only 48 were needed (allowing for selection of two clusters from each of two PSUs in the urban high-mortality zone). In zone 3, where fewer PSUs were enumerated than were anticipated in the research design, all 10 enumerated PSUs

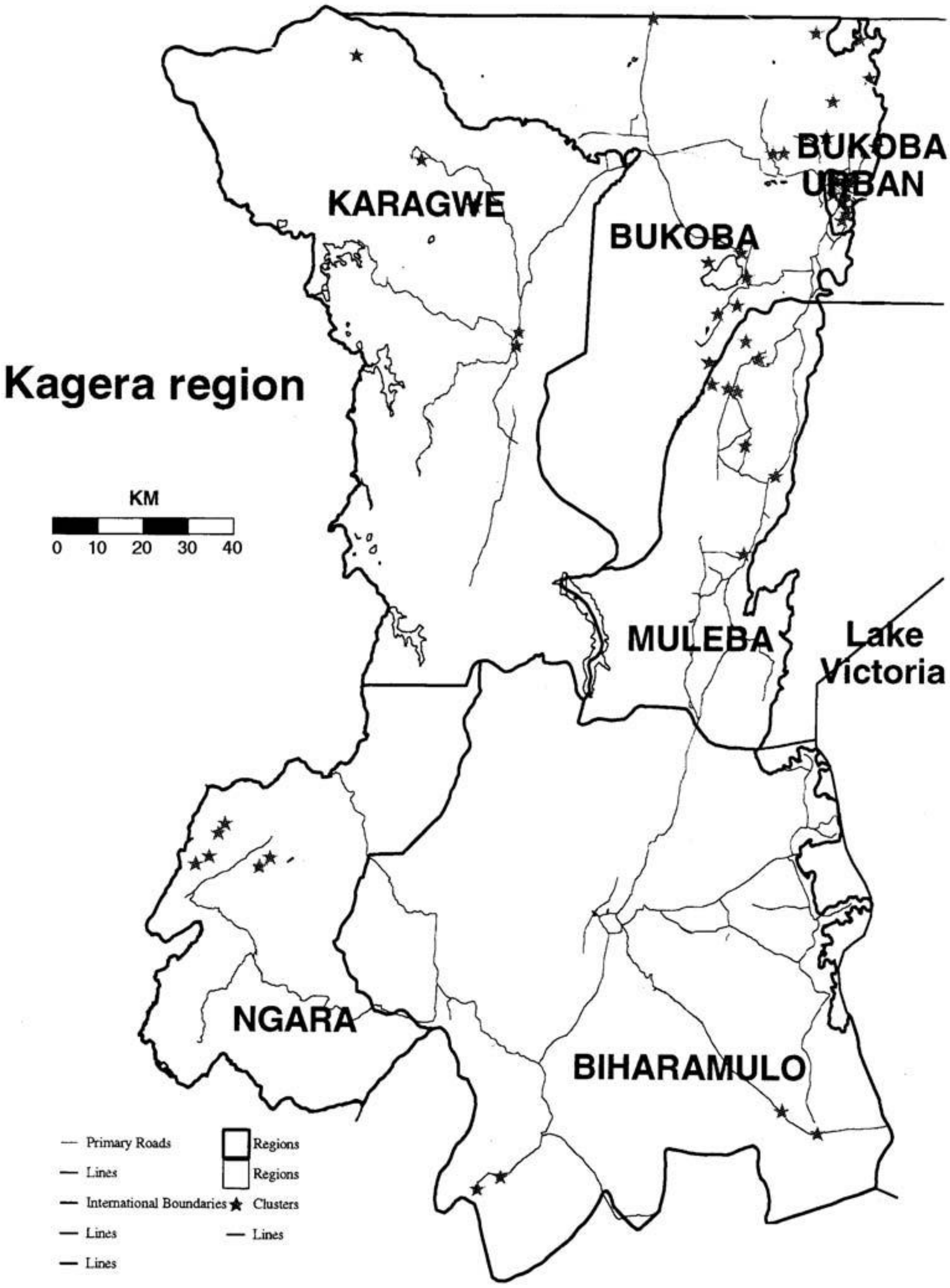
[29] In the high-mortality urban stratum, eight clusters had to be selected from only six PSUs. In that case, for some PSUs in the stratum the probability exceeded one and more than one cluster was drawn from a PSU.

were accepted into the sample. To compensate, it was decided to select a total of 14 PSUs in the tree crop zone, and 12 each in the annual crop and urban zones, for a total of 48. In deciding which PSUs to drop, the PSUs were ordered within each zone, from highest to lowest adult death rate based on the enumeration results.[30] In order to maximize the differences between PSUs in the high- and low mortality groupings within a zone (the definition of which remained based on the census), the PSUs dropped from each zone were in the "middle" of the distribution of enumeration adult mortality rates for that zone. For example, in the riverine zone, where 13 PSUs were enumerated, the PSU with the median adult mortality rate from the enumeration was dropped. Using this method, one PSU each was dropped from the riverine and urban zones and two were dropped from the tree crop zone, leaving 48 PSUs from which 50 clusters were selected. A 51st cluster from the high mortality tree crop stratum was added toward the end of the first passage of field work, to ensure that an adequate sample size would be maintained, should an entire cluster drop out later during the panel. Thus, the final KHDS sample included 49 PSUs from which 51 clusters of 16 households each were drawn.

Selecting households: In the KHDS, a household was defined as a person or group of persons who live in the same dwelling and eat meals together for at least three of the 12 months preceding the date of the survey. There are four exceptions to this definition: one, persons who have recently joined the household, such as spouses, newborn infants, adopted orphans and others who intend to stay until the next interview. Two, the head of the household is identified by the household without any criteria established by the study team and is considered a household member regardless of his/her length of absence. Three, "makubaliano" servants, who live with the household without contracts, are considered household members as long as they satisfy the residency requirement. Four, tenants and boarders are not household members, regardless of their length of residence.

[30] The correspondence between the adult mortality rates from the 1988 Tanzanian Census and the rates found by the enumeration was not particularly good. The AMR from the enumeration were often higher for PSUs classified as "low mortality" within a zone, than they were for "high mortality", and vice-versa.

Figure A1.1: Location of KHDS clusters in Kagera, Tanzania



Source: Beegle *et al* (2006)

There were often important changes in household composition between interviews. To be classified as a continuing household (and not a new one), at least one member from the household of the previous interview had to be a continuing household member living in the same dwelling. This requirement was satisfied in all instances, except for cases in which the sole household member of a single-person household died.[31]

In the second stage, households within each of the selected PSUs were assigned to one of two strata—“sick” or “well”—based on the results of an enumeration of all households in each community. Sixteen households were selected at random per cluster, of which 14 were selected from the “sick” group and 2 from the “well” group.

Between March 15 and June 13, 1991, 29,602 households were enumerated in 52 primary sampling units. In addition to recording the name of the head of each household, the number of adults in the household (15 and older), and the number of children, the enumeration form asked whether any adults in this household were ill at this moment and unable to work; and if so the age of the sick adult and the number of weeks he/she has been too sick to work. The form also asked whether any adult aged between 15 and 50 in this household died in the past 12 months; and if so, the age of each adult and the cause of death.

The enumeration form asked explicitly about illness and death of adults 15-50 because this is the age group disproportionately affected by the HIV/Aids epidemic and it is the impact of these deaths that were of research interest. Since Aids is sexually transmitted, other adults in the same household with an Aids patient may also become infected, either through sexual contact with the HIV-infected person or because of similarities in sexual behaviour. Thus, Aids morbidity and deaths are likely to be clustered in households. Information on illness and deaths on the enumeration form could be recorded for a maximum of three people (for each question) per household.

Of the more than 29,000 households enumerated, only 3.7%, or 1,101, had experienced the death of a an adult 15-50 due to illness during the twelve months before the interview and only 3.9%, or 1,145, contained a prime-age adult too sick to work at the time of the interview. Only 77 households had both an adult death due to

[31] The correspondence between the adult mortality rates from the 1988 Tanzanian Census and the rates found by the enumeration was not particularly good. The AMR from the enumeration were often higher for PSUs classified as “low mortality” within a zone, than they were for “high mortality”, and vice-versa.

illness and a sick adult. This underscores the point that, even with some stratification based on community mortality rates and in an area with very high adult mortality due to an Aids epidemic, a very large sample would have had to have been selected to observe a sufficient number of households that would experience an adult death during the two-year survey.

To further increase the probability of capturing households with adult deaths in the sample, households were stratified according to the extent of adult illness and mortality. It was assumed that in communities suffering from an HIV epidemic, a history of prior adult death or illness in a household might predict future adult deaths in the same household. The households in each enumerated PSU were classified into two groups, based on their response to the enumeration. "Sick" households were those that had either an adult death 15-50 due to illness in the past 12 months, an adult too sick to work at the time of the survey, or both (n=2,169). "Well" households were those that had neither an adult death 15-50 due to illness nor an adult 15- 50 too sick to work (n=27,433).

Table A1.2: Distribution of households by stratum, KHDS1

	Adult Mortality Rate, 1998		
Agroeconomic Zone	Low	High	Total
Tree Crop	128	112	240
Riverine	80	112	192
Annual Crop	96	64	160
Urban	96	128	224
Total	400	416	

Source: Beegle *et al* (2006)

In selecting the 16 households to be interviewed in each PSU from which a cluster was drawn, 14 were selected at random from among the "sick" households in that PSU and two were selected at random from among the "well" households. In one cluster, where the number of "sick" households available was less than 14, all available sick households were included in the sample and the balance was from well households. The final sample drawn for the first passage was therefore 816 households in 51 clusters drawn from 49 PSUs (Table A1.2).

Household attrition and replacement

Attrition from the household sample: Among the original 816 households selected from the enumeration, 47 (5.8%) could not be interviewed during the first passage (ie in 1991-92) which occurred 7-12 months after the enumeration. The most important reason for attrition was that the household had moved (Table 4.3). In about a third of these cases, the move was related to the death of a household member. This included five cases in which the household moved following a death and two cases in which the person who died was a single-person household. In nine cases (19%) the household was not interviewed because the head was away.[32] Only four households—less than half of a percent of the entire sample of 816 households—refused to participate.

During the first passage, a total of 840 households were interviewed. This group included the 816 "original" households selected from the enumeration (or their replacements) and 24 "extra" households. The field teams added these households, taken from the list of replacement households, when they sensed that another continuing household in the sample was likely to drop out or was a poor source of information.[33] By the end of the fourth passage (1993-94), more than two years later, 81 households (9.6% of the 840 interviewed in the first passage) had dropped out (Table 4.3). In 80% of the cases, the reason for attrition was that the household moved; about a third of those moves were related to an adult death in the household, including one case in which a single-person household died. Only 13 households - 16% of the household attrition during the panel - refused to participate. Of all 840 households interviewed during the first passage, only 1.5% of the households completing a questionnaire in the first passage refused to be interviewed by the end of the survey.

[32] This was in fact an error on the part of the interviewers early in the survey, which was subsequently corrected. The presence of the household head was not necessary to conduct the interview, unless a household was a single-person household.

[33] Extra households were interviewed during the first passage at the initiative of the field manager. The "extras" were selected from the list of replacement households, however the decision rule for adding extra households was not well documented. An additional 75 households began the survey in later passages, completing a wave 1 questionnaire at the first interview. Their subsequent attrition (5 households) is not studied here.

Table A1.3: Household attrition, KHDS1

	Attrition between enumeration and first passage		Attrition between first and last passage	
Reason	Number	Percent	Number	Percent
Moved (not related to death)	18	38.3	46	56.8
Moved (related to death)	7	14.9	19	23.4
Head away	9	19.1	2	2.5
Refused	4	8.5	12	16
Illness	2	4.3	1	1.2
Not found	1	2		
Reason unknown	6	12.8		
Total	47	100	81	100
Sample Size	816		840	
Percentage lost	5.8		9.6	

Source: Beegle *et al* (2006)

While there is no indication that adult deaths were the major reported cause of attrition, it was nevertheless not uncommon for a move to be associated with an adult death. Households with an adult death in the 12 months before the enumeration were less likely to drop out before the first passage than were households without a death. On the other hand, the 94 households that had an adult death between passages one and four were half again as likely as households without a death to drop out by the end of the fourth passage. Neither of these differences is statistically significant.[34]

During the course of the household survey, between the first and fourth passages, a total of 86 households left the sample, including the 81 households that began the survey in the first passage and five households that replaced them and subsequently dropped out. During the fourth passage, the interviewers attempted to locate the 306 individuals who were members of these households - if they were still alive and living in Kagera region - to be interviewed with a "follow-up questionnaire". The time that had elapsed since the last interview was from six-28 months.

The interviewers were able to locate and interview 169 individuals from 52 households that had dropped out, or 55% of the total. An additional 10 individuals

[34] In a logit regression of the probability that a household would continue in the sample, controlling for geographic zone or district, neither an adult death nor an illness prior to the enumeration was a statistically significant predictor of continuation between the enumeration and the first passage. However, both the urban zone and Bukoba Urban district had a highly significant negative impact. In a logit regression of the 840 households beginning the panel, a death between waves significantly lowered the probability of continuing to the end of the panel (p=.08), as did urban location. For a description of the characteristics of households that dropped out and those that didn't, see Appendix 1 of Ainsworth, Ghosh, and Semali (1995).

(3%) were known to have died in that interval, and the remaining 127 (42%) individuals were not interviewed, either because they were outside Kagera (4%) or because the whereabouts of the individual could not be determined (37%). Only three individuals known to be residing in Kagera could not be found for a follow-up interview.

In order to guard against a dwindling sample and to eliminate any incentive for interviewers to reduce their workload by not striving to find a household, households that moved, refused, or otherwise dropped out were replaced. At the start of the first passage, the team supervisors were provided with a list of additional households chosen at random from the PSU to be used as replacements.

Beginning in the second passage, the supervisors were to replace a household with another of the same type - ”sick” or “well” drawn from the list of replacements. They were provided with the names of 12 additional households from each PSU - six each of “type A” (sick households) and “type B” (well households) - and a new list of sampled households in which the type was indicated. The interviewers and supervisors were not told which type of household (A or B) was a “sick” household.

Selecting health facilities, markets and healers

The sample of health facilities, schools, and markets that were interviewed or visited was selected based on the information provided by community leaders. The facilities interviewed generally represent those closest to the cluster, and thus do not represent a random sample of facilities in Kagera region. Traditional healers were randomly selected within each community.

Health facilities: The sample consisted of the nearest health facility (dispensary, health centre, or hospital) to each cluster, as indicated on the community questionnaire. Where there was more than one health facility in the cluster (i.e., Bukoba town), all health facilities were to be interviewed. At the same time, some clusters shared the same facilities. The number of facilities interviewed over time increased from 42 in the first passage to 61 by the fourth passage.

Primary schools:. The sample consists of the nearest primary school to each cluster. In the event that there were several primary schools in a cluster, a separate questionnaire was completed for each. As a result, 62 primary schools were interviewed in the first passage. This increased by the fourth passage to 64 because of two schools inadvertently omitted in earlier passages

Markets: During the first passage, price data were collected from the nearest market to each cluster. There was no distinction made between whether the data were collected from an open market with several stalls or vendors or whether it was a "*duka*" or shop of a local merchant, although the type of establishment was noted on the form.[35] For the second through fourth passages, in principle, two price questionnaires were completed for each cluster. One was completed for the nearest marketplace and another was completed for the nearest *duka*(s).

Traditional healers: During the third passage, respondents to the community questionnaire were asked to list all of the traditional healers in the community. A total of 317 healers were listed, with two-13 recorded per cluster. Two healers were selected at random from the list in each cluster to receive the healer questionnaire. An enthusiastic interviewer in fact interviewed a third healer in one cluster, so 103 of these questionnaires were completed in the third passage—two per cluster in 50 clusters and three in one cluster.[36]

KHDS2

The KHDS2 took place in 2004 as a fifth round following on the four rounds of the baseline KHDS 91-94. The KHDS 2004 was designed to provide data to understand economic mobility and changes in living standards of the sample of individuals interviewed 10-13 years ago. The KHDS 2004 attempted to reinterview all respondents ever interviewed in the KHDS 91-94. This entailed attempting to track these individuals, even if they had moved out of the village, region or country. Where possible, comparability is maintained with the KHDS 91-94 survey

[35] In theory, there should have been 51 price questionnaires for the first passage, one per cluster. However, in some clusters the interviewer completed separate questionnaires for markets and dukas, even in the first passage. Further, two PSUs and four clusters were selected from the Hamgembe neighborhood of Bukoba town. However, the interviewers failed to realize that a price questionnaire was to be completed each time a Hamgembe cluster was interviewed.

[36] The results of the survey of traditional healers are described in Semali and Ainsworth (1995).

instruments. However, the questionnaires for the KHDS 2004 were revised to reflect changes in the region since 1994. Further, the household questionnaire was redesigned in an effort to capture key transitions that have occurred since the previous survey (Beegle et al, 2006)

Sampling Strategy

Households: KHDS 2004 sampling strategy was to reinterview all individuals who were household members in any round of the KHDS 1991-1994 and who were alive in the last interview.[37] The household in which these individuals live were administered the full household questionnaire. For all household members alive during the last interview in 1991-1994, but found to be deceased by 2004, information about the deceased was collected in the mortality questionnaire. This questionnaire collected data on the circumstances of their death, as well as on their living arrangements and limited information on health seeking behaviour prior to death. The respondents for this questionnaire were typically panel respondents who were previous household members with the deceased, other relatives, neighbours or close friends.

Although the KHDS is a panel of respondents and the concept of a "household" after 10-13 years is a vague notion, it is common in panel surveys to consider recontact rates in terms of households. Table A1.4 shows the rate of recontact of the baseline households, where a recontact is defined as having interviewed at least one person from the household. In this case, the term household is defined by the baseline KHDS survey which spans a period of 2.5 years. Due to movements in and out of the household, some household members may have not, in fact, lived together in the household at the same time in the 1991-1994 rounds (for example, consider one sibling of the household head moving into the household for one year and then moving out, followed by another sibling moving into the household).

[37] One serious problem that is side-stepped by this approach is constructing a definition of what makes a household the same household as 10 years ago, especially if there are individuals who have migrated, split-off or the household has dissolved.

Table A1.4: KHDS2 households

KHDS 1		KHDS2 reinterview rates		
Number of interviews (1991-94)	Houesholds interviewed	Reinterviewed	Deceased	Untraced
1	39	22	2	15
		56%	5%	39%
2	45	38	1	6
		84%	2%	13%
3	69	59	1	9
		86%	1%	13%
4	759	713	13	33
		94%	2%	4%
Total	912	832	12	63
		91%	2%	7%

Notes: "Re-interviewed" means that at least one member of the baseline household was reinterviewed in the KHDS 2004. "Deceased" means that all previous household members are reported to be dead. "Untraced" means that no previous household member was re-interviewed. Of the 915 original sample households, 3 were single-person households in which the respondent died before the end of the KHDS 1991-1994 rounds, leaving 912 "surviving" households.
Source: Beegle *et al* (2006)

Excluding households in which all previous members are deceased (17 households and 27 people), the field team managed to recontact 93% of the baseline households. Not all 912 households received four interviews. Not surprisingly, households that were in the baseline survey for all four rounds had the highest probability of being reinterviewed. Of these 746 households, 96% were reinterviewed.

Because people have moved out of their original household, the new sample in KHDS 2004 consists of over 2,700 households from the baseline 832, which were recontacted. Much of the success in recontacting respondents was due to the effort to track people who had moved out of the baseline villages. One-half of all households interviewed were tracking cases, meaning they did not reside in the baseline communities. Of those households tracked, only 38% were located near the baseline community. Overall, 32% of all households were not located near the baseline communities. While tracking is costly, it is an important exercise because migration and dissolution of households are often hypothesized to be important responses to hardship. Excluding these households in the sample raises obvious concerns regarding the selectivity of attrition. In particular, out-migration from the village, dissolving of households, and even marriage, may be responses to adult mortality. At the same time, tracking will provide a unique opportunity to study these coping mechanisms: who uses them, what is the effect, do they get people out of poverty or do they themselves constitute a poverty trap.

Reinterview rates are monotonically decreasing with age, although the reasons (deceased or not located) vary by age group. The older respondents were much more likely to be located if living, which is consistent with higher migration rates among the young adults in the sample. Among the youngest respondents, over three-quarter were successfully re-interviewed. Excluding people who died, 82% of all respondents were re-interviewed. Without tracking, re-interview rates of surviving respondents would have fallen from 82% to 52%. Non-local migration is not trivial; restricting the tracking to nearby villages would have resulted in 63% recontact of survivors. Migration proved to be an important factor in determining whether someone was recontacted. Respondents who were untraced were much more likely to be residing outside Kagera (52%) compare to their counterparts who were re-interviewed (9%).

KHDS 2004 tracked international migrants for Uganda only. Although the location of those in other countries was known, they were not traced. For those respondents who were not reinterviewed, the KHDS 2004 gives some information about their interactions with the reinterviewed respondents.

Community surveys: The community questionnaire was administered in all KHDS baseline communities. There are 49 unique communities; as noted above, the sample has 51 enumeration areas but two pairs are in the same community (areas 44 and 45; areas 46 and 47). In 2004, the community questionnaire was administered in the same manner as in 1991-1994.

Questionnaires and Information Collected

The KHDS1 and KHDS2 collect detailed information at the individual, household and community level. The household questionnaire is the main instrument used to assess the impact of fatal adult illness. It collects data on individuals and households in the following areas: demographic characteristics; health status, symptoms, health-seeking behaviour and medical expenditures; nutritional status; mortality and related expenditures; human capital, enrolments and education expenditures; fertility and contraceptive use; time use in the labour force, other productive and health-related activities; income levels and sources; assets and durable goods, including housing, farm and business assets; consumption expenditure, by component; savings, debts, transfers and receipt of assistance; characteristics of non-resident parents and children, including their mortality

The objective of the community questionnaire is to elicit community-wide information on demographic characteristics; economy and infrastructure; education; health; agriculture; and culture that are common to all households residing in each community. The questionnaire is directed at community leaders who were also specifically asked about the location, distance and identity of the closest market, primary school, dispensary, health centre, and hospital. In addition, they were asked to name traditional healers within the community. Information from these questions was used to identify the sample of markets, schools, health facilities, and traditional healers for specific questionnaires in the study. It is important to note that these samples are not randomly selected and therefore, are not representative of the markets, health facilities, schools, and traditional healers in Kagera. They are representative of the facilities located near the selected sample of households.

The school questionnaire is aimed at assisting the analysis of demand for schooling of household members. It was completed for every primary school in a cluster. If there was no school in the cluster, a school questionnaire was completed for the nearest primary school to the cluster. There are two parts to the school questionnaire. Part A focused on the characteristics, enrolments and fees for each school and was administered by the interviewer. Part B was left with the headmaster or head teacher of each school so they could refer to school records and inventory to provide information on the number of textbooks (Kiswahili, math, other) available for the students of each grade; and the number of classes, enrolled students, enrolled female students, students who attended last week, and two-parent orphans enrolled for each grade. In 2004, the school questionnaire was administered in the same manner as in 1991-1994. The number of schools per enumeration area ranged from one to three schools per enumeration area. A total of 72 school questionnaires were administered in 49 baseline communities.

The price questionnaire measured prices of key consumption goods throughout the survey area and over time. The price questionnaire contained a list of 30 food items, six pharmaceutical products and 13 non-food items. Three prices were collected for each item from three different traders at different locations in the market. Price data were collected from two types of market: the nearest community market and roadside shops or dukas for each cluster in each passage. In 2004, the price questionnaire was administered in the same manner as in 1991-1994. Where possible two questionnaires were completed per enumeration area. In most enumeration areas one questionnaire was done in shops and one in markets, although some enumeration areas have only one questionnaire and one enumeration area has three questionnaires. A total of 90 price questionnaires were administered, 47 from markets and 43 from shops.

The health facility questionnaire was used to establish changes in the demand for health services and the supply of health services offered at a health facility. It was administered to the health facility closest to each cluster. Data collected in this section was organized in three parts. Part A was administered to the medical person in charge and collected information on characteristics of the facility; personnel; equipment; services; immunizations; family planning; inpatient services; demand; and fee exemption policies. Part B was administered to the pharmacist of the facility and asked about the availability of drugs at the facility. Part C, on inpatient and outpatient consultations, was not administered by an interviewer but was completed by the medical officer in charge. This was not administered in KHDS2

The questionnaire administered to the traditional healer documents the prices, types of facilities, services, and referral practices of traditional healers in the survey area. The questionnaire was administered to two healers per cluster, who were randomly selected from those listed by the community leaders. Administered only in Passage 3 of KHDS1, this survey includes questions on the number and types of patients seen, the types of health problems encountered, and the healer's knowledge of the etiology of AIDS and of other diseases as well as personal background of respondents; consultations in past seven days; facilities and equipment; knowledge and practices; prescription and referrals; income and prices; and childbirth services. This was also not administered in KHDS2.

Appendix 2: Asset Index

Using an asset based measure of poverty and well-being would also overcome measurement problems that are associated with income and expenditure measures. First, consumption and expenditure data (with a few exceptions) is of poor quality. It is difficult to obtain accurate information on consumption and income at the household level as individuals are likely to forget purchases if the recall period is too long. Individuals may also not be aware of incomes of other household members or their consumption. Another factor that may cause inaccurate inferences based on consumption and income is the time of the survey as it may not take into account seasonal changes and transitory shocks, which can affect income and consumption (Wall and Johnston, 2008). This is as true for African countries as for others. Another reason is that technical capacities within government institutions that conduct these surveys are limited and budget constraints are often extremely severe. Consequently, international donor agencies such as the World Bank have assumed the charge for the design and implementation of such surveys, albeit at very high financial costs to government statistical agencies (Sahn and Stifel, 2000).

When constructing consumption aggregates, the value of goods consumed needs to be derived. This requires data on prices of goods, nominal interest rates and depreciation rates for semi durable and durable goods, which can be difficult to discern. Even if such data were available, it would need to be differentiated across urban/rural locations, administrative districts and geographical regions owing to high variation in prices that may exist between these (Sahn and Stifel, 2002). A related problem is the choice of the deflator owing to the fact that inflation in developing countries tends to be high and variable across regions and seasons. In the event that this data is not available, unit prices derived from surveys may be used to construct deflators but there are shortcomings in this approach too. Finally, there is a difficulty in making inter country comparisons because of exchange rate distortions that could make the conversion of goods purchases into common prices perilous (Sahn and Stifel, 2002).

The reason behind exploring the use of asset indices as a measure of poverty and well being is compelling: assets in poorer countries are fewer and easier to measure and recall bias tends to be minimal and so, standardisation of surveys is less problematic. Further, relying on the use of actual physical assets such as durable goods and housing characteristics eliminates the need for deflators and data on prices etc.

Construction of the Index

Assets that were included in the index were household durable goods, construction materials of houses as well as access to improved sources of water. Both rounds of the KHDS collect information on whether at least one individual in the household owns consumer durables such as a car, television, radio, stove, refrigerator, fan, sewing machine. Both rounds also collect information on housing quality such as construction materials used for walls, floors, roofs and source of water. Often included in an index of household assets is the household's access to electricity. However, only KHDS2 collects information on access to electricity (KHDS1 data has too many missing observations), so this is excluded in the construction of the index.

The construction of an index of households requires the selection of a set of weights for each asset. The KHDS does not collect data on the numbers of particular assets owned by each household, how old a particular asset is, whether it is still functional and what condition it is in. It also does not collect information on the value that the household places on that particular asset. In the absence of this data and of price data, we let the data determine the weights. This approach is used by Filmer and Pritchett (2001), Sahn and Stifel (2000, 2002), Wall and Johnston (2008) and Booysen, van der Berg *et al* (2008). This may be done either by using principal component analysis as done by Filmer and Pritchett (2008), factor analysis as done by Sahn and Stifel (2000, 2002) and Wall and Johnston (2008) or multiple correspondence analysis as done by Booysen, van der Berg *et al* (2008).

Principal component analysis forces the components to explain the entire correlation structure between the assets and is essentially designed for the use of continuous variables (Sahn and Stifel, 2002; Booysen, van der Berg *et al*, 2008). In contrast, factor analysis accounts for the covariance of the assets in terms of a smaller number of possible common variates (Lawley and Maxwell, 1971). It is also designed for the use of continuous variables but may be used for discrete variables. The multiple correspondence analysis imposes even fewer constraints on the data than factor analysis (Booysen, van der Bert *et al*, 2008). We use factor analysis as not all of the common factors are forced to explain the entire covariance matrix. This was done using STATA.

Table A2.1: Factor loadings for assets, KHDS 1

Asset	Factor 1	Factor 2	Factor 3
Consumer durable goods			
Bicycle	-0.119	0.9571	0.0195
Audio	0.9566	-0.2019	-0.0066
Stove	-0.007	-0.0121	-0.0271
Sewing machine	-0.0176	-0.0299	0.0395
Refrigerator	-0.0043	-0.0084	-0.0138
Fan	-0.0071	-0.0423	-0.0386
Camera	-0.0087	-0.0147	0.0326
Television	-0.0119	-0.0198	-0.036
Car	-0.0124	-0.0221	0.0218
Jewellery	-0.7092	-0.6018	-0.0154
Durable household construction			
Wall	0.026	0.0095	0.6668
Roof	0.0037	-0.0096	0.409
Floor	-0.0252	0.0595	0.6891
Safe drinking water	-0.0428	0.0017	0.0307

Source: KHDS (1994)

Table A2.2: Factor loadings for assets, KHDS 2

Asset	Factor 1	Factor 2
Consumer durable goods		
Bicycle	0.0097	0.0274
Audio	0.2508	0.0645
Stove	0.2363	0.0828
Sewing machine	0.0733	-0.1273
Refrigerator	0.5758	0.1421
Fan	0.2682	0.0116
Camera	0.046	-0.0321
Television	0.7231	0.234
Car	0.7741	0.234
Jewellery	-0.0971	0.0262
Durable household construction		
Wall	-0.2729	0.7376
Roof	-0.1057	0.4589
Floor	-0.2941	0.7313
Safe drinking water	0.0583	0.0329

Source: KHDS (2004)

For Round 1, we used weights (factor loadings) for the first three factors – the first two factors pointed out which durable goods were an indicator of long-term household wealth while the third gave us an indication that having houses built from durable materials also signalled lower poverty in the long-term. For Round 2, we used weights (factor loadings) for the first two factors – the first factor pointed out which durable goods were an indicator of long-term household wealth while the second gave us an indication that having houses built from durable materials also signalled lower poverty in the long-term. These weights are presented below. After the weights (factor loadings) were obtained, they were applied to each asset for each household. The asset index for households in 1994 and 2004 is thus a weighted average of the ownership of 14 assets including consumer goods, having roofs, walls and floors made from durable construction material and a reliable source of water.

Appendix 3: Correlation Matrices

Table A3.1: Correlation between children's health and nutrition outcomes

	Stunted in 1994	Thin in 2004	Recent illness	Longterm illness
Stunted in 1994	1			
Thin in 2004	0.0852	1		
Recent illness	0.0603	0.0187	1	
Longterm illness	0.0131	0.061	0.242	1

Table A3.2: Correlation between annual total household expenditure and expenditure quintiles

	Annual HH consumption expenditure	Richest expenditure quintile	Poorest expenditure quintile
Annual HH consumption expenditure	1		
Richest expenditure quintile	0.7887	1	
Poorest expenditure quintile	-0.4744	-0.2507	1

Table A3.3: Correlation between annual total household expenditure and parental education

	Annual HH consumption expenditure	Mother's education	Father's education
Annual HH consumption expenditure	1		
Mother's education	0.2866	1	
Father's education	0.0287	0.1044	1

Table A3.4: Correlation between annual total household expenditure and household size and composition

	Annual HH consumption expenditure	HH size	No of girls (5-17 yrs)	No of boys (5-17 yrs)
Annual HH consumption expenditure	1			
HH size	0.3287	1		
No of girls (5-17 yrs)	0.2302	0.5903	1	
No of boys (5-17 yrs)	0.1397	0.588	-0.0115	1

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