Food security and child nutrition status among urban poor households in Uganda: Implications for poverty alleviation

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List of abbreviations and acronyms

ACC/SCN	United Nations Administrative Committee on Coordination, Subcommittee on Nutrition
BMI	Body mass index
FAO	Food and Agriculture Organization
HAZ	Height-for-age z-score
HDI	Human development index
IFPRI	International Food Policy Research Institute
IV	Instrumental variable method
MoFPED	Ministry of Finance, Planning and Economic Development
NCHS	National Centre for Health Statistics
OLS	Ordinary least squares method
SSA	Sub-Saharan Africa
UBS	Uganda Bureau of Statistics
UDHS	Uganda Demographic and Health Surveys
UNDP	United Nations Development Programme
UNHS	Uganda National Household Survey
UNICEF	United Nations Children’s Fund
WAZ	Weight-for-age z-scores
WHO	World Health Organization
WHZ	Weight-for-height z-scores

Units of measurement

gm	gram
kcal	kilocalorie
kg	kilogram
ltr	litre
mg	milligram
Ush	Uganda shilling

Abstract

The urgent need for in-depth analyses of the patterns and determinants of food and nutrition insecurity in urban areas in Uganda cannot be overemphasized. Using cross-sectional data, this study explores the key determinants of the food security and child nutrition status among poor households in Kampala.

First, raising the incomes of the urban poor may turn out to be an effective means of reducing the food insecurity problem and child malnutrition. Second, while maternal education has a stronger impact on girls' long-term nutrition, paternal education has a stronger impact on that of boys. Conversely, increases in income tend to have a bigger effect on girls' current nutrition compared to that of boys. All in all, efforts to fight poverty per se may not improve the food security and nutrition status of the urban poor; other factors need to be considered.

Keywords: child nutrition, household food security, urban poverty, urbanization, Uganda

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1. Introduction

The concept of food security has evolved, developed, multiplied and diversified since the World Food Conference of 1974 (Maxwell and Smith, 1992; S. Maxwell, 1996). The main focus has shifted from global and national to household and individual food security and from food availability to food accessibility. The shift to food accessibility is partly attributed to Sen's (1981) seminal work on entitlement theory. Despite these developments, much of the literature on urban food security has concentrated at higher levels, paying little attention to the household level. More so the issues of food accessibility are yet to receive due attention. On the other hand, while food security and nutrition status are separate but inextricably linked components, some have continued to apply the two concepts interchangeably. Food security is necessary but not sufficient for nutrition security. Similarly, poor nutritional status should not be interpreted wholly as indicative of inadequate food intake. UNICEF (1990) and Engle et al. (1999) highlight these differences in their conceptual framework on nutrition.

Additionally, International Food Policy Research Institute (IFPRI) studies (such as Ruel et al., 1999; von Braun et al., 1993) have pointed to the alarming lack of information on the pattern and determinants of food and nutrition insecurity in urban areas. By extension, Maxwell (1998b) asserts that the urban food problems have not commanded political attention in the 1990s as they did in the 1970s and 1980s including those of the most vulnerable population. More importantly, the urban poor and their food security have remained invisible and undocumented (Lourenco-Lindell, 1995). This is also true for nutrition security. Most development priorities including poverty alleviation programmes are targeting the rural areas on the perception that poverty is a rural phenomenon, paying no attention to the growing number of urban poor. This is also true in terms of food and nutrition intervention programmes.

Global context

Globally, while many may doubt the estimates of urbanization and the number of urban poor, most would agree that the world has experienced rapid rates of urbanization and an increasing number of the poor. Roughly, the number of people living in urban areas is expected to surpass that in the rural areas by the year 2005 and to account for about 60% of the global population by the year 2020 according to the Food and Agriculture Organization (FAO, 2001). While the percentage of the total population living in urban areas of less developed countries is still low (below 23% by 1995), the growth rates are greater than those of industrialized nations. For example, for the period

1970 to 1995 the growth rate was 5.1%; it is expected to be 4.6% for the period 1995 to 2015 compared with only 1.1% and 0.6% over the same periods, respectively, for industrialized countries (UNDP, 1998). Concomitantly, the number of urban poor is said to be increasing in most developing countries (Haddad et al., 1999). In South Asia, for example, the growth in the urban poor was 52% for the period 1980 to 1990 and expected to rise to 53% for the period 1990 to 2000 (Hussain, 1990). The most worrying issue is how to satisfy the food needs and meet the other basic needs of the growing population in the urban areas and ensure their nutritional security.

While progress in food security has been reported it has not been even. Developing countries as a whole have reported positive signs but in some regions, notably sub-Saharan Africa (SSA) and South Asia, the picture has been the opposite. The number of chronically undernourished persons increased for SSA from 167.7 million to 194 million during the period 1990–1992 and 1997–1999, respectively, and for South Asian countries from 288.8 million to 303 million persons over the same period (FAO, 2001). Nor is the picture promising in terms of micronutrient deficiencies, particularly iron, vitamin A and iodine. In 1995 over 2 billion people were estimated to be at risk of micronutrient deficiencies, with higher prevalence of iron deficiencies (Latham, 1997). Micronutrient deficiencies have been reported even among calorie-secure populations.

It is evident from the literature that nutrition status has been examined at individual level with much attention to that of children aged 0–5 years. This is so because this group of the population is more vulnerable to inadequate food and poor nutrition. Poor nutrition in infancy and early childhood will result in poor physical and mental development and will affect their productivity in adulthood (Martorell, 1993) and cause them to suffer from chronic illness and disability (Barker, 1994). Globally, the number of stunted children declined from 221 million in 1980 to 182 million in 2000. In contrast, SSA countries had an increase in the average prevalence of stunting for children under five years of age, with the numbers increasing from 35 million in 1980 to 47 million in 1995 (ACC/SCN, 2000) and expected to rise to 49 million by 2005 (Smith and Haddad, 2000). The eastern Africa region is the most affected region in SSA. Over the period 1980–2000, the number of stunted preschool children increased from about 12.9 million to 22 million and the trend is estimated to continue, leading to about 24.4 million by 2005 (ACC/SCN, 2000; de Onis et al., 2000). More specifically, Haddad et al. (1999) found the absolute number of undernourished children and the share of underweight children to be increasing at a faster rate in urban areas than in rural areas. What could possibly explain this rising number of malnourished children in SSA countries? More importantly, what explains the increasing prevalence of child under-nutrition in urban areas? This is one element of the the lamentable situation the SSA countries are trapped in—increasing food insecurity, nutritional insecurity and increasing urbanization and at the same time increasing poverty levels. Against this background, there is need to understand the underlying causes and their contribution to child malnutrition, for which food insecurity and poverty are among the key factors.

These issues of urban poverty continue to receive the attention of researchers. Such studies focus on urban poverty in general (Naylor and Falcon, 1995; Amis and Rakodi, 1994; de Haan, 1997); urban poverty and urban agriculture (Maxwell, 1998a; Rogerson, 1998); urban poverty and food security (Atkinson, 1995); urban livelihood and food security and/or child nutrition (Maxwell et al., 2000); urban livelihood and coping strategies (Maxwell et al., 2000; Moser, 1998; Bigsten and Kayizzi-Mugerwa, 1992); and urban poverty and employment (Amis, 1995). Paradoxically, no blueprint remedies are available to all developing countries given the differences in underlying causes and dimensions of food and nutrition insecurity.

Uganda context

With this global context in mind, the main focus of the present study is on the urban poor in Uganda and their food security and nutrition status. Uganda is among the countries with the lowest levels of urbanization in Africa but with very high growth rates (UNDP, 2002). The urban population has grown from 8% of the total population in 1970 to 13% in 1995 and the rate is estimated to grow to 25% by 2015 according to the Uganda Bureau of Statistics (UBS, 2001). The population growth rates for Kampala, the capital city, alone are well above those observed at the national level, as presented in Table 1. Paradoxically, even with these low levels of urbanization, urban areas are already experiencing pressure on social services and infrastructure.

Table 1: Population, density and growth rates as per 1969, 1980 and 1991 censuses

	1969	1980	1991	2000	2015
Population ('000)					
Kampala	331	457	774	903	1,048
Other urban		1,115	3,565	8,648	
Uganda	9,353	12,636	16,672	22,210	32,517
Population density (per sq. km) ('000)					
Kampala	1,957	2,713	4,581	5,343	6,201
Uganda	48	64	85	113	165
	1948–59	1959–69	1969–80	1980–91	1969–91
Average population growth rate (%)					
Kampala			3.1	4.8	4.0
Uganda	2.5	3.9	2.7	2.5	2.6

Source: UBS (1996, 2001)

UBS has undertaken six national household surveys that provide insights on the dynamics of poverty disaggregated at urban and rural levels over time (see Table 2). The poverty indicators suggest a reduction in poverty over time. The head-count index, as a measure of the proportion of the population below the poverty line, suggests a declining trend between 1992/93 through 1999/00. However, the drop in the rural areas was 20.4%, which is relatively higher than that in urban areas (18.1%) between 1992/93 and 1999/00. In other words, the incidence of rural poverty declined much faster than the incidence of urban poverty over time. Disaggregated information on the poor indicates that the percentage of the population living below the poverty line increased from 12.5 in 1992/93 to 14 in 1995/96 in the urban areas; the corresponding figures for rural areas were 87.5 and 86.0 over the same period (Appleton et al, 1999; MOFPED, 1998/99). While rural poverty is and will continue to dominate, the evidence suggests that poverty is growing in the urban areas. In other words, urban poverty now contributes to a rising share to aggregate poverty in Uganda. The same trend is observed for the other two poverty indicators. It is clear that there were improvements in the distribution among the poor as indicated by a declining trend of the index.

Generally, the Gini coefficient recorded minimum changes between 1992/93 and 1999/00 as shown in Table 2. However, slightly higher income inequalities are observed in the urban areas than in rural areas. In other words, better distribution of income is noted in the rural than in the urban areas. Furthermore, a comparison of the human development index (HDI) between the rural and urban areas reveals that the rural areas experienced a slightly higher improvement, from 0.358 in 1998 to 0.495 in 1999 compared with that of the urban areas of 0.584 to 0.633 over the same period (UNDP, 2000).

Table 2: Changes in poverty and income inequality indicators 1992/93–1999/2000

Indicator		1992/93	1993/94	1994/95	1995/96	1997	1999/00
i) *Poverty*							
Head-count index (P0)	Rural	59.4	56.7	54.0	53.0	48.2	39.0
	Urban	28.2	20.6	22.3	19.5	16.3	10.1
	Uganda	55.5	52.2	50.1	48.5	44.0	35.1
Poverty gap (P1)	Rural	22.1	18.7	17.7	18.1	15.2	11.8
	Urban	8.3	5.4	6.4	5.4	4.3	2.2
	Uganda	20.4	17.0	16.3	16.3	13.7	10.5
Severity of poverty (P2)	Rural	10.9	8.4	8.0	8.5	6.6	5.1
	Urban	3.5	2.0	2.7	2.1	1.7	0.7
	Uganda	9.9	7.6	7.3	7.6	5.9	4.5
ii) Income inequality							
Gini coefficient	Rural	0.33	0.30	0.33	0.34	0.32	0.32
	Urban	0.43	0.39	0.42	0.40	0.37	0.40
	Uganda	0.38	0.36	0.38	0.39	0.36	0.38

Source: UBS (2001), Appleton et al. (1999).

The macroeconomic policy reforms implemented under the structural adjustment programmes have partly contributed to the plight of the urban population especially the poor. First, while such reforms have improved producer prices of the agricultural crops including food in the rural areas, they have partly contributed to the increases in food prices and other consumer items in the urban areas in general and Kampala in particular as depicted in Figure 1. Clearly, such rising trends in food prices may have negative effects on the purchasing power of the urban poor.

Second, reforms led to government cuts in the provision of social services and to

Figure 1: Price trends in selected consumer items in Kampala, 1990–2000

retrenchment of civil servants. Contraction of government's expenditure on the provision of social services is an indication that the available services have not matched the burgeoning increases in the urban population. Bigsten and Kayizzi-Mugerwa (1992) argue that budget cuts, especially for the health sector, could have partly contributed to increased inaccessibility to such services.

In addition to the problem of increasing inaccessibility to social services, unemployment and underemployment remain as contributors to urban distress. The size of the public service was reduced from 320,000 in 1990 to 164,632 in 1998, recording a 48.6% reduction (MoFPED, 1998/99). Increasingly, the labour market is unable to absorb the burgeoning labour force. More importantly, job creation by the private sector is yet to match the growth in the labour supply. The most hit in such reforms are the urban poor (Moser et al., 1993; Sahn et al., 1996). MoFPED (2000) notes that the urban poor suffer unemployment while the poorest 20% are faced with acute underemployment. It is also important to note that the involvement of retrenched civil servants in the informal activities[1] where the urban poor dominate has had serious consequences on the poor's already meagre incomes (Bigsten and Kayizzi-Mugerwa, 1992). By extension, the very restrictive controls imposed by the City Council authorities on the informal activities, including urban crop agriculture and street vending to name a few activities, have worked against the urban poor in general and women in particular.

There is international consensus that rural women play a crucial role in ensuring food and nutrition security in developing countries. Studies by D. Maxwell (1996) and Hasna (1998) theoretically confirm women's role in ensuring food security and nutrition in the urban areas of Uganda. Improving the status of women has therefore been seen as a means to improving food and nutrition security. In contrast, improvements in the status of women as reported by the UBS and ORC Macro (2001) are yet to translate into improved child nutrition indicators.

Evidence from the available literature has continued to link gender to poverty with a stronger linkage to female-headed households (Amis, 1995). For example, Appleton (1996) found female-headed households in urban Uganda to be significantly poorer than male-headed households, even for the lowest 25% of the poorest. Concomitantly, the proportion of female-headed households in urban areas has been increasing over time. Studies carried out elsewhere, such as Hussain (1990), do argue that the increasing urban poverty has partly contributed to the increasing number of female-headed households. While some studies have found female-headed households to be more vulnerable to food and nutrition insecurity than male-headed households, other studies have found the reverse. Issues of the status of women and the increasing proportion of female-headed households need to be incorporated in a study of this kind.

Ssewanyana (1999) elucidated the importance of food security research in Uganda and also highlighted the paucity of studies on food security at the household level. D. Maxwell (1996, 1998a) and Hasna (1998) have to some extent given insights into urban food security in Kampala City, but none have explored in depth the causal factors. Nationally, the percentage of undernourished persons increased from 24 in 1990/92 to 28 in 1997/99 (FAO, 2001). The recent Uganda National Household Survey (UNHS) data suggest that household food insecurity (in terms of calorie and iron intakes) is significantly higher in urban areas than in the countryside. About 63% of urban households are unable to achieve 75% of the required daily calorie intake, compared with 49% of rural households (Ssewanyana, 2001). These are aggregate figures, masking the important differences across socioeconomic groups. Thus, the in-depth analysis is timely, as it will provide the urgently needed empirical evidence to support the current efforts of the government of Uganda in ensuring food security for all.

The prevalence of child malnutrition has remained high despite the observed decline in poverty levels as discussed above. Nationally, about 38% of children aged five years and less were stunted; 24% were underweight and 5% were wasted in 1995 (see Table 3). While slight improvements were recorded for underweight and wasting, prevalence of stunting increased between 1995 and 2000. Child malnutrition data disaggregated at rural and urban levels reveal some interesting results. In 1988/89, in urban areas of Uganda, nearly 35.6% of the children aged five years and less were stunted: 12.8% underweight and 1% wasted (von Braun et al. 1993). The prevalence of stunting in urban areas increased from 22.5% in 1995 to 26.5% in 2000 (see Table 3). As much as these facts give insights into the prevalence of child malnutrition in the urban areas, they conceal useful information on what proportion of these come from poor households and so called more prosperous middle- and high-class households. For example, significant differences in the level of child nutrition across different socioeconomic groups in urban areas have been reported elsewhere (see, for example, Menon et al., 2000). The preliminary findings based on the panel households of UNHS (1992/93 and 1999/00) reveal that stunting reduced more among the richer population than the poor one.

Additionally, the prevalence of child malnutrition seems to be higher among male children than their female counterparts (see Table 3). Similar trends are observed in terms of vitamin and iron deficiencies. Could this be indicative of a gender bias in child nutrition?

Table 3: Child malnutrition indicators in Uganda, 1995 and 2000

	Place of residence						Gender			
	1995			2000			1995		2000	
Prevalence	Rural	Urban	National	Rural	Urban	National	Male	Female	Male	Female
Stunting	40.3	22.5	38.3	39.9	26.5	39.1	40.0	36.7	40.4	36.9
Wasting	5.4	4.9	5.3	4.2	2.9	4.1	6.1	4.6	5.0	3.1
Underweight	26.8	15.3	25.5	23.6	12.4	22.8	27.1	24.1	23.7	21.4
Deficiencies:										
Vitamin A				29.1	15.9	27.9			29.7	26.1
Anaemia										
- Severe				7.3	2.2	6.5			7.0	6.7
- Moderate				38.9	29.2	37.1			39.5	36.6
- Mild				20.4	19.8	20.5			20.1	20.6

Source: Uganda Demographic and Health Surveys (UDHS, 1995, 2000).

The debate on the relationship between poverty and food security is not new. Low incomes in developing countries have been cited as perpetuating food inaccessibility, especially of the poor (Reutlinger, 1985; Riley, 1994; Pinstrup-Andersen and Pandya-Lorch, 1995). Some researchers, such as Drakakis-Smith et al. (1995), assert that the structural adjustment programmes implemented by African governments have greatly contributed to growing poverty in urban areas, resulting in increasing food and nutrition insecurity problems. At the same time, empirical studies have reported mixed results, with some finding nutrient–income elasticities close to one and others close to zero (see, for example, Behrman, 1995). Such results need to be deciphered cautiously, however, as differences may be ascribed to methodological differences.

To maintain their food security, households need to have a stable food supply. However, shocks to food security of the urban poor are imminent given the myriad of problems they face. Like rural households, urban poor households cope with food shortages with no government assistance. D. Maxwell (1996), and Maxwell et al. (1998) report urban farming as a long-term adaptive strategy by women in their efforts to enhance not only food security of their household members but also to alleviate urban poverty in Kampala City. Studies carried out elsewhere (such as Rogerson, 1998) have also confirmed that urban farming enhances household food security and nutrition status. However, if the urban poor lack effective access to urban farming land, as asserted by D. Maxwell (1996), then what other strategies do they use to minimize the consequences of food insecurity? More importantly, how do the urban poor cope with fluctuations in food prices and shortfalls in their incomes? Besides urban agriculture, Bigsten and Kayizzi-Mugerwa (1992) report diversification of income sources by the households in Kampala as among the strategies to minimize urban distress. In addition, Amis (1995) asserts that there is a critical gender dimension in the coping strategies adopted by the urban poor.

In the past, lack of data on consumption and other issues relevant to understanding the food security and nutrition status of the urban poor partly hindered the examination of the responses of urban poor households to changes in government policies that affect their food security and nutrition status. While UBS has carried out a series of national household surveys, these surveys cannot answer most of the concerns raised in this study. First, these surveys have concentrated on the collection of quantitative data, paying little attention to qualitative data. Second, the anthropometrics data are collected only for children under the age of five years, making it difficult to have insights on the nutrition status of other members of the household above five years. Likewise, the demographic and health surveys conducted by UBS do not capture data on economic variables such as prices and income that would influence food security and nutrition outcomes in an urban setting.

In general, the observed decline in poverty does not seem to have resulted in a proportionate decline in child malnutrition, which calls for a broader focus on child nutrition determinants. In other words, poverty reduction per se may not lead to improvements in child nutrition. The current efforts by the government to address poverty, food security and child malnutrition are mainly targeting the rural areas, stressing the fact that the poverty, child malnutrition and food insecurity in urban areas are still invisible to policy makers. However, an increasing trend of the share of the poor population in urban areas, high inequalities in income distribution, high population growth rates, high food prices and low job creation all combine to threaten the food and nutrition security of the urban poor. This presents a new challenge to policy makers of balancing their efforts to address not only rural poverty but also urban poverty. More importantly the issues of urban poverty such as food and nutrition insecurity need attention.

Undoubtedly, a lot of gaps still exist in understanding food security and child nutrition status issues in general and urban areas in particular at the household level. The Ugandan government in its National Nutrition and Food Policy Paper pointed to these gaps. While the government recognizes the need for more research in this area, financial and human resource constraints are still a major hindrance. Thus this research contributes greatly to the dearth of literature on food security and child nutrition status and provides insights that can assist policy makers to act more effectively to reduce poverty and food and nutrition insecurity among the urban poor.

Objectives of the study

In light of the issues posed above, the current study seeks to answer the following questions:

- What are the major factors affecting the food security and child nutrition status of urban poor households? More specifically, is poverty, as claimed by some researchers, a major cause of food insecurity and child nutrition insecurity among urban poor?
- Is there a gender dimension in the determinants of the nutrition status?

- To what extent is the food security and child nutrition status at the household level related to the status of women?
- What are some of the coping strategies adopted by the urban poor to minimize the stress and shocks to food and nutrition insecurity?
- What policy options can be drawn?

Hypotheses

- Poverty is not the most important factor affecting the food security and child nutrition status of the urban poor households.
- Food security and child nutrition status of the urban poor households do as not depend on the socioeconomic status of women.
- There are no gender differences in the determinants of child nutrition.

The rest of the study is presented as follows. The second section presents the methodology used to achieve the objectives of the study. It lays out the conceptual framework that guides the empirical exploration. While the modelling of food security is examined at the household level, the nutrition status and sanitation environment are examined at the individual child level. The estimation techniques and description of the variables included in the models are also discussed in this section. The third section presents the data collection methodology. Owing to financial limitations it was not feasible to cover all urban areas in Uganda in a single study. Instead, the sample covered households in Kampala. Given that Kampala is the capital and largest city in Uganda, the findings will have relevance in informing food and nutrition policies in urban areas. The fourth section discusses the empirical results derived from the bivariate and econometric analyses. Conclusions, policy implications and recommendations drawn from the findings of the study are the subject of the last section.

2. Methodology

Conceptual frameworks

Studies such as Maxwell et al. (2000) have adopted the causative conceptual framework developed by UNICEF (1990) and extended by Engle et al. (1999) to examine the determinants of the nutritional status of children (see Appendix A). This framework breaks the determinants into three levels of causality: immediate determinants, underlying determinants and basic determinants. The immediate determinants of child nutrition manifest themselves at the individual level. As shown in the diagram in Appendix A, these factors are interdependent. The immediate determinants, in turn, are influenced by the underlying determinants, including food security, adequate care of mothers and children, and a good health environment, all manifesting themselves at the household level. Adequate care of mothers and children involves the provision in households and communities of time, attention and support to meet physical, mental and social needs of the growing child and other members of households. The framework points to the very important issue that the adequacy of this care will depend on the control of resources by the caregivers, who in most cases are women. The health environment rests on the availability of safe water, proper sanitation, health care and a safe environment. Poverty is singled out as a key factor affecting the underlying determinants of child nutritional status. These underlying determinants of child nutrition are, in turn, influenced by basic determinants, which include the resource endowments available within the community. The utilization of these resources and how they are translated into resources for food security, care and health are affected by social, cultural, economic and political factors.

The main factors that affect individual food security are household food accessibility rather than food availability according to Sen (1981); household behaviour including decision making and choices made about food acquisition, which are in turn influenced by cultural factors and knowledge; and individual health and nutritional status. At the individual level, health is affected by food intake, nutritional status and health status; at the household level such factors include general housing conditions, food accessibility, overall hygienic conditions, household caring behaviours and feeding practices to name a few. At the community level such factors include the availability, cost and quality of services such as safe drinking water, proper garbage disposal and health services, and the quality of the overall environment. Finally, an important element is the care extended to the most vulnerable groups in the society, that is, children and pregnant and lactating mothers.

Most researchers have concentrated on the prevalence of malnutrition among children under five years with little emphasis on the underlying causes (Young and Jaspars, 1995). This current study overcomes this weakness by focusing on the immediate and underlying determinants of child nutrition among urban poor households in Kampala.

Conceptually, factors affecting food security in urban areas are quite different from those in rural areas (Haddad et al., 1999; Garret and Ruel, 1999). Food accessibility is influenced by the availability of food in the markets, its physical accessibility and affordability, which in turn affect household dietary intake. In urban areas among the poor households, the main determinants of food accessibility at the household level are hypothesized to include prices, income and access to formal and informal transfers. That is, the access that a household has to food depends on whether the household has enough income to purchase food at the prevailing prices, which income may exhibit a seasonal dimension since many of the urban poor tend to be employed in the informal sector. Factors other than food prices and income can affect household food security, mostly by influencing tastes and preferences. Such factors include the household demographic structure in terms of sex and age, education especially that of women, health status of the members of the household, and activity status to mention a few factors.

Modelling and estimation techniques

Methodological differences in terms of proxy variables, estimation methods, sets of independent variables and sampling techniques are evident from the available literature on food security and child nutrition status (see for example, Strauss and Thomas, 1995; Teklu, 1996; Behrman, 1995). More importantly, studies such as Strauss (1990) and Deaton (1997) point to the failure of the past studies to distinguish between exogenous and endogenous household choice variables. Consequently, systematic consideration of these issues is crucial for derivation of policy-relevant information. To come up with plausible results, the present study has to a great extent taken these differences into account.

Modelling procedures

Following well-known expositions (Schultz, 1984; Behrman and Deolalikar, 1988; Strauss and Thomas, 1995) a household production framework is used to examine the determinants of household food security and child nutrition status by specifying, respectively, demand functions for dietary intakes and nutrition outcome functions for children less than five years of age. The household is postulated to maximize a utility, which comprises the nutrition of each household member, food and non-food items purchased, and household production and leisure. The present study's main interest is the child nutrition status and food security at the household level. The model specification for child nutrition outcome is presented prior to the modelling of food security at the household level. The utility function is expressed in Equation 1, with N_1 representing the nutrition status of the i^{th}

child using standardized anthropometric measures of height-for-age (HAZ_i), weight-for-age (WAZ_i) and weight-for-height (WHZ_i); consumption of food, F_i; consumption of non-food, C_i; leisure, L_i; exogenous household-specific inputs, X_h; and unobservable heterogeneity in preferences, ξ. Utility is maximized subject to a time-nutrition production function and income constraints.

$$U_i = f_i(N, F, C, L; X_h, \xi) \qquad (1)$$

Guided by the underlying economic determinants of nutrition status, N_i is an outcome of the height/weight production functions as expressed in Equation 2. N_i is said to be produced by a set of inputs including child-specific characteristics (such as age, sex), X_s; exogenous household-specific inputs (such as parental characteristics), X_h; endogenous health inputs (such as dietary intake, health behaviour, sanitation), X_t; community-specific variables (such as distances to the nearest health facility, prevailing food prices), X_c; and unobserved heterogeneity characteristics at community, household and individual levels, η, that affect the i^{th} child's nutrition outcome.

$$N_i = f_i(X_s, X_h, X_t, X_c, \eta) \qquad (2)$$

The input vector X_t comprises the most important inputs such as dietary intake taken as a measure of food security, care giving behaviours and health environment (such as the sanitation environment) and services as identified in the conceptual framework, which variables are also outcomes of a variety of factors as expressed in Equation 3. X_t is said to be affected by exogenous household-specific factors, Z_h; exogenous community characteristics (including distance to nearest health facility, prevailing food prices), Z_c; and unobserved heterogeneity characteristics at community, household and individual levels, μ, that affect the i^{th} child's dietary intake.

$$X_t, + f_i(Z_h, Z_c, \mu) \qquad (3)$$

Although studies such as Maxwell et al. (2000) have examined the structural causes of child malnutrition, the endogeneity nature of the input vector X_t in the nutrition outcome model exacerbated by lack of data has to some extent made it difficult for other studies to estimate the same. However, the present study seeks to examine the extent to which the socio-demographic, economic and community-based variables affect the child nutrition outcome. In other words, the study intends to measure the ultimate impact of these exogenous factors rather than their impact conditional on a set of choice variables into the nutrition production function. According to Strauss and Thomas (1995), Sahn and Alderman (1997), and Thomas et al. (1996) such total impacts can easily be captured through reduced form anthropometric outcome models as expressed in Equation 4. These models are functions of only the exogenous variables in each respective equation. The error terms $\varepsilon, \tau, \omega$ are also assumed to be uncorrelated with the covariates included in the reduced nutrition outcome models.

$$HAZ_i = f_i(Agec1, Agec2, Sex, Educw, Mhgt, educm, LnIncome, Sexh,, X_C, \varepsilon)$$
$$WAZ_i = f_i(Agec1, Agec2, Sex, Educw, Mhgt, educm, LnIncome, Sexh,, X_C, \tau) \qquad (4)$$
$$WHZ_i = f_i(Agec1, Agec2, Sex, Educw, Mhgt, educm, LnIncome, Sexh,, X_C, \omega)$$

where:

*Agec*1	= child aged 0–15 months
*Agec*2	= child aged more than 15 months
Sex	= 1 if child is male; 0 otherwise
Educw	= maternal education measured in number of completed years
Educm	= natural father education measured in number of completed years
Mhgt	= maternal height as a proxy for the unobserved family background factor
LnIncome	= logarithm of household per capita real income proxied by household per capita real expenditures
Sexh	= 1 if head of household is a female; 0 otherwise

and the rest of the variables are as defined before.

Having specified the model for child nutrition outcome, the study goes ahead to specify the food security models at the household level in terms of calorie, protein and iron intakes. The study goes beyond calorie intake to measure household food security to include protein and iron intakes, as serious deficiencies have been reported in SSA (ACC/SCN, 1997) and in particular Uganda (Republic of Uganda, 1996). Continuing with the utility function in Equation 1, the reduced-form demand functions for the n^{th} dietary intakes, DA_j^n for the j^{th} household, are derived and presented in Equation 5. The independent variables are all exogenous and the error terms ν are said to be uncorrelated with these variables.

$$LnDA\frac{n}{j} = f_j(x_c, LnIncome, Hcomp_k Educsm, Agesf, Agesm\ Sexh, v \qquad (5)$$

where:

$LnDA\frac{n}{j}$	= logarithm of daily dietary intake per capita (*n=calorie, protein and iron*) for the j^{th} household
$Hcomp_f$	= linear indicators of number of persons in the k^{th} age and sex group
Agesf	= age in completed years of the senior adult female
Agesm	= age in completed years of the senior adult male
Educsf	= education of the senior adult female measured in number of completed years

Educsm = education of the senior adult male measured in number of completed years

and the rest of the variables are as defined before.

The study goes ahead to specify a reduced-form equation with sanitation environment (San) as the dependent variable. The model is expressed as in Equation 6 with the same covariates as in Equation 5.

$$San = f\,(Agec1, Agec2, Sex, Educw, Mhgt, Educm, LnIncome, Sexh,,X_c,\gamma) \qquad (6)$$

Estimation techniques

The empirical estimation problem posed by some of the inputs into the child's nutritional status and household level demand function being endogenous is to some extent overcome by the specification of the equations in their reduced form. Yet, other pertinent problems to consider are those of having household per capita expenditure as a proxy for household per capita income, the unobservable heterogeneity characteristics at community, household and individual levels, and the treatment of zero observations for some observations. Some studies such as Strauss and Thomas (1990), Sahn (1990), Sahn and Alderman (1997), Thomas et al. (1996), and Haddad and Hoddinot (1994) point to the possibility of household per capita income being endogenous in equations 4 and 5. This is true especially if the consumption decisions in Equation 1 are jointly determined with anthropometric outcome and dietary intake demand functions. Consequently, there may be need to control for the simultaneity of household per capita income and nutrition outcome and demand functions.

To consistently estimate the reduced-form models in equations 4 and 5 some researchers such as Strauss (1990) and Haddad and Hoddinot (1994) use the fixed-effects and the instrumental variable (IV) methods by such researchers as Sahn and Alderman (1997). This study uses OLS and IV estimation methods. To address the possibility that the household per capita income variable might be endogenous, asset index and age and education of the head of the household are used as identifying instruments. Consequently, all the covariates in equations 4 and 5 are assumed to be exogenous.

To evaluate the credability of the IV approach, three tests are carried out: the relevance of the instruments (Bound et al., 1995), over identification tests and the Durbin–Hausman–Wu test. While the relevance of the instruments determines whether the selected instruments can explain the variation in the endogenous variable that is about to be instrumented, the over identification test determines whether the selected instruments belong in the second stage equation (Davidson and MacKinnon, 1993). The Durbin-Hausman-Wu statistic tests for the endogeneity of the independent variables. This test determines whether the OLS and IV estimates are significantly different. The results from the OLS estimation are said to yield better results than the IV method especially if the latter fails the test specified above (see, for example, Kennedy, 1992). Consequently, the OLS results are preferred.

The present study tests for gender differences in the determinants of child nutrition using a dummy variable approach. This approach permits information on both male and female children to be used in the same model, thus increasing the degrees of freedom and also improving the relative precision of the estimated parameter coefficients (see, for example, Gujarati, 1995). All variables in the child nutrition model were interacted with the male/female dummy, with the exception of the community dummies.

Prior to the econometric estimation of equations 4 and 5 a bivariate statistical analysis using a one-way analysis of variance and t-test are specifically carried out to understand the causes and extent of the food insecurity problem using the dietary adequacy variable on socio-demographic characteristics at the household level. The same is done for child nutrition outcome proxies prior to the actual estimation of the equations. This type of analysis is important in that it gives a feel for the data and to some extent facilitates the choice of the model and estimation techniques. STATA 7.0, which provides corrected standard errors in IV and OLS estimation, is used to estimate the equations.

The possible presence of zero observations for some variables was taken care of in order to minimize the errors associated with them. To avoid selectivity bias and following Battese (1997), these variables were recorded so that a missing or 0 value was replaced by the median value based on the non-zero observations for a particular variable. Then a separate dummy variable, coded as 1 when the corresponding variable was missing and 0 when it was not, was included in the model. Tests for the level of significance of the parameter coefficient on this variable indicate whether the missing observations differ in some way from those with observations.

Description of the variables

The literature on the determinants of household food security and child nutrition outcomes makes it clear that the choice of the dependent and independent variables has varied across studies. In particular, differences in the variables being controlled for in various studies have led to numerous debates in the literature. This issue is discussed for child nutrition outcome models by such studies as Strauss (1990) and for household food security by such studies as Behrman (1995) and Teklu (1996). Therefore, this section describes the variables used in the empirical econometric analyses. The dependent variables are presented first, then the independent ones.

Dependent variables. It is evident from the available literature that there has been a shift from objective measures to subjective measures (see, for example, S. Maxwell,1996; Maxwell et al. 1999). While some researchers have used such objective measures as food availability as a proxy for household food security, others have measured the same using food intakes. The latter takes into account the food accessibility issues. To be treated cautiously is the empirical evidence based on studies where these two measures of household food security have yielded different results.

In this study, dietary intake is used as a proxy for household food security. Households consume a variety of foods, mainly from purchases, that are converted into their calorie, protein and iron equivalents using the *Uganda Nutritional Guide System* by the Ministry of Agriculture and *The Composition of Foods Commonly Eaten in East Africa* by West et al. (1988). On the basis of both the demographic composition and food composition tables, the per capita weighted daily actual intake (DA^n) is derived at a household level (for details, see Appendix B). The derivation of these dietary intakes included non-members of the household including visitors and assumed fair intra-household food distribution.

The standardized anthropometric indicators including height-for-age (HAZ), weight-for-age (WAZ) and weight-for-height (WHZ) commonly expressed as standard Z-scores were taken as dependent variables for the reduced-form child nutrition models. WHZ, a measure of wasting, is used as an indicator of the current nutritional status of a child, where a low WHZ score indicates the child is excessively thin. HAZ, a measure of stunting, is an indicator of long-term nutritional status of a child. Finally, WAZ is a composite measure that incorporates aspects of both stunting and wasting, making the interpretation of the indicator difficult. As previously discussed, the sanitation environment is one of the inputs into the nutritional status of children. The sanitation variable as a dependent variable was derived as an index. The index of sanitation[3] was constructed for each household based on the field assistants' ranking of the sanitation, which included information on human excreta facilities, garbage disposal and housing condition.

Independent variables. In this category are characteristics of the individual child, the household and the community.

Individual child variables: The individual child characteristics include age in completed months at the time of the survey for all children in the household less than five years of age entered using a linear spline. The piecewise linear specification allows the age variable to have different effects on the child's anthropometric outcomes. The age-specific dimension is emphasized here, as some studies such as Sahn and Alderman (1997) have found it to be important in understanding child nutrition outcomes. Other variables include gender entered as a dummy variable taking a value of 1 if male child to capture any gender differences.

Household level variables: These can be divided into parental and other household characteristics. Parental characteristics are included to control for household background; they include mother's education and height and the education of the natural father. Education is based on the number of years of completed formal education. Maternal education is assumed to have a direct link to child nutrition through better child-care practices and resource allocation in the household. Maternal height is included to capture both the genetic effects and effects resulting from family background characteristics that are not picked by the education level. It is also taken to capture the quantity and quality of investments made in the mother's nutrition and health early in her life. This variable enters the nutrition outcome model in a linear manner. The age of the mother and that of the father were not included in the model because of the possibility that they are endogenous variables.

In the demand for dietary intake models, age and education of the senior adult female or male, who is either the spouse of the head or the head of the household, are included since they may influence the expenditure patterns and dietary preferences in the household. Age and education are hypothesized to have a positive impact.

Other household level variables include household composition, headship, income and asset index. The headship variable entered as a dummy variable is expected to capture the effects of household organization on the allocation of resources including food within the household. The real per capita household income variable is proxied by per capita total household expenditures deflated by the consumer price index for all items for the year 2000 (base: 1997/98=100). The total household expenditures are derived, on a monthly basis, as a sum of food expenditures and non-food expenditures including expenditures on health, semi-durables and durables. The per capita expenditures were derived by dividing total household expenditures by household size less non-members. The real per capita income variable is expected to have a positive impact on both the anthropometric outcomes and dietary intakes. Household composition enters through linear indicators of the number of persons, excluding visitors, in a specified age and sex group in the demand for dietary intakes models.

Community level variables: The variables are said to represent the overall availability of services such as health, schools and food prices in the community. Distance to social facilities is used as a proxy for the overall availability of such facilities within a parish and the distance to the nearest such facilities if not available in the parish. These variables enter the anthropometric outcome models as distance to the nearest facility and weighted food group prices. The food prices are derived for major food groups including cereals, roots and matooke (plantain or banana), meat and dairy products, legumes, oils, and other miscellaneous foods. The cereal group includes rice, bread and flours of maize, millet and sorghum. The roots and matooke group includes dried and fresh cassava, fresh sweet potatoes, Irish potatoes, yams and matooke. Groundnuts, fresh and dry beans, fresh and dry peas, and soybeans make up the legume group, whereas beef, pork, goat meat, poultry, fresh milk and eggs make up the meat and dairy products group. The miscellaneous group includes vegetables and fruits such as onions, cabbage, eggplant, pumpkin, pineapple and avocado. These prices were derived at the cluster level, that is, all households within a cluster faced the same prices. The same prices enter the demand for dietary intake models and are hypothesized to have a negative impact.

3. Data

Sample selection

To achieve the objectives of this study, primary data were collected through a cross-sectional survey at the household level. A multi-stage sample design was adopted. The survey covered 630 households selected from all the five divisions of Kampala (Nakawa, Makindye, Kawempe, Kampala Central and Rubaga). The number of parishes varies across divisions, with Nakawa recording 23 parishes, Makindye 21, Kawempe 22, Kampala Central 20 and Rubaga 13 (Uganda Electoral Commission, 2000). The parishes are taken as the primary sampling units, and zones as secondary sampling units. The study covered 40 parishes in all. While the parishes may be selected on the basis of being homes to the majority of the urban poor, the study recognizes that there are poor households even within "better off" parishes. Consequently, parishes were divided into two strata: stratum 1 was made up of all parishes (with the majority of poor households) regarded to be "more poor"; and stratum 2 consisted of all parishes (with the majority of better off households) regarded as "less poor", as presented in Table 4.

Table 4: Summary of sample units by division and stratum

	Stratum 1: More poor			Stratum 2: Less poor			
Division	Total parishes	Sample weights	Number of parishes selected	Total parishes	Sample weights	Number of parishes selected	Excluded*
Central	6	0.25	7	5	0.24	3	9
Kawempe	8	0.27	7	9	0.18	2	4
Makindye	9	0.30	8	9	0.26	4	3
Nakawa	6	0.08	2	7	0.08	1	10
Rubaga	5	0.10	3	8	0.24	3	-

Note: *The parishes were excluded from the sampling method, as some are parishes in business or industrial areas.

Sample weights were calculated for each division per stratum proportionate to the population according to the population census of 1991. The sample weights for each stratum were 0.65 and 0.35 for the "worse off" stratum and the "better off" stratum, respectively, making 26 parishes from the former and 14 parishes from the latter. The number of parishes sampled from each stratum is proportional to the number of parishes identified in each stratum.

The next task was to compute the sample weights based on divisions within each stratum proportionate to the population. These sample weights were in turn used to derive the number of parishes to be sampled in each division on the basis of the parish sample size per stratum discussed above. The results of this process are also presented in Table 4. Then, a three-stage random sampling was used. First, parishes in each division by stratum were listed and thereafter the random sampling method was used to select the parishes. Second, zones were listed for each selected parish and thereafter one zone was selected as a secondary sampling unit on the basis of simple random sampling. With the help of local councillors at Local Council 1 (LC1)[5] a list of all households in the randomly selected zones with children aged five years and younger was compiled to generate a sampling frame. Third, a total of 16 households were randomly selected from each selected zone.

Data collection

The actual fieldwork started with a pilot survey with the objectives of checking on the clarity of the questions and training of field assistants. Both quantitative and qualitative data were collected through interviews with the help of a structured questionnaire. Since women are the key players in ensuring food security and nutrition status of household members, women were the main respondents. In addition, their spouses (where applicable) were also interviewed only for the section marked “for men only”. Data were collected between January and March 2001. The respondents were very cooperative and were eager to get feedback on the nutritional status of their children. The data collected contain information at individual and household levels plus some information on the community characteristics.

Dietary data

The seven-day recall period was used to capture the food consumption data using the consumption approach. Food consumption data include all food purchases, as well as food received as gifts or free collection and from own production excluding all food stocks in the reference period. Both quantity and price data were collected. With this information, estimates of the dietary intake were calculated at the household level on a daily basis as discussed in Appendix B. Food quantities consumed refer to the amount of food that entered the cooking pot. The foods consumed away from home by household members were ignored, as it was difficult to get such information. The quantities of such foods as matooke, fresh cassava, yams, sweet potatoes and vegetables were reported in units such as heaps, bundles, clusters and bunches, which were to some extent market-specific measures. Kilogram equivalents of the market-specific measures were obtained by actual weighing of the food items for each market. It should be noted that within each market there was some variability in the kilogram equivalent of, for example, a heap of sweet potatoes selling at the same price. To minimize measurement errors, the items were bought from at least three buyers in the same market and thereafter an average kilogram equivalent was computed. Furthermore, for food such as matooke, cabbage, pineapple, fish and chicken, the field assistants were instructed to grade them on the questionnaire as small, medium or large. Again this facilitated the conversion of such food into their kilogram equivalent. The whole exercise of converting into kilogram equivalents was done after the survey, with the assumption that there was a small variation in the amount of food measured for each unit of measurement during the seven days prior to the survey. Consumption of alcoholic beverages was excluded from the dietary intake conversions, since not all of the members of the household derived utility from it.

Anthropometry data

The measurements for weight in kilograms and height in centimetres (both collected to one decimal place) were taken for all members of the households, making the data set unique from other surveys that have concentrated on the anthropometry of children aged five years and under. There were a few cases where such measurements were not taken, however, because the member was not home at the time of the survey, was unwilling to be measured or had some degree of deformity. At least two visits were made to reduce the non-response in this regard. Heights were measured using the Shorr height boards, and weights using the Salter scale. The heights of children less than two years old were taken while the children were lying on the Shorr height board; for older children the heights were taken while standing.

To reduce the age misreporting, error checks were included in the questionnaire. For children aged five years and less, where age is important in the calculation of the anthropometric scores, the field assistants were instructed to collect information on both current age and date of birth. Most children's birth dates were obtained from their immunization cards, birth certificates or baptism cards. However, this proved to be a problem where some children were born at home and had never been immunized or baptized. More still, some respondents could only remember the approximate age in years but not the exact months. Consequently, some 3.5% of the children had no information on their ages in completed months.

The nutritional status of children was measured in terms of the anthropometric scores, HAZ, WAZ and WHZ. These scores were computed using EPInfo version 6 software package. Unfortunately, it was not possible to compute the WHZ for children with height less than 49cm or the HAZ scores for children less than one month; concerned children are excluded from the means. These scores were then compared with the National Centre for Health Statistics (NCHS) reference population as a standard recommended by the World Health Organization (WHO). A child with a Z-score of less than –2 standard deviations of the NCHS reference standards was considered as undernourished. Children with extreme score values were excluded from the analyses. Adult anthropometry was measured in the form of body mass index (BMI), calculated as weight in kilograms divided by height in metres squared.

Other data

The other data collected include the socioeconomic characteristics of the members, decision making within the household, health status, non-food household expenditures, shocks and stresses to household food security, sanitation, and community characteristics.

4. Empirical results and discussion

Study results are presented here in two categories: a descriptive analysis of the results of the household survey and an analysis of the interactions and relationships among the various econometric models.

Descriptive analyses

This discussion focuses on socioeconomic and demographic characteristics of the surveyed households, anthrometric characteristics, and household food consumption and food security.

Socioeconomic and demographic characteristics

The sample of 630 households had 3,453 members including children, making an average of 5.46 persons per household, which is higher than that of the entire Kampala area of four persons per household according to the 1991 population census. The household composition in terms of sex reveals that 48.5% were male and 51.6% female. One in every two persons was under 15 years of age and three in every ten persons were under five years of age. In other words, the survey data reveal a very high consumer/worker ratio among the households in the study area. The implications of this in terms of meeting the minimum basic needs especially food and health cannot be taken for granted. For all households 83.8% of membership consists of the head, the spouse of the married head and their children. Other members not related to the head of household account for less than 1%.

Some observations do emerge on the information collected on the activity status of all members above five years of age. Based on the main activity categories, of the members above 15 years excluding those still attending school, 37.3% were own account workers, 15.5% private employees, 12.7% unemployed and 29.1% unpaid family workers.

Income. Only 43.5% of the main respondents reported to have earned some income the week prior to the survey, compared with 81.5% of male heads. Most of the respondents reported food vending and trading[7] as their main source of income. Most male heads derived their incomes from permanent employment and trading. This finding suggests that females are disproportionably less likely to be absorbed in the formal sector, which could be attributed to their low education levels and the fact that they have to look after the children. In general, the mean weekly income varied with sources of income as presented in Table 5. Overall, the mean weekly income of men is significantly higher than that of women. One-fifth of the main respondents and nearly two-fifths of the male heads lamented that their incomes were not stable except for those earning income from permanent employment. The percentage of those reporting stable income varied with the source of income as shown in Table 5. In general, these households face a great risk of income failure because of the large percentage of income derived from the informal sector where employment is also irregular, which in turn puts them at a high risk of food and nutrition insecurity.

Table 5: Weekly average income and income stability by source

	Person earning the income				
	Women		Men		Other members
Source of income	Ush	Stable (%)	Ush	Stable (%)	Ush
Food vending	9,685	8.5	28,933	6.3	7,595
Property income	15,644	92.9	151,907	72.2	-
Remittances	8,721	40.0	19,107	42.9	2,500
Employment income	24,761	67.7	35,603	85.2	19,273
Construction and building	6,125	50.0	23,969	13.0	-
Trading excluding food trading	20,929	2.8	34,101	8.6	27,500
Transport	21,000	0.0	25,904	34.5	40,000
Repairs	25,000	0.0	31,188	11.1	-
Plumber/carpenter	-	-	20,786	25.0	-
Farming	15,219	0.0	12,333	0.0	-
Others	12,750	4.3	15,159	16.0	8,250
Total (average)	14,830	21.2	35,771	37.4	13,513

Education. The overall literacy rates suggest that over 49% of members older than 15 years of age had primary education. Generally speaking, the level of education of females was significantly lower than that of their male counterparts (p=0.00) as expected. Results (Table 6) suggest that the natural mothers, on average, had completed only six years of schooling compared with that of natural fathers of about eight years. In other words, natural mothers had completed slightly less schooling, on average, than natural fathers.

Sanitation. Over 67% of the sampled households had access to treated water and 54.1% disposed of their solid garbage in the nearest Kampala City Council collection bins. Surprisingly, there was a lack of hygienic consciousness in the disposal of liquid waste. Over 80% reported to dispose such waste either in the surroundings or in channels with stagnant waters. These were in most cases breeding places for mosquitoes. Sharing toilet facilities especially pit latrines was common, but over 30% of the households reported the latrines to be in a poor state. Based on field assistant ranking, the overall sanitation condition for 37.6% of the sampled households was ranked between very poor and poor.

The corresponding percentage using similar ranking for housing condition was 35.2; it was 34.6 for garbage disposal and 32.7 for availability of human excreta disposal facilities.

Health status. About 76% of household members over five years of age had a health rating of good and above, 17.2% fair, and 4.1% poor. Some 35.3% (825) experienced some illnesses in the four weeks prior to the survey. The most reported symptoms were high temperature, headache and respiratory infections, in that order. Only 51.6% of those reporting some symptoms sought medical attention, mainly from private clinics (60.1%), followed by pharmacies (12%) and government hospitals (10.8%). Of those who did not seek medical advice, the majority went in for self-medication (51.2%) and about 38.6% felt not sick enough to seek medical attention.

Table 6: Sample characteristics and standard error

A: Children	Female		Male		All		
	Mean	Standard error	Mean	Standard error	Mean	Standard error	Valid Cases
Z-scores							
Height-for-age	-1.31	0.09	-1.39	0.08	-1.35	0.05	802
Weight-for-height	-0.07	0.06	-0.14	0.06	-0.11	0.04	830
Weight-for-age	0.92	0.07	-0.99	0.06	-0.95	0.05	853
Child characteristics							
Age in months	29.06	0.85	28.06	0.80	28.54	0.58	927
Birth weight (kg)	3.17	0.04	3.26	0.03	3.21	0.02	770
Current weight (kg)	11.07	0.17	11.46	0.18	11.27	0.12	887
current height (cm)	82.90	0.73	83.2	0.72	83.07	0.51	857
Sex (1) male	-	-	-	-	0.52	0.02	961
Lives with natural mother (1)	-	-	-	-	0.89	0.01	
Lives with natural father (1)	-	-	-	-	0.75	0.01	

B: Natural parents' characteristics

	Mother			Father		
	Mean	Standard error	Valid cases	Mean	Standard error	Valid cases
Age (years)	25.32	0.19	832	31.44	0.28	639
Education	6.89	0.11	824	8.89	0.15	608
Weight (kg)	53.38	0.38	819	62.46	0.74	133
Height (cm)	157.89	0.22	822	168.62	0.69	130
Body mass index	23.40	0.14	819	21.93	0.22	130

Table 6: Contd.

C: Household characteristics

	Mean	Standard error
Annual per capita household expenditure (Ush)	441,807	8,896
Annual per capita food expenditure (Ush)	296,282	5,426
Annual per capita non-food expenditure (Ush)	145,524	4,901
Female household head	0.17	0.01
Household size (head count)	5.42	0.10
Percentage of members <5 years	30.86	0.52
Percentage of members 5–15 years	22.42	0.78
Percentage of members 15–60 years	43.67	0.63
Percentage of members > 60 years	0.58	0.14

D: Male head and senior female characteristics

	Senior adult female			Male head		
	Mean	Standard error	Valid cases	Mean	Standard error	Valid cases
Age (years)	27.67	0.36	609	33.20	0.40	575
Education (years)	6.79	0.13	604	8.27	0.17	552
Weight (kg)	58.84	0.48	593	61.09	0.82	193
height (cm)	157.73	0.26	594	162.89	0.67	191
Body mass index	23.62	0.18	593	23.00	0.28	191

E: Community characteristics (metres)

	Mean	Standard error
Safe drinking water	113.88	6.88
Garbage disposal	148.70	8.80
Pit latrine	15.62	1.27
Market	792.46	30.00
Trading centre	469.90	30.00

Household expenditure patterns. If household expenditures are used as proxy for income, the median monthly income for the sample is approximately Ush33,194 per capita. The median monthly food expenditure per capita is Ush21,120, compared with Ush11,011 for non-food expenditure per capita. Results in Table 7 show that the mean per capita expenditure of the highest quintile is more than twice that of the lowest quintile. The survey data suggest that food purchases account for, on average, 64.1% of all the household expenditure including health-related expenditures. After food, non-durables expenditures including rent and cost of electricity are the second most important expenditure items accounting for 20.3%. Education accounted for only 6.0% and clothing and bedding for 3.2% (see Table 7). The very low budget share on education is observed. Results suggest a systematic change in the composition of household expenditures as income increases. The budget shares of all the group items increase with increasing household expenditures used as a proxy for income, except for food. The percentage budget share for food declines with increases in income, a finding consistent with Engel's law. Furthermore, results in Table 7 indicate significant differences in the budget shares across expenditure quintiles at standard levels.

Table 7: Mean share of monthly household expenditures by expenditure quintile

		Percentage share in household expenditures					Mean	
Expenditure quintile	Valid cases	Food	Non-durable	Education	Clothing	Others	Per capita expenditure	Per capita real expenditure
1	126	66.8	22.5	2.6	2.9	1.1	24,175	231
2	126	66.6	23.0	3.2	4.0	1.0	31,355	300
3	126	66.0	19.9	5.5	3.0	1.0	32,644	312
4	126	62.6	19.9	7.3	2.9	1.6	41,856	400
5	126	58.1	16.4	11.7	3.5	2.0	55,346	529
All	630	64.1	20.3	6.0	3.2	1.3	37,075	354
p-value	0.00	0.00	0.10	0.10	0.07		0.00	0.00

Anthropometry

The sample data include information on weight and height for all individuals in the household, making it possible to examine not only the nutritional status of children under five years of age but also that of members older than five years, as presented below.

Nutritional status of adults. The nutritional status of adults especially mothers should be of particular concern in view of possible consequences for other household members' nutritional status in general and in particular that of young children. The nutritional status of members above five years of age was classified based on their body mass index (BMI) and the results are presented in Table 8. Using the standard measure suggested by James et al. (1988) some observations emerge. Approximately 6% of natural mothers and fathers are considered chronically energy deficient since their BMI is below 18.5 while about 17% of the natural fathers and 39% of natural mothers are considered overweight/obese. Considering all adults aged 15–60 years, 30% of female adults were suffering from overweight/obesity compared with only 13% of male adults. Could this be indicative of an emerging nutrition problem among female adults? The percentage of those suffering from chronic energy deficiency ranged between 5% and 7%. It is further observed that females within this age group had, on average, a significantly higher BMI than the male adults (p=0.00) a finding consistent with studies carried out elsewhere. Over 19% of household members in the age group of 6–15 years were classified as suffering from chronic energy deficiency, compared with nearly 16% suffering from overweight and/or obesity.

Table 8: Distribution of body mass indexes of members older than 5 years (%)

	Female	Male	All
Children (6–15 years)			
< 14.5	20.21	18.07	19.22
14.5–18.5	60.28	69.48	64.55
> 18.5	19.51	12.45	16.23
Valid cases	287	249	536
Mean	16.59	16.22	16.42
Adults (16–59 years)			
< 17.5	2.13	1.96	2.10
17.5–18.6	4.55	3.92	4.44
18.6–23.8	52.92	80.39	57.88
23.8–28.5	29.87	11.76	26.64
> 28.5	10.53	1.96	9.00
Valid cases	703	153	856
Mean	23.49	21.58	23.15
Adults (> 60 years)			
< 17.5	-	-	-
17.5–18.6	-	-	-
18.6–23.8	30.77	33.33	31.25
23.8–28.5	38.46	66.67	43.75
> 28.5	30.77	-	25.00
Valid cases	13	3	16
Mean	25.83	25.24	25.72
Natural parents			
< 17.5	1.95	3.08	
17.5–18.6	4.15	5.38	
18.6–23.8	54.70	73.85	
23.8–28.5	28.45	16.92	
> 28.5	10.74	0.77	
Valid cases	819	130	
Mean	23.39	21.93	

In general, male members were leaner than female members but a higher proportion of males had BMIs falling within the acceptable ranges. Taking the sample as a whole, results reveal that over 60% of the members had their nutritional status falling within the acceptable ranges. In addition, the overall average BMIs fall in the acceptable ranges except for all adults above 60 years and female adults aged 16–59 years. Worth noting is a relatively high prevalence of about 8.9% of households with both overweight/obese and chronically energy deficient persons, a finding consistent with studies such as Maxwell et al. (2000), Ruel et al. (1999) and Popkin (1998, 1999). This finding presents a double burden to policy makers of finding solutions for underweight and overweight in the same household.

Nutritional status of children under five years. Nearly 11% of the sampled children recorded low weight at birth of less than 2.5kg. The mean weight and height distribution of children aged 0–60 months is presented in Table 9. Some observations worth noting emerge from this table. Female children in the age group 12–23.99 months are significantly shorter than male children in the same age group. Male children are significantly heavier compared with female children in the same age group with the exception of children under six months and those in the age group 24–35.99 months. The overall averages based on the sample data are comparable to those of Maxwell et al. (1998) for low-income households in Kampala.

Table 9: Mean weight (kg) and height (cm) of children by sex by age group

	Male			Female			
Age group (months)	Mean	Standard error	Cases	Mean	Standard error	Cases	*p-value*
Weight							
0–5.99	5.93	0.22	53	5.90	0.23	45	0.94
6–11.99	8.33	0.17	51	7.64	0.23	39	0.02
12–23.99	9.90	0.14	107	9.48	0.18	106	0.05
24–35.99	12.05	0.27	79	11.47	0.22	62	0.11
36–47.99	13.79	0.22	84	13.22	0.22	74	0.07
48–59.99	16.19	0.42	72	14.88	0.24	83	0.01
Height							
0–5.99	58.84	1.00	46	59.08	0.91	40	0.86
6–11.99	67.34	0.67	48	66.56	0.89	34	0.48
12–23.99	76.87	0.58	103	74.67	0.61	104	0.01
24–35.99	86.00	0.89	79	84.25	1.02	61	0.20
36–47.99	93.45	0.67	84	92.49	0.76	73	0.34
48–59.99	101.32	1.23	72	100.07	0.81	82	0.39

Sex differences were not observed in any of the overall mean anthropometric scores presented in Table 6. However, disaggregating by age groups yields the results presented in Table 10, with significant differences observed across age groups within sex. Generally speaking, no similar significant differences are observed across sex within the same age group except in a few cases. For example, the youngest female children had a significantly lower weight-for-age and those in the age group 12–23.99 months a significantly lower weight-for-height than their male counterparts in the same age groups. The weight-for-age and height-for-age scores tend to display the same pattern across the age group unlike the weight-for-height score. The children in the age group 12–23.99 months display the lowest height-for-age and weight-for-age scores. The anthropometric scores improve suddenly after 36 months of age and decline again until 48 months of age. The drastic

Table 10: Mean child anthropometry by age group by sex

	Male			Female			All		
	Mean	Standard deviation	Cases	Mean	Standard deviation	Cases	Mean	Standard deviation	Cases
Height-for-age									
0–5.99 (months)	-0.71	1.01	40	-0.34	1.75	39	-0.53	1.42	79
6–1.99	-1.55	1.37	45	-1.03	1.91	33	-1.33	1.63	78
12–23.99	-1.89	1.85	102	-1.78	1.83	102	-1.84	1.83	204
24–35.99	-1.18	1.67	76	-1.18	1.58	58	-1.18	1.64	134
36–47.99	-1.42	1.52	84	-1.46	1.69	73	-1.45	1.59	157
48–59.99	-1.13	1.74	69	-1.25	1.47	81	-1.20	1.60	150
All	-1.39	1.66	416	-1.31	1.73	386	-1.35	1.69	802
p-value			0.00			0.00			0.00
Weight-for-age									
0–5.99 (months)	-0.08	1.22	53	-0.47	1.48	45	0.17	1.37	98
6–11.99	-0.76	1.41	51	-0.79	1.60	39	-0.77	1.48	90
12–23.99	-1.35	1.20	107	-1.10	1.40	106	-1.23	1.31	213
24–35.99	-1.19	1.27	78	-1.09	1.19	62	-1.14	1.24	140
36–47.99	-1.11	1.12	84	-1.22	1.09	74	-1.15	1.11	158
48–59.99	-0.91	1.30	71	-1.1	1.09	83	-1.01	1.19	154
All	-0.99	1.30	444	-0.92	1.38	409	-0.95	1.33	853
p-value			0.00			0.00			
Weight-for-height									
0–5.99 (months)	0.58	1.63	40	0.97	1.50	39	0.77	1.56	79
6–11.99	0.45	1.35	45	0.39	1.53	33	0.42	1.42	78
12–23.99	-0.30	1.16	102	0.02	1.30	102	-0.14	1.24	204
24–35.99	-0.37	1.24	77	-0.37	1.03	60	-0.37	1.15	137
36–47.99	-0.33	0.99	84	-0.34	0.90	73	-0.34	0.95	157
48–59.99	-0.35	1.01	70	-0.41	0.96	81	-0.38	0.98	151
All	-0.16	1.24	418	-0.01	1.24	388	-0.12	1.24	806
p-value			0.00			0.00			0.00

decline in the anthropometric scores after six months of age could be attributed to the fact that children enter the difficult transition from exclusive breastfeeding to solid foods. This finding is consistent with the patterns of the z-scores by age groups observed elsewhere.

Children from households where women earned some income were less likely to be stunted than children from households where spouses earned no income (p=0.03). This could reflect that women are more likely to allocate resources under their domain to children. No similar significant differences were observed for weight-for-age and weight-for-height measures of nutrition status. By extension, there were no significant differences in child nutrition status and a male head reporting a source of income.

As previously discussed, parental characteristics are said to influence the child nutritional status. Nearly 11% and 25% of the children below five years of age in the sampled households do not live with their natural mothers and natural fathers, respectively. More still, about 15% are not children of the head of the household; they are other relatives of the head especially grandchildren. The bivariate relationship between the nutritional status of children and the natural mother's characteristics yield some interesting findings (Table 11) .

The available literature indicates that the mother's education is an asset to good household nutrition and health. Mothers with more education are expected to provide better health care to their children. Surprising to note is the lack of a significant relationship between mother's education and HAZ scores of children regardless of their ages. However, disaggregating children by age groups based on one-way analysis of variance results indicates a significant relationship between the HAZ scores of children under the age of 15 months and mother's education (p=0.04). No similar significant relation is observed for children above 15 months of age. This finding supports the assertion by Sahn and Alderman (1997) that failure to disaggregate children by age groups may lead to a weak relationship between mother's education and the nutritional status of children. No significant relationships were observed for either weight-for-age or weight-for-height scores even after disaggregating children by age group.

A statistically significant relationship between the age of the mother and the z-scores of the children under five years of age is observed with the exception of weight-for-height (see Table 11). A systematic pattern is evident for the height-for-age and weight-for-age scores, suggesting that child nutritional status is likely to improve as mothers grow older. Results in Table 11 further suggest a significant relationship between the anthropometric scores and mother's nutritional status as measured by BMI. The children of chronically energy deficient mothers were more likely to have significantly lower scores.

HAZ and WAZ scores improve linearly with increasing expenditure quintile, p=0.06 and p=0.05, respectively. However, no similar significant differences are observed for current child nutrition status. The main activity category of the head of the household is significantly associated with long-term child nutrition status but not for weight-for-age and weight-for-height scores. The highest nutritional status is observed among children where the head reported government and political/social/religious workers. The possible explanation could be that these heads were sure of getting a steady income.

A household's hygienic condition is said to be one of the key determinants of child infectious diseases including diarrhoea. As alluded to in the first sections of this study, hygienic and sanitation conditions are pervasive problems in the majority of urban areas where the poor population lives. The study results suggest that children from households where human excreta were visible had significantly lower WAZ and WHZ scores, on average, than their counterparts from households where such excreta were not visible (p=0.05, p=0.09, respectively). Children from households with a higher rating of overall sanitation condition were less likely to suffer from chronic malnutrition (p=0.00). The poor sanitation conditions are the most effective routes for transmission of diarrhoeal pathogens. Diarrhoea may predispose children under five years of age to malnutrition and micronutrient deficiencies, and a high prevalence of diarrhoea may not allow children to maintain optimal nutritional status. Children reported to have had a diarrhoea episode prior to the survey were more likely to have lower height-for-age (p=0.01) and weight-for-age (p=0.00) scores, as expected.

Table 12 presents the extent of the child malnutrition problem among the sampled households, and the trends in the anthropometric scores follow the same pattern as those in Table 6. Results suggest a low prevalence of wasting (2.4%) a high prevalence of stunting (30.3%) and high prevalence of underweight (19.3%) using a cut-off of -2 standard deviations of the NCHS reference standards. One child in 50 suffers from acute malnutrition one-third are chronically malnourished and almost one in every five is underweight. Although acute malnutrition does not seem to be a serious problem, the high level of chronic malnutrition should be of great concern to policy makers.

Results suggest a higher percentage of male children who are stunted than of female children, a finding consistent with the preliminary results based on the UNHS of 1999/2000 (UBS, 2001) and those of the 1995 and 2001 Uganda Demographic and Health Surveys (UBS and ORC Macro, 1996, 2001). There are more stunted children in the 12–23.99 months age group than in the other groups. While results suggest a low prevalence of low weight-for-height for female children, a high prevalence is observed for male children. The trends in the anthropometric indicators in Table 12 are similar to those of UBS (2001) and those of the low-income households in Kampala reported by Maxwell et al. (1998), but slightly higher prevalence of malnutrition is reported for the sampled households. This finding reinforces the finding that child under nutrition is a more severe problem among urban poor households, which is concealed by the aggregate data used by UBS (2001).

Considering only the children classified as suffering from chronic malnutrition, results in Table 6 suggest a sex bias with females more likely to be more stunted than their male counterparts (p=0.01). Mean weight-for-age was not different by sex, although among male children it was somewhat higher than among females. Results further suggest that stunting is the most prevalent nutritional problem among the sample children. Considering the mean anthropometric scores for stunted children some observations do emerge. Statistically significant differences are observed in height-for-age across age for female children (p=0.06).

Table 11: Natural mother characteristics and child anthropometry

Characteristic	Height-for-age Mean	Height-for-age Standard error	Height-for-age Cases	Weight-for-age Mean	Weight-for-age Standard error	Weight-for-age Cases	Weight-for-height Mean	Weight-for-height Standard error	Weight-for-height Cases
BMI of mother									
< 17.5	-2.14	1.97	15	-1.91	1.53	15	-0.85	1.12	15
17.5–18.6	-1.25	1.90	29	-1.19	1.37	30	-0.59	1.28	29
18.6–23.8	-1.48	1.63	383	-1.05	1.35	410	-0.12	1.26	392
23.8–28.5	-1.15	1.51	197	-0.76	1.27	214	-0.03	1.28	198
> 28.5	-0.75	1.81	76	-0.58	1.18	78	-0.02	1.18	76
Valid cases			700			747			710
p-value			0.00			0.00			0.03
Education of mother									
No education	-1.33	1.19	44	-0.95	1.23	49	-0.01	1.51	47
Primary education	-1.29	1.81	394	-0.93	1.38	418	-0.17	1.23	400
Secondary education	-1.41	1.42	237	-0.98	1.25	252	-0.07	1.21	239
Post secondary education	-0.72	1.86	25	-0.58	1.29	26	0.21	1.52	25
All	-1.31	1.66	700	-0.94	1.33	745	-0.12	1.25	711
p-value			0.25			0.54			0.35
Age of mother									
< 20	-1.48	1.96	82	-1.20	1.39	89	-0.36	1.32	86
20–30	-1.36	1.59	485	-0.97	1.30	520	-0.11	1.27	489
30–40	-1.24	1.73	122	-0.72	1.36	127	0.07	1.15	124
> 40	-0.40	1.63	19	-0.27	1.44	19	-0.10	0.99	20
All	-1.32	1.66	708	-0.94	1.33	755	-0.11	1.26	719
p-value			0.07			0.01			0.11

Table 12: Distribution of the prevalence of child malnutrition by sex and age (%)

Age group	Height-for-age score			Weight-for-height score			Weight-for-age score		
(months)	Male	Female	Total	Male	Female	Total	Male	Female	Total
< 6	7.5	12.8	10.1	5.7	2.0	3.9	7.5	2.2	5.1
6–11.99	31.1	36.4	33.3	2.2	9.1	5.1	17.6	23.1	20.0
12–23.99	55.9	41.2	48.5	8.8	4.9	6.9	29.9	26.4	28.2
24–35.99	34.2	20.7	28.4	7.8	6.7	7.3	32.1	17.7	25.7
36–47.99	33.3	35.6	34.4	2.4	2.7	2.5	20.2	27.0	23.4
48–59.99	29.0	22.2	25.3	2.9	3.7	3.3	16.9	21.7	19.5
All	35.6	29.8	32.8	5.3	4.5	4.9	22.3	21.3	21.8
Valid cases	148	115	263	23	18	41	99	87	186

Household food consumption and food security

This study measures household food security in terms of the adequacy of calorie, protein and iron intake levels adjusted for household demographic composition. To assess dietary adequacy, Uganda Nutrition Guide recommendations were used. Although the sampled households reported consumption of over 70 food items, only 35 of these were used in the calculation of dietary intakes. The most commonly eaten foods were maize flour, rice, bread, fresh potatoes, irish potatoes, matooke, groundnuts, beans, beef and fresh milk. A high proportion of the households reported having consumed animal products, but the per capita weekly consumption seems to be very low. For example, only 0.77lts of milk and 0.36kg of beef were consumed. This could possibly be attributed to the high prices and low incomes of the sampled households. The percentage of the households that consumed fish was relatively higher than the percentage reported for rural Uganda by Ssewanyana (1999). Table 13 summarizes the percentage contribution of the major food group to dietary intake by expenditure quintile. Significant contributions across expenditure quintiles are observed except for roots and matooke at the 0.05 level.

In general, the sampled households seem to derive a higher percentage of their calorie intake from roots and matooke, followed by cereal, as these are regarded as the traditional food staples. Although meat and diary products are the main source of protein for all expenditure quintiles except the lowest, the low consumption levels have serious implications for overall protein intakes. The lowest quintile derives much of its protein and iron intake from legumes. On the other hand, the high percentage of iron derived from roots and tubers for all expenditure quintile is worrisome given that the food items within this food group have a low bioavailable form of iron. Households derive a higher percentage of iron intake from meat and dairy products than from the miscellaneous group. Consumption of vegetables and fruits (thereafter referred to as miscellaneous group) is still very low among households despite their high micronutrient levels, especially iron and vitamin A, and low cost. Lack of nutrition information and social factors such as tastes and preferences could possibly explain this low consumption. The consumption patterns and diets of the study population seem to be different from those reported by Ssewanyana (1999, 2001) in rural Uganda. Worth noting is the almost equal contribution of roots and matooke to dietary intake across the expenditure quintiles, indicating that the percentage contribution remains more or less constant. However, households tend to increase their consumption of meat and dairy products as expenditure quintile increases.

A closer look at food group expenditures shows a decrease in expenditure for all food groups with increasing expenditure quintile except for meat and dairy products. Cereals and roots seem to take up a large share of the total food expenditure for the lowest quintile. The expenditure on meat for the lowest quintile is almost half that of the highest quintile.

The percentage of total household expenditure spent on food is among the household food insecurity indicators used by most economists following Engel's law. On average, 64.1% of the total household expenditure including on health was spent on food alone, suggesting a food insecurity problem among the sampled households. The overall mean actual dietary intakes were 688kcal, 33gm and 7mg for calories, protein and iron, respectively, which are relatively lower than those reported in Ssewanyana (2001). This may relate to different demographic composition and different activity levels, implying different dietary requirements. More importantly, the inability of the survey to capture street foods may have contributed to the observed low caloric intake. Elsewhere studies such as Maxwell et al. (2000) report a significant contribution of street foods to the diets of low-income earners.

It must be noted that this procedure of using recommended dietary requirements has received enormous criticism (see, for example, Poleman, 1981; Srinivasan, 1985; Payne, 1990). To overcome this problem, some researchers have used different cut-off points of the recommended daily dietary intake to examine households at risk of food insecurity. For example, Rogers (1996) and Alderman and Garcia (1994) use a cut-off point of 75%, while Delisle et al. (1991) set it at 60% for calories and 75% for protein. This study uses the Delisle et al. (1991) suggested cut-off for calories and protein, as well as a 75% cut-off for iron.

Only 9.5% of the sampled households consumed more than 60% of their daily caloric requirements; for protein and iron, respectively, the percentages were 34.6 and 20.2. As the expenditure group increases, the risk of becoming food insecure declines as presented in Table 14. In general, actual daily protein and iron intakes were less of a problem among the sampled households than were the calorie intake levels. This is consistent with findings by Ssewanyana (2001) and studies elsewhere as cited in Ruel et al. (1999) where protein and iron intakes in the urban areas are less of a problem even among the low-income population. With regard to headship, a higher percentage of male-headed households showed dietary deficiencies than did female-headed households.

Table 13: Contribution of the major food groups to dietary intake by expenditure quintile (%)

	Expenditure quintile						
	1	2	3	4	5	All	*p-value*
Calories							
Cereal	33.1	27.0	23.9	22.9	25.6	26.5	0.00
Legumes	17.4	15.8	15.6	15.7	12.6	15.4	0.00
Meat and dairy products	7.5	11.9	13.6	13.5	17.8	12.9	0.00
Roots and matooke	33.1	35.6	36.2	38.1	33.1	35.2	0.09
Fruits and vegetables	1.8	2.0	2.1	2.5	2.9	2.3	0.07
Protein							
Cereal	27.8	21.5	18.0	16.7	18.3	20.5	0.00
Legumes	31.7	26.7	25.6	25.0	19.6	25.7	0.00
Meat and dairy products	22.2	32.0	35.7	35.2	43.4	33.7	0.00
Roots and matooke	16.7	18.0	19.0	21.2	16.3	18.3	0.12
Fruits and vegetables	1.7	1.7	1.7	1.8	2.3	1.8	0.27
Iron							
Cereal	22.3	19.5	16.7	16.5	19.8	19.0	0.00
Legumes	32.7	27.0	27.0	25.5	20.6	26.5	0.00
Meat and dairy products	9.8	16.3	17.2	16.3	23.2	16.5	0.00
Roots and matooke	31.0	33.0	34.1	36.1	29.6	32.8	0.08
Fruits and vegetables	4.2	4.8	4.9	5.5	6.8	5.3	0.02
Expenditure by food							
Cereal	29.6	23.1	20.2	19.7	21.3	22.7	0.00
Legumes	15.9	12.6	11.8	12.2	8.7	12.2	0.00
Meat and dairy products	19.1	26.2	31.2	31.1	36.8	28.9	0.00
Roots and matooke	29.6	32.5	31.0	30.8	26.9	30.2	0.03
Fruits and vegetables	5.9	5.6	5.8	6.6	6.3	6.0	0.51
Actual dietary intakes							
Calories (kcal)	522	569	662	822	866	688	0.00
Protein (gm)	22.3	26.4	32.2	42.5	42.0	33.1	0.07
Iron (mg)	5.55	5.91	7.17	9.02	8.40	7.21	0.00
Recommended dietary intakes							
Calories (kcal)	2,159	2,168	2,145	2,159	2,176	2,161	
Protein (gm)	38.4	38.5	38.2	38.4	38.8	38.5	
Iron (mg)	11.95	11.71	11.76	11.74	11.93	11.82	

Table 14: Dietary deficient households by socioeconomic characteristics (%)

	Valid cases	Below 60% of the required daily calories	Below 75% of the required daily Protein	Iron
Expenditure group				
1		95.24	84.13	85.71
2		94.44	78.57	86.51
3		92.06	73.02	81.75
4		84.92	47.62	73.02
5		85.71	43.65	73.02
Sex of household head				
Male	523	92.20	66.50	81.80
Female	107	82.20	59.80	71.00
Migration status of the respondent				
Non-migrant (born in Kampala)	62	87.1	64.5	80.7
Migrants	568	90.9	65.4	79.9
Property status of the respondent				
No property	191	91.6	68.1	84.3
Had property	439	90.0	64.2	78.1
Income status of the respondent				
No income	372	92.2	66.9	82.8
Earned income	227	88.0	63.2	76.0
Total		90.48	65.40	80.00

A comparison of households at risk of becoming food insecure with those at no such risk using selected variables is presented in Table 15. The households with larger family size were more likely to be at risk of becoming protein insecure at 0.05 level. Further results suggest that households at risk of becoming food insecure are more likely to spend less on food purchases, in absolute terms, than their counterparts. The households with younger spouses were more likely to be protein and iron insecure. Households with more children were less likely to be at risk of becoming calorie and protein insecure. Taking total household expenditure as a proxy for income, households with lower income per capita were more likely to become food insecure for all the three measures of household food security. This finding is consistent with the results discussed previously.

Household food security and child anthropometry. Table 16 presents a comparison of child anthropometry with household food security status. For all household food security proxies, children from households at no risk of becoming food insecure are likely to have better height-for-age z-scores than their counterparts from households at risk of becoming food insecure.

Table 15: A comparison of household food security status using selected variables

	Calories			Protein			Iron		
	No risk	At risk	P-value	No risk	At risk	P-value	No risk	At risk	P-value
Household size	5.1	5.5	0.20	4.8	5.8	0.00	5.2	5.5	0.14
Weekly food expenditure	33,638	28,638	0.02	31,963	27,595	0.00	32,555	28,235	0.01
Annual per capita household expenditure	492,090	436,513	0.00	528,853	395,745	0.00	493,966	428,766	0.00
Proportion of children	34	31	0.09	34	29	0.00	32	31	0.22
Age of spouse	29	28	0.49	27	28	0.06	29	27	0.02

The same trend is observed for weight-for-age z-scores, although it is not significant at the standard levels. This implies that dietary deficiencies may not help to screen households with underweight children. It may be that intrahousehold distribution of protein- and iron-rich foods is not commensurate with individual specific nutritional requirements. This is supported further by the survey finding that more than 80% of the children did not receive special meals from those of the rest of the family.

Table 16: Household food security and child anthropometry

	Height-for-age		Weight-for-age		Weight-for-height	
	Mean	Standard error	Mean	Standard error	Mean	standard error
Calories						
Not at risk	-0.90	0.19	-0.72	0.14	-0.23	0.13
At risk	-1.40	0.06	-0.98	0.05	-0.10	0.05
p-value		0.01		0.09		0.37
Protein						
Not at risk	-1.17	0.10	-0.87	0.08	-0.16	0.07
At risk	-1.45	0.08	-1.00	0.06	-0.08	0.05
p-value		0.03		0.19		0.30
Iron						
Not at risk	-1.13	0.14	-0.89	0.10	-0.20	0.09
At risk	-1.41	0.07	-0.97	0.51	-0.08	0.05
p-value		0.07		0.50		0.27

Subjective indicators of household food insecurity. Only a single round of data was collected, making it difficult to capture the time dimension. Consequently, it is difficult to determine whether households experienced chronic or transitory food insecurity. However, the survey data contain some elements that provide insights on the vulnerability of the households to food insecurity (Table 17). Respondents' perceptions were measured in two categories, the lack of money and the domestic workload. The same checklists (see column 1, Table 17) were used to score perception. The survey items were designed to allow affirmative responses. Ordinal ratings were used as follows: never = 1; sometimes = 2; and often = 3. The indexes due to lack of money and domestic workload are summative, formed by adding these survey items. The smaller the score the less vulnerable is a household to food insecurity due to either lack of money or domestic workload. The internal consistencies of the indexes were confirmed using Cronbach's alpha and yielded the following alpha (and inter-item correlations): lack of money 0.90 (0.65) and domestic workload 0.71 (0.33).

Table 17: Main respondents' perception of household food security (%)

	Lack of money			Domestic work		
	Never	Sometimes	Often	Never	Sometimes	Often
Worry about the type of food to serve members	33.0	55.6	11.4	84.5	15.2	0.3
Household members ever go to bed hunger	66.9	29.7	3.4	86.2	13.1	0.6
Household members ever eat less than expected	49.4	44.4	6.2	82.4	17.2	0.5
Household members ever skip meals	65.1	29.8	5.1	78.9	20.3	0.8
Respondent eats less than expected	48.7	45.9	5.4	87.9	11.8	0.3

Evidence in Table 17 suggests that domestic work is not as serious a constraint to improving food security as is lack of money. Some 55.6% of the respondents sometimes worry about the type of food to serve members due to lack of money. Skipping meals due to lack of money does not seem to be a regular occurrence as compared with members eating less than expected. The use of two cut-offs of a raw score of 7 and 10 for the lack of money index, which correspond to the fiftieth and seventy-fifth percentiles, respectively, in the distribution some observations do emerge (see Table 18). The percentage of vulnerable households decreases with increasing expenditure quintile with the exception of the fourth quintile. Significant differences are observed within each category of socioeconomic variables except for migration status. While female-headed households were less likely to be dietary deficient, they were more vulnerable to food insecurity due to lack of income compared to male-headed households. Further still, the households above these cut-off thresholds recorded significantly higher household size, older senior women, and lower educational levels for both mothers and fathers compared with the other households. Additionally, the lack of money index declined with increasing expenditure quintile, suggesting that the households at the bottom of the expenditure distribution were more vulnerable to food insecurity.

Table 18: Households vulnerable to food insecurity by socioeconomic characteristics (%)

	Cases	Below the cut-off	
Socioeconomic characteristic		50%	75%
Expenditure group			
1		63.5	19.0
2		44.4	9.5
3		48.4	7.9
4		52.4	11.9
5		38.1	5.6
Sex of household head			
Male	523	43.8	6.7
Female	107	76.6	30.8
Migration status of the respondent			
Non-migrant (born in Kampala)	62	51.6	9.7
Migrant	568	49.1	10.8
Property status of the respondent			
No property	191	64.4	13.6
Had property	439	42.8	9.6
Income status of the respondent			
No income	372	43.0	6.7
Earned income	227	58.5	16.7
Overall		49.4	10.8

For all the households, 56.9% experienced shortfalls in food during the two weeks prior to the survey, with 24.4% reporting a single meal every day. This finding partly explains the low dietary intakes discussed above. The respondents were further requested to indicate shocks to their food security during the past five years and the strategies taken to minimize the impact (see Table 19). The most devastating shock was the death of a household member, followed by unemployment of a household member. The shock with the greatest impact on the households in terms of frequency, however, was the increase in food prices. This was followed by the death of other relatives outside the household. In other words, higher food prices during the past five years seem to have made the households more vulnerable to food insecurity. This finding supports the observation made on the increasing trend in food prices in Kampala in section one.

In the absence of formal food safety nets, households adopted a range of strategies to minimize the impact of the shocks on household food security (Table 19). Social networks seem to play a great role in cases of death and sickness. Expenditure reduction strategy involving saving money by reducing spending on consumption was a common strategy in periods of reduction in household income and increases in food prices. It is evident that distress sale of household assets was not common among households in the study

Table 19: Distribution of type of shock during past five years by strategy (%)

Strategy	Type of shock: Death of household members	Death of other relatives	Sickness of household member	Unemployment of a household member	Decline in income	Increases in food prices
Income raising						
Borrowing money from friends	17.6	25.3	27.7	9.5	17.3	12.5
Search for causal labour	6.7	2.7	2.1	53.5	5.8	5.0
Distress sale of household assets	9.5	5.9	9.2	1.7	6.4	2.1
Expenditure reduction						
Reducing household expenditures	24.3	19.9	24.8	12.9	40.4	52.0
Social networks						
Assistance from relatives/friends	32.4	25.3	29.1	12.9	4.5	8.2
Others	10.5	21.0	7.1	4.3	25.5	20.3
Effect of shock on food purchases						
A great extent	76.0	51.6	54.6	61.2	39.4	47.9
Some extent	20.0	37.0	40.6	33.6	60.0	48.2
Not at all	4.0	11.5	4.2	5.2	0.7	3.9
Valid cases	76	207	150	118	165	287

area. The effects of the shocks on food purchases were greatest for those households reporting the death of a household member and least for those reporting death of other relatives.

Evidence based on the sample data suggests that chronic malnutrition is a more serious problem than acute malnutrition among children less than five years of age. Additionally, food insecurity seems to be a serious problem. The strikingly lower anthropometric scores and lower dietary intakes compared with other studies carried out in both rural and urban Uganda should be of great concern to the policy makers. Despite providing some insights into the child malnutrition and food insecurity problem in poor urban households, the descriptive analyses presented above fail to provide the information needed most by the policy makers in redefining and refining policies to tackle these problems. Therefore, the next section presents an in-depth analysis using econometric techniques intended to provide the urgently needed empirical evidence to support the current efforts of the Government of Uganda to reduce poverty, which in turn is expected to reduce child malnutrition and food insecurity in the urban areas.

Econometric analyses

The estimated reduced model results based on equations 4–6 are presented in tables 20–23. Results for child nutrition models are presented and discussed first, followed by those of sanitation models and then household food security models. The asset index turned out to be too weak an instrumental variable for the log of the real per capita household expenditure to justify estimation using the instrumental variable method. The poor performance of the asset index variable has to be deciphered with caution. It arises partly from the way the variable was measured, as the survey did not collect information on the value of the assets themselves other than whether the household had a particular asset or not.

Estimated reduced child nutrition models

Tables 20–21 present the reduced-form models that examine the determinants of child nutritional outcome models using anthropometrics indicators of height-for-age, weight-for-age and weight-for-height. Table 20 presents results for the aggregated model with all children combined. As previously mentioned, the gender-disaggregated reduced-form equations as presented in Table 21 were estimated using a dummy variable approach. Where no gender differences were observed, the interaction term was insignificant and consequently dropped before the final model was estimated. In this case, the same coefficient is reported for both male and female children. For variables that displayed gender differences, the interaction terms were significant as reported in the table.

The overall performance of the models is discussed prior to the estimated parameter coefficients. The range of the adjusted $\overline{R}^2$ is within those of the previous studies cited above that have examined the determinants of the child nutrition outcome via reduced-form equations. The observed RESET values suggest no evidence of omitted variables. The assumption of homoscedasticty is not rejected for all the proxies of child nutrition status. Likewise, weaker evidence of multicollinearity based on the variance inflation factors is observed for all the estimated models.

Table 20: OLS results for the aggregated reduced-form child nutrition models

	Dependent variable					
	Height-for-age		Weight-for-age		Weight-for-height	
Independent variables	Coef.	t-value	Coef.	t-value	Coef.	t-value
Child characteristics:						
Child age 0–15 months	-0.110	-7.06 *	-0.119	-8.21 *	-0.081	-5.19 *
Child age 15–60 months	0.015	3.01 *	0.005	1.45	-0.008	-2.43 *
Male child dummy	-0.109	-0.80	-0.109	-1.11	-0.110	-1.36
Household characteristics:						
Log of per capita expenditure	0.307	1.95 *	0.151	1.16	-0.090	-0.69
Female head dummy	-0.022	-0.09	0.096	0.55	0.144	1.00
Maternal height	0.026	2.59 *	0.014	1.99 *	-0.004	-0.59
Maternal education	0.020	0.93	0.013	0.76	0.021	1.08
Paternal education	-0.051	-2.67 *	-0.029	-1.54 #	-0.004	-0.25
Log of household size	0.287	1.74 *	0.272	1.75 *	0.020	0.15
Community characteristics:						
Log of price of cereals	0.039	0.12	0.225	0.90	0.411	1.96 *
Log of price of roots and matooke	-0.328	-0.92	0.057	0.25	0.395	1.75 *
Log of price of meat products	0.151	0.86	0.086	0.67	0.014	0.14
Log of price of legumes	-0.314	-1.59 #	-0.087	-0.43	0.041	0.20
Log of price of miscellaneous	0.034	0.20	-0.101	-0.81	-0.212	-1.96 *
Distance to government hospital	-0.075	-3.18 *	-0.048	-2.33 *	0.004	0.21
Distance to private clinic	0.035	0.43	0.104	1.70 *	0.105	1.44
Kawempe	-0.332	-1.58 #	0.028	0.19	0.051	0.34
Makindye	0.038	0.20	0.154	1.40	-0.073	-0.50
Nakawa	-0.326	-2.20 *	0.148	0.75	0.182	0.75
Rubaga	0.008	0.03	0.208	1.09	-0.064	-0.39
Constant	-3.109	-0.77	-3.887	-1.37	-1.919	-0.86
R- squared		0.10		0.14		0.12
Test Statistics						
Wald test for significance:						
All covariates	9.14	0.00 *	10.6	0.00 *	7.98	0.00 *
Child characteristics	17.48	0.00 *	23.58	0.00 *	14.24	0.00 *
All community characteristics	2.98	0.01 *	2.02	0.07 #	2.04	0.07 #
All food prices	0.72	0.61	0.41	0.84	2.44	0.05 *
Maternal characteristics	3.92	0.03 *	2.31	0.11	0.90	0.41
RESET test	1.46	0.22	1.93	0.12	1.78	0.15
Number of observations	802		853		806	

Note: * significant at 0.05 level; # significant at 0.10 level.

Table 21: OLS results for the gender-disaggregated reduced-form child nutrition models

	Dependent variable											
	Height-for-age				Weight-for-age				Weight-for-height			
	Female child		Male child		Female child		Male child		Female child		Male child	
Independent variables	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Child characteristics:												
Child age 0–15 months	-0.110	-6.97 *	-0.110	-6.97 *	-0.119	-8.16 *	-0.119	-8.16 *	-0.081	-5.17 *	-0.081	-5.17 *
Child age 15–60 months	0.015	3.00 *	0.015	3.00 *	0.005	1.51 #	0.005	1.51 #	-0.007	-2.26 *	-0.007	-2.26 *
Household characteristics:												
Log of per capita expenditure	0.307	2.02 *	0.307	2.02 *	0.319	2.27 *	-0.012	-0.06	0.185	1.30	-0.357	-2.05 *
Female head	0.024	0.10	0.024	0.10	0.094	0.53	0.094	0.53	0.140	0.95	0.140	0.95
Maternal height	0.026	2.57 *	0.026	2.57 *	0.014	1.94 *	0.014	1.94 *	-0.005	-0.63	-0.005	-0.63
Maternal education	0.076	2.88 *	-0.028	-0.82	0.013	0.72	0.013	0.72	0.020	1.00	0.020	1.00
Paternal education	-0.093	-3.36 *	-0.020	-0.82	-0.028	-1.50 #	-0.028	-1.50 #	-0.003	-0.19	-0.003	-0.19
Log of household size	0.295	1.85 *	0.295	1.85 *	0.276	1.77 *	0.276	1.77 *	0.029	0.22	0.029	0.22
Community characteristics:												
Log of price of cereals	0.071	0.22	0.071	0.22	0.230	0.91	0.230	0.91	0.423	2.00 *	0.423	2.00 *
Log of price of roots and matooke	-0.366	-1.04	-0.366	-1.04	0.061	0.27	0.061	0.27	0.404	1.76 *	0.404	1.76 *
Log of price of meat products	0.172	0.99	0.172	0.99	0.086	0.67	0.086	0.67	0.016	0.16	0.016	0.16
Log of price of legumes	-0.768	-2.74 *	0.232	0.77	-0.097	-0.48	-0.097	-0.48	0.026	0.13	0.026	0.13
Log of price of miscellaneous	0.011	0.06	0.011	0.06	-0.107	-0.85	-0.107	-0.85	-0.222	-2.05 *	-0.222	-2.05 *
Distance to government hospital	-0.075	-3.34 *	-0.075	-3.34 *	-0.049	-2.34 *	-0.049	-2.34 *	0.004	0.17	0.004	0.17
Distance to private clinic	0.027	0.34	0.027	0.34	0.107	1.73 *	0.107	1.73 *	0.110	1.49	0.110	1.49
Kawempe	-0.333	-1.63 *	-0.333	-1.63 *	0.034	0.23	0.034	0.23	0.058	0.39	0.058	0.39
Makindye	0.023	0.12	0.023	0.12	0.157	1.43	0.157	1.43	-0.071	-0.50	-0.071	-0.50

Table 21 continued

	Dependent variable											
	Height-for-age				Weight-for-age				Weight-for-height			
	Female child		Male child		Female child		Male child		Female child		Male child	
Independent variables	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Nakawa	-0.348	-2.45 *	-0.348	-2.45 *	0.145	0.74	0.145	0.74	0.171	0.72	0.171	0.72
Rubaga	-0.023	-0.08	-0.023	-0.08	0.220	1.15	0.220	1.15	-0.049	-0.30	-0.049	-0.30
Constant	-0.031	-0.01	-6.932	-1.51	-4.758	-1.62	-2.979	-1.05	-3.421	-1.53	-0.435	-0.19
R- squared		0.11		0.11		0.14		0.14		0.13		0.13
Gender differences:												
Log of per capita expenditure					-0.331	-1.59 *	0.331	1.59 *	-0.542	-2.97 *	0.542	2.97 *
Maternal education	-0.104	-2.39	0.104	2.39 *								
Paternal education	0.073	2.00	-0.073	-2.00 *								
Log of price of legumes	1.000	2.31	-1.000	-2.31 *								
Test statistics												
Wald test for significance:												
All covariates	17.69	0.00 *	17.69	0.00 *	10.82	0.00 *	10.82	0.00 *	9.32	0.00 *	9.32	0.00 *
Child characteristics	18.52	0.00 *	18.52	0.00 *	26.52	0.00 *	26.52	0.00 *	19.74	0.00 *	19.74	0.00 *
All community characteristics	6.00	0.00 *	6.00	0.00 *	2.03	0.07 #	2.03	0.07 #	2.15	0.06 #	2.15	0.06 #
All food prices	2.35	0.06 #	2.35	0.06 #	0.44	0.82	0.44	0.82	2.60	0.04 *	2.60	0.04 *
Maternal characteristics	7.39	0.00 *	7.39	0.00 *	2.16	0.13	2.16	0.13	0.85	0.44	0.85	0.44
RESET test	1.47	0.22	1.47	0.22	1.80	0.15	1.80	0.15	3.35	0.02	3.35	0.02
Number of observations	802		802		853		853		806		806	

Note: * significant at 0.05 level; # significant at 0.10 level.

Effect of individual child characteristics. The parameter coefficient on the sex variable is negative, implying that relative to a healthy population z-scores, boys are more malnourished than girls, although not significantly different from zero at 0.05 level for all the three proxies of child nutritional status (see Table 20). This would imply that the sex of a child is not related to the child's nutrition outcome, indicating that there is no gender bias. This is consistent with some other studies carried out elsewhere in Africa (such as Strauss, 1990; Sahn, 1990) and also with the descriptive analyses above, but contrary to findings of Garret and Ruel (1999) and Sahn and Alderman (1997) for Mozambique. As Thomas (1994) clearly points out, such analysis might conceal a lot of information important for understanding gender differences. Against this finding, it is observed that although female and male children tend to display equal nutrition status, the nature of the determinants and the magnitude of their effects seem to differ across gender for parental education and household income proxy as presented in Table 21.

Results do suggest a significant relationship between the age of a child and the nutrition outcome. The long-term child nutrition status deteriorates at the rate of about 0.11 z-scores per month until the child is 15 months of age, probably reflecting a slowing of the rapid growth that typically occurs in younger children. After the age of 15 months, an improvement of 0.015 per month is observed. Likewise, deterioration in child nutrition in terms of weight-for-height and weight-for-age z-scores is observed among younger children per month until the age of 15 months. Contrary to the findings of other child nutrition indicators, results of the weight-for-height display a further deterioration of about 0.01 per month for older children between the ages of 15 and 60 months.

Effect of household characteristics. Here we consider household income and the characteristics of the parents, including age, education, etc.

Income**:** The log of the per capita real household expenditure variable as a proxy for household resources has a positive and significant impact on the child's long-term nutritional outcome, but no similar significant differences are observed for weight-for-height and weight-for-age. Results suggest that a 10% increase in income would close 2.27% of the gap between the mean height-for-age score of the population and the mean of the NCHS reference standards. The insignificance of the income variable for current child nutrition is consistent with the findings of Strauss (1990) and Sahn (1994). This finding based on the aggregated model could be attributed to the fact that current nutrition status is more likely to be affected by stochastic events such as food prices than is income per se, as results in the following sections suggest.

Turning to the gender-disaggregated models some observations worthy of noting do emerge. Results in Table 21 tend to suggest that failure to disaggregate children by gender may lead to a weak association between household income and current nutrition of children, as observed in Table 20. Improvements in household resources will have a significant impact on the female child's weight-for-age score, but will not affect that of the male child. Surprising to note is the negative and highly significant results for the male child's current nutritional status indicator, which is difficult to explain. More interesting are the significant gender differences at 0.05 level. In relative terms, this finding might suggest that improvements to female children's current and medium-term nutritional status are greater than their male counterparts' as a result of increases in household resources. However, results suggest no important differences by the gender of children in terms of long-term child nutrition.

*Parental characteristics***:** A positive and significant impact of maternal height on the long-term nutritional status of the child is observed, which is again consistent with the previous studies cited above. This implies that genetics and human capital investment play a role in affecting the stature of children. Results further suggest a positive and significant correlation between maternal height and the weight-for-age scores, although no similar significant relationship is observed for current child nutrition. The negative and insignificant relation between the current nutrition indicator and the mother's height is consistent with the findings of Strauss (1990) and Sahn (1994). The gender-disaggregated results indicate that mother's height affects both female and male children's HAZ and WAZ scores in a similar manner. This implies that policies aimed at improving the human capital investment in women of childbearing age are likely to have a positive impact on their children's nutritional status.

Also surprising is the insignificant but positive sign on the maternal education after controlling for income in the aggregated model. Several methods of entering the education variables were investigated including adding an interaction term of education and log of per capita real household expenditure and the quadratic term of maternal education. However, none of these methods led to improved significance of the education variable. This finding suggests that the mother's education does not exert independent influence on child nutrition after controlling for household income. However, the gender-disaggregated results indicate that more years of schooling of mothers has a significantly larger effect on the long-term nutrition status of female children compared with male children. This finding suggests that when mothers are more educated, their female children are less likely to suffer chronic malnutrition.

As with maternal education, several methods of entering paternal education variable were investigated, including the possibility of non-linearities, but a simple linear relationship was found to be more plausible. Father's schooling has a negative and significant influence on the long-term nutritional status of children based on the aggregated model, a finding consistent with that of Sahn (1994). Could this negative impact be picking up the differences in the allocation of household resources? While paternal schooling has a significant negative effect on female children's height, it has a smaller although significant effect on the male children's long-term nutrition status. Better schooling of the natural fathers seems to benefit the male children's nutrition status more than that of the female children.

The findings based on the gender-disaggregated models are consistent with the findings of Thomas (1990, 1994) that parental education affects child nutrition differently. While maternal education benefits girls after controlling for income, paternal education benefits boys. Additionally, the widely held finding that long-term child nutrition is affected more by the long-term household resource availability in terms of income and parental education is supported by the study findings.

Community characteristics. A series of community characteristics including prices of food, division dummies and distances to social services were included in the model.

Food prices: The real prices of food entered the reduced-form equations in their logarithmic form. The impact of prices on child nutrition seems unstable across the three nutritional status proxies after controlling for household income. Some prices especially those of legumes are negatively and statistically correlated with long-term child nutrition. That is, negative effects of prices of legumes lead to lower dietary intake especially in terms of proteins, which in turn results in poor child nutrition status. The current child nutrition scenario seems to be more responsive to price variations of cereal, roots and miscellaneous foods. These are the main source of calorie intake and a decline in their prices will lead a child to gain some weight in relation to height. The significant positive sign on the prices of cereal and roots is worth noting. Presumably, households substitute inferior food staples for cereal in response to its price increase. Nevertheless, while the inferior food staples may be cheaper sources of calories, a child's growth and long-term nutritional status might suffer since such foods provide less protein. The changes in the log of the price of legumes tend to affect female children differently from male children—evidence of gender differences. In relative terms, a change in the price of legumes will exert a negative and significant impact on the long-term nutrition status of the female child. This finding is difficult to explain given that the protein requirements for girls and boys under five years of age are the same.

Although some food prices considered individually for the current nutrition indicator do not display a strong significant effect as expected, the joint test shows a significant effect at the 0.05 level. The same patterns are observed for the long-term child nutrition at 0.10 level. The finding supports the earlier observations that current nutrition is more responsive to stochastic events.

Distance to social facilities: The distance to the nearest government hospital is negatively and significantly correlated to long-term child nutrition but not to the current nutritional status. That is, children tend to be taller in communities that are closer to a government hospital as such facilities tend to be better equipped and staffed and the cost sharing is within affordable ranges, not forgetting the in-hospital information services on nutrition and health. The positive and significant coefficient on the distance to the nearest private clinic in the composite measure of child nutrition is difficult to explain.

Division dummies: The division dummies show strong effects. The division dummies for Kawempe and Nakawa divisions are negatively and statistically related to the long-term nutrition status, indicating that children in these divisions are significantly worse off than those in Central region, the reference category. This could imply that children under five years of age in these two divisions are at a greater risk of long-term under-nutrition than their counterparts in Central division. The pure effect of residing in Kawempe or Nakawa reduces the HAZ scores by 0.332 and 0.326, respectively. These differences seem to reflect the importance of divisional differences in terms of social infrastructure to name a few in determining child nutrition outcome. A joint test on the division dummies is significant, indicating the importance of local-level variation in the determinants of long-term child nutrition.

Estimated reduced sanitation models

Some of the previous studies on child nutrition have included sanitation as a purely exogenous variable in the reduced-form models. However, this study recognizes the greater potential for its endogeneity. Table 22 presents OLS estimates with sanitation environment as a choice variable on the part of the household. The importance of gender of a child is equally in evidence when it comes to sanitation, especially in terms of child's age, maternal height and food prices.

Effect of child characteristics. The coefficient on the sex variable is positive but insignificant at the standard levels. Turning to the gender-disaggregated results some observations do emerge. Results suggest a significant relationship between the children's age and the sanitation environment except for the older female children. Younger children are more likely to affect the sanitation environment around them. The negative on the male children could possibly be picking up the fact that younger children are often allowed to defecate in and around the home, which in turn leads to a poor sanitation environment. As children grow beyond the age of 15 months, however, they tend to defecate less and less in and around the home or alternatively are trained to use the latrine/toilet, all leading to improvements in the sanitation environment in which the household resides. However, it is difficult to explain the positive sign on the younger female children. Significant gender differences are observed, with younger female children having a bigger impact on sanitation than their male counterparts and the reverse is true for older children.

Effect of household characteristics. The logarithm of per capita real household expenditure has a significant and positive impact on the household sanitation condition. In relative terms, an increase in household income is likely to lead to improvement in the sanitation environment in which the household lives. Interpreted differently, a household with higher income is likely to live in a locality with a better sanitation environment.

Education of both natural parents has a positive and significant effect on sanitation, suggesting that having a more educated parent is associated with a better sanitation environment. However, the mother's education has a significantly bigger effect (p=0.04) than that of paternal education.

Although the aggregated model seems to suggest a weak and insignificant relationship between maternal height and the sanitation environment, the gender-disaggregated results suggest a negative and significant impact for the female children, which is difficult to explain. However, results suggest a significantly bigger effect on the male children compared with their female counterparts.

The female head dummy has a negative and significant impact on the sanitation environment, suggesting that a household with a female head is more likely to stay in areas with poor sanitation. The low levels of income of these households could partly explain this finding.

Table 22: OLS estimates for reduced-form sanitation model

	Aggregated		Gender-disaggregated Female		Gender-disaggregated Male	
Independent variables	Coef.	t-value	Coef.	t-value	Coef.	t-value
Child characteristics						
Child age 0–15 months	-0.007	-0.36	0.048	1.60 #	-0.057	-1.97 *
Child age 15–60 months	0.005	0.82	-0.009	-1.10	0.016	1.99 *
Male child	0.084	0.59				
Household characteristics						
Log of per capita expenditure	0.422	2.07 *	0.437	2.17 *	0.437	2.17 *
Female head	-0.482	-1.97 *	-0.450	-1.86 *	-0.450	-1.86 *
Maternal height	-0.014	-1.13	-0.045	-2.51 *	0.014	0.88
Maternal education	0.140	5.16 *	0.137	5.12 *	0.137	5.12 *
Paternal education	0.044	1.60 #	0.049	1.78 *	0.049	1.78 *
Log of household size	0.381	1.83 *	0.408	1.98 *	0.408	1.98 *
Community characteristics						
Log of price of cereals	-0.035	-0.09	-1.277	-2.42 *	0.900	1.84 *
Log of price of roots and matooke	0.655	1.81 *	0.651	1.82 *	0.651	1.82 *
Log of price of meat products	-0.026	-0.14	0.003	0.01	0.003	0.01
Log of price of legumes	0.215	0.76	0.194	0.70	0.194	0.70
Log of price of miscellaneous	-0.107	-0.59	0.195	0.77	-0.448	-1.79 *
Distance to govt hospital	0.184	5.88 *	0.176	5.66 *	0.176	5.66 *
Distance to private clinic	-0.158	-1.26	-0.150	-1.19	-0.150	-1.19
Kawempe	1.239	5.58 *	1.254	5.70 *	1.254	5.70 *
Makindye	0.508	2.17 *	0.502	2.16 *	0.502	2.16 *
Nakawa	0.582	1.89 *	0.605	1.98 *	0.605	1.98 *
Rubaga	0.309	1.06	0.326	1.13	0.326	1.13
Gender differences						
Child age 0–15 months			-0.105	-2.51 *	0.105	2.51 *
Child age 15–60 months			0.025	2.21 *	-0.025	-2.21 *
Maternal height			0.059	2.46 *	-0.059	-2.46 *
Log of price of cereals			2.177	3.19 *	-2.177	-3.19 *
Log of price of miscellaneous			-0.643	-1.82	*0.643	1.82 *
Constant	1.320	0.32	12.041	2.26	-6.985	-1.37
R-squared		0.16		0.18		0.18
Test Statistics						
Wald test for significance:						
All covariates	6.73	0.00 *	6.65	0.00 *	6.65	0.00 *
Child characteristics	0.33	0.80	2.53	0.07 #	2.53	0.07 #
All community characteristics	5.43	0.00 *	5.91	0.00 *	5.91	0.00 *
All food prices	0.83	0.53	2.08	0.00 *	2.08	0.00 *
Maternal characteristics	13.85	0.00 *	13.53	0.00 *	13.53	0.00 *
Parental education			19.52	0.00*		

Note: * significant at 0.05 level; # significant at 0.10 level.

Effect of community variables. With regard to division dummies, the impacts are larger in Kawempe, Makindye and Nakawa compared with Central division. In relative terms, households in these divisions are more likely to have better sanitation environments than their counterparts in Central division.

Estimated reduced household food security models

Table 23 presents results for the three proxies of household food security. Strauss and Thomas (1994) extensively discuss the consequences of common measurement errors in the derivation of dietary intakes and expenditures on the coefficient of the income variable. To avoid this problem, the per capita non-food expenditures were used to find per capita total expenditures. Results indicate that income, food prices and household composition variables are significant factors in influencing household food security.

Household characteristics. Among others, this section looks at household income, composition and headship.

Income: Results suggest a positive and significant impact of household income on all the three dietary intakes. This accords with the descriptive analyses of the respondents' perception of their food security and the type of strategy taken to reduce the impact of shocks, where income stands out clearly as a key factor. The income elasticities are 0.188 for calories , 0.238 for protein and 0.213 for iron intake. The results indicate that households will demand relatively more protein rich food as their incomes improve. Iron, as a proxy for micronutrients, is responsive to income changes, a finding consistent with observations by Behrman (1995).

The income elasticities derived from this study are within the ranges reported by Ssewanyana (2001) after controlling for prices, taking into account foods consumed by visitors and excluding visitors in the computation of household size. Therefore, raising the incomes of the sampled households will lead to improvement in their food security status.

Household composition**:** The impacts of the addition of household members by age group and gender on dietary intakes are also estimated. Calorie intakes decrease with increases in the number of females aged 15–34 and above 50 years. Similarly, protein intake decreases with increases in the number of females aged 5–14, 15–34 and above 50 years. On the contrary, the addition of a male household member of age 5–14 years would increase the calorie intakes and the addition of older males above the age of 50 years would increase the protein intake, assuming other factors remain constant. These observed differences could possibly be attributed to the gender differences in daily dietary requirements. Generally speaking, an additional female member aged 15–34 or an older female above 50 years would reduce the iron intakes.

Table 23: IV models of household food security

	Dependent variable log of per capita					
	Calories		Protein		Iron	
Independent variables	Coef.	t-value	Coef.	t-value	Coef.	t-value
Household characteristics						
Log of per capita expenditures	0.188	2.56 *	0.238	2.47 *	0.213	2.40 *
Female head dummy	0.061	0.61	0.166	1.17	0.175	1.28
Number of females 0–4 years	-0.021	-0.48	0.001	0.01	0.021	0.41
Number of females 5–14 years	-0.001	-0.02	-0.055	-1.69 *	-0.030	-0.81
Number of females 15–34 years	-0.091	-2.66 *	-0.123	-2.71 *	-0.104	-2.39 *
Number of females 35–49 years	0.030	0.34	0.005	0.05	0.049	0.48
Number of females more than 50 years	-0.391	-2.58 *	-0.379	-1.98 *	-0.340	-1.66 *
Number of females age not stated	-0.026	-0.31	-0.145	-1.26	-0.107	-0.74
Number of males 0–4 years	0.006	0.13	-0.011	-0.18	0.007	0.12
Number of males 5–14 years	0.074	2.64 *	0.028	0.70	0.050	1.35
Number of males 15–34 years	0.009	0.27	-0.008	-0.18	-0.040	-0.96
Number of males 35–49 years	-0.042	-0.51	-0.007	-0.07	0.057	0.62
Number of males > 50 years	-0.079	-0.44	0.414	1.90 *	0.183	0.78
Number of males age not stated	0.220	2.48 *	0.340	2.76 *	0.219	1.77 *
Senior adult characteristics						
Male aged less than 30 years	0.002	0.16	0.016	1.33	0.011	0.94
Male aged 30–45 years	-0.005	-0.44	-0.009	-0.76	-0.017	-1.34
Male aged more than 45 years	0.018	1.34	-0.013	-0.66	0.013	0.69
Male education less 8 years	0.006	0.47	0.007	0.45	0.015	1.00
Male education 8–12 years	-0.041	-2.33 *	-0.031	-1.33	-0.050	-2.31 *
Male education more than 12 years	0.041	1.32	0.030	1.06	0.071	2.54 *
Female age less than 25 years	-0.008	-0.88	-0.004	-0.39	0.015	1.46
Female age more than 25 years	0.013	2.37 *	0.015	2.38 *	0.011	1.54 #
Female education less than 7 years	-0.004	-0.39	-0.026	-2.03 *	-0.022	-1.75 *
Female education more than 7 years	0.022	1.55 #	0.007	0.40	0.005	0.30
Community characteristics						
Log of price of roots	-0.585	-4.36 *	-0.517	-3.72 *	-0.542	-3.92 *
Log of price of cereals	-0.164	-1.43	-0.291	-2.95 *	-0.338	-2.60 *
Log of price of meat	0.074	1.79 *	0.155	2.45 *	0.145	2.72 *
Log of price of legumes	0.047	0.77	0.010	0.13	-0.447	-5.33 *
Log of price of miscellaneous	-0.108	-2.45 *	-0.061	-0.98	-0.124	-1.90 *
Kawempe	-0.022	-0.45	-0.001	-0.01	0.078	1.08
Makindye	0.135	2.11 *	0.221	2.48 *	0.207	2.35 *
Nakawa	0.158	1.30	0.181	1.83 *	0.128	1.08
Rubaga	0.008	0.13	0.000	0.00	0.024	0.27
Constant	9.781	9.02	6.074	5.34	8.243	7.00
R-squared		0.26		0.27		0.26
Test statistics						
Wald test for joint significance						
All covariates	81.80	0.00 *	83.24	0.00 *	14.61	0.00 *
Food prices	6.31	0.00 *	5.63	0.00 *	15.76	0.00 *
Household composition	3.61	0.00 *	3.38	0.00 *	2.24	0.02 *
Senior adult female characteristics	1.59	0.19	2.88	0.03 *	2.25	0.08 #
Senior adult male characteristics	1.87	0.11	0.99	0.45	1.88	0.11
Division dummies	2.31	0.07 #	2.98	0.03	1.81	0.14
Durbin–Wu–Hausman	30.60	0.00	24.61	0.00	30.53	0.00

Note: * significant at 0.05 level; # significant at 0.10 level.

Headship: The study findings fail to support the observations made elsewhere (see, for example, Hussain, 1990) that female-headed households are more vulnerable to food insecurities than are male-headed households. The reverse seems to be true for the female-headed households in this study, although not significant at the standard levels.

Senior male and female characteristics: A senior adult female with less than seven years of schooling has a negative and significant impact on the overall protein and iron intakes in the household. With more years of schooling beyond primary, results suggest a positive impact, although the impact is only significant for calories. The effect on the senior adult male at lower levels is almost zero. A negative and significant effect is observed for the senior adult male who has completed 8–12 years of schooling, but this negative impact disappears as his education increases beyond 12 years, especially for iron intakes.

By extension, the age of the senior adult male seems not to be a significant determinant for all the three dietary intakes. While the younger senior female members variable displays a negative and insignificant correlation with calorie and protein intake, positive and significant results are observed for senior adult females above 25 years for food security proxies. A joint test on all senior adult female characteristics indicates statistical significance, implying that their status is a key determinant in household food security especially for protein and iron.

Community characteristics. Interactions here relate primarily to food prices and location.

Food prices: Generally speaking, prices of roots and cereals are negatively and significantly correlated with all the three dietary intakes. The prices of legumes and miscellaneous foods, although negative, are found to be significant only in the iron model. Given that the urban poor spend a very high percentage of their income (55–70%) on food purchases, the negative impact of food prices will have serious consequences on their food security. More worrisome is the impact on the households in the lowest quintile. Results show that price elasticity of demand for dietary intakes is inelastic. High prices are said to hinder poor urban households' food accessibility after controlling for household income.

The positive sign on meat and meat related products for the protein and iron models may suggest a possible cross-price substitution effect resulting from a meat price increase. A rise in the price of meat may discourage its consumption and the subsequent substitution toward nutritionally richer but less expensive food items such as beans and groundnuts.

Of interest is the responsiveness of iron intakes to changes in food prices. The possible explanation could partly be due to the fact that food staples provide a high proportion of iron.

Division dummies: Results suggest a locational difference in the level of dietary intake especially for Makindye and Nakawa divisions. Households in Nakawa division are said to consume more protein intake than their counterparts in Central division. A household in Makindye division is more likely to have better dietary intakes than its counterparts in Central division.

The key determinants and their nature and magnitude tend to differ across the three food security proxies, protein, iron and calorie intakes. Income and food prices come out as critical factors as expected, since the sampled households depend heavily on the market as the source of their food.

5. Conclusions and policy implications

Conclusions

While the results based on the descriptive and econometric analyses are broadly consistent with what has previously been reported in the urban literature, they do yield a number of interesting findings that will presumably be valuable to policy makers and urban planners. First, the study confirms that food insecurity and child malnutrition are serious problems among urban poor households, with stunting the most prevalent nutritional problem among children under five years of age. Of major concern is the finding that three in every ten adult women aged 15–60 years are overweight and/or obese. The findings also indicated a relatively high percentage of chronic energy deficiencies among children aged 6–15 years. Slightly lower height-for-age z-scores were observed among children whose mothers' BMIs were within the normal range. More importantly, results tend to suggest a double burden of underweight and overweight/obese adult persons living in the same household.

It is evident from the study findings that consumption of a variety of foods by the urban poor may not have increased their probability of meeting the minimum recommended daily dietary requirements. Food staples, which are richer in one nutrient but deficient in others, are the main dietary sources. The consumption of protein-rich food is still very low especially among the lower expenditure quintiles, and seems not to differ much from those of the rural households. Calorie deficiencies were the most pressing problem of the three proxies of household food security. Children from households at a risk of becoming food insecure were more likely to suffer from stunting than children in those households at no risk. The households with older women, larger household size and members with lower education levels were more likely to be vulnerable to food insecurity. Inadequate income, high fluctuations in prices of food and unemployment of members of the household were singled out as the major shocks to food security in the five years prior to the survey.

Most of the urban poor especially women are employed in "informal" sector activities, where earnings are very low and irregular. This has serious consequences for household food security and child nutrition status. These results have demonstrated that children in households with heads employed in the formal sector are more likely to be better nourished than those in households whose heads are either employed in the informal sector or not employed at all.

Second, the nature of the key determinants of child nutrition status and the magnitude of their effects may differ according to the nutrition outcome indicators selected. This is also true for the three proxies for household food security. Results have demonstrated the importance of community characteristics as well as household characteristics in influencing not only child nutrition but also household food security and the sanitation environment. More importantly, addressing poverty per se is not likely to lead to improvements in the food security and nutrition status of the urban poor. The issue of female-headed households being more vulnerable to food and nutrition insecurity is not evident from the survey data.

Policy implications

The key policy issues that tend to come out include improving the income of urban poor households, addressing food prices, providing public health facilities, educating parents, improving overall human capital investment in women and promoting nutrition education.

Raising income: Strategies aimed at increasing the incomes of the urban poor are expected to improve both the nutrition of children under five years of age and the household food security. As previously discussed, the urban poor not only depend on markets for food purchases but also spend the largest share of their income on food purchases. Given the vital role of informal sector activities in the employment and livelihood of the urban poor in general and women in particular, the strategies for improving income should focus on improving the productivity of these activities. The informal activities should not be looked at as a menace to urban development, but rather as activities that are helping to deal with the employment problem. The controls imposed by the City Council authorities on informal activities should be revisited as they simply drive down the incomes of the urban poor, which in turn negatively influences their food and nutrition status.

Anecdotally, the level of unemployment is on the rise and in conjunction with the rapidly growing urban population, it severely impairs the purchasing power of the urban poor. Without adequate food and nutrition, people cannot break the vicious cycle of poverty. The poverty alleviation programmes implemented in rural areas to date place little emphasis on employment generation. Thus if such programmes are to be tried in urban areas targeting the urban poor, policies meant to increase employment opportunities, especially for women, should be top on the agenda and supported by politicians and urban planners.

Food prices: Food prices are also essential determinants not only of food security but also of child's nutrition status especially for current nutrition. In general, food prices seem to be rising faster than the incomes of the urban poor. Even if some might argue that Kampala is well supplied with food from almost all rural areas in Uganda, the poor may not have access to it without adequate purchasing power. Since the government does not exercise control over food prices, and given the lack of formal safety nets, this study recommends designing and implementing policies that will eventually reduce the cost of food in urban areas. Such policies should among other things address the efficiency of the food marketing system. This in turn may reduce food prices to levels affordable by the urban poor. However, improving the efficiency of the marketing system in urban areas will not be achieved without addressing the problems of the rural areas that supply most of the foods in the urban areas. Key among these are infrastructure and other rural services.

Parental characteristics: The education of the parents is important but varies depending on the gender of the child. While maternal education has a strong impact on girls' nutrition, paternal education has a stronger effect on boys' nutrition status. Controlling for income, the preferences of mothers and fathers differ and could suggest that the partners' power over resources is a function of their education. As pointed out by researchers such as Glick and Sahn (2000), educated mothers might use their enhanced bargaining position to direct household resources toward their daughters' nutrition. This calls for long-term investments in the formal education of girls beyond primary level and informal education of women.

Maternal height as a proxy for maternal nutrition was also found to be an important factor, especially for the long-term nutritional status, with no gender dimension. There is need to break the inter-generational cycle by ensuring better growth, health and nutrition throughout the lifecycle of mothers. Consequently, improving the nutritional status of women during pregnancy and also ensuring that girls have good nutrition in their early childhood might lead to a reduction in child malnutrition. The efforts by the government to combat child malnutrition in rural areas through the CHILD project should also target the urban poor, especially those with lower education levels, as well as households with large family size and those with elderly women.

Nutrition education: In the short run, there is need to encourage households to improve their intakes through a reallocation of food expenditures away from higher-price dietary sources to less expensive ones. The promotion of food staples that are high in iron can also eventually lead to increases in calorie and iron intakes simultaneously. In Uganda, food consumption patterns are deeply entrenched in people's culture, making the attempts to introduce new but more nutritious food difficult. Therefore, promoting the shift to richer foods should be at the core of the long-term strategy.This calls for more rigorous nutrition education meant to change consumption behaviours and a lot of sensitization programmes to promote awareness of the risks involved in dietary intake deficiencies.

In summary, the increasing numbers of the urban poor and their food and nutrition insecurity problems should be a major concern among policy makers. First, policy makers have to recognize that the urban share of the poor population is rising and that urban areas are experiencing high population growth rates that have outpaced the provision of social services and infrastructure. There is need to reverse the current bias not only in the poverty alleviation programmes but also in the nutrition interventions toward the rural areas. Such policies should be designed in a way that is flexible and reflects the needs, conditions and resources in each community. Second, efforts to improve household food security and child nutrition should be broad based. Reducing poverty only by increasing household incomes is not sufficient. Such programmes should be accompanied by improvements in education, especially for girls, sanitation and the overall health status of women.

Although the study has provided some insights into the food security and child nutrition status among the urban poor, the emerging issue of underweight and overweight and/or obese members in the same household raises a big challenge to policy makers and politicians alike. Previous researchers have extensively expressed the challenge facing policy makers of fighting increasing urbanization, poverty, child malnutrition and food insecurity. It is extremely difficult for policy makers to address the problems of overweight and/or obesity when they focus on child malnutrition and food insecurity. The study recommends further policy-oriented research on how best the Government of Uganda can address this double burden.

Notes

1. Informal activities employ over 80% of the urban population, Maxwell et al. (1998b) cites.

2. This study defines a household as a group of persons living under the same roof and eating from the same pot.

3. For the index to be content valid, a reliability index was assessed using Cronbach's alpha test, which was derived as 0.87 with inter-correlation of items with the index of 0.5.

4. These consumer price indices are collected by the Ministry of Finance and Economic Planning on a monthly basis.

5. Local Councils 1 keep a list of households in their localities. These lists are comprehensive in terms of demographic characteristics of household members and are regularly updated.

6. Nearly 2% of the original targeted 640 questionnaires were spoilt and hence omitted from the analysis.

7. Trading excludes food vending.

8. The econometric results are presented only for the final equations used in the discussion to keep the number of tables manageable. The results of the missing observation dummies are also left out for the same reason. Printouts are available from the author upon request.

9. Legumes are the major source of protein for most households in the study area.

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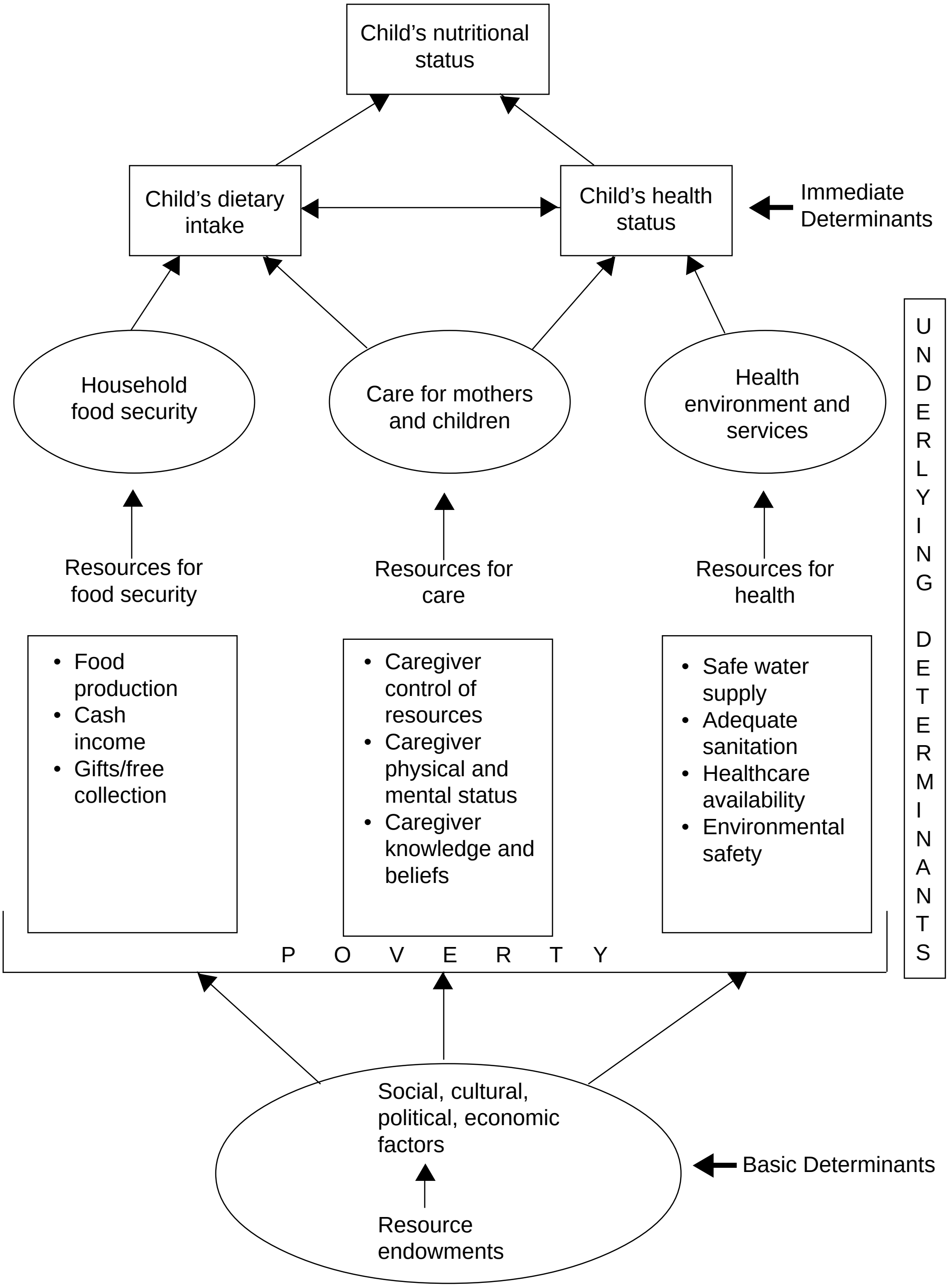
Appendix A: Conceptual framework on the determinants of child nutritional status



Adapted from UNICEF (1990) and Engle et al. (1999).

Appendix B: Conversion of foods into their nutritional equivalent

In the sample taken as a whole, households consumed more than 70 different food items, making aggregation of some kind inevitable. The food items considered included: beef, pork, goat meat, poultry, eggs, fresh milk, millet, sorghum, maize flour, rice, dried cassava, fresh cassava, fresh sweet potatoes, matooke, fresh beans, dried beans, groundnuts, simsim and peas.

Unlike previous studies that used per capita nutritional intake, this paper takes into account the household age and sex composition. Given the heterogeneity of households in terms of age and sex, a weighted recommended daily intake per household was derived using the recommended daily intake by the *Uganda Nutri-Guide System* prepared by the Home Economics Department under MAAIF (undated). The individual recommended daily calorie intakes are given for moderate activity for those ten years old and above by sex. Let n denote the n^{th} nutritional value, r_{jg} the recommended daily intake for the g^{th} age group by j^{th} sex; and h_{jg} the number of household members falling in the g^{th} age group by j^{th} sex. Accordingly, the total recommended daily intake for the i^{th} household by j^{th} sex, was expressed as in Equation A1.

$$R_{ij}^{n} = \sum r_{jg}.h_{jg} \qquad \text{(A1)}$$

The share of the recommended daily intake for the members in the g^{th} age group in the i^{th} household was expressed as in Equation A2.

$$S_{ijg}^{n} = \frac{r_{jg}.h_{jg}}{R_{ij}^{n}} \qquad \text{(A2)}$$

The weighted n^{th} recommended daily intake for the i^{th} household for the j^{th} sex was expressed as in Equation A3.

$$N_{ij}^{n} = \prod_{g} (r_{jg}.h_{jg})^{S_{ijg}^{n}} \qquad \text{(A3)}$$

Therefore, the weighted recommended daily intake for the i^{th} household was expressed as in Equation A4.

$$N_i^n = \prod_g N_{ij}^p \quad \text{(A4)}$$

where superscript p is the proportion of the total number of j^{th} sex in the total household size.

The next task was derivation of the n^{th} nutritional value from the reported food intake by the i^{th} household. To facilitate the conversion process, all the food items that were reported in units other than kilograms were converted using the region-specific conversion factors for kilogram equivalents. Households derived their food consumption from three main sources: purchases, own production and gifts/transfers. All these food sources were aggregated for each food item and converted into their nutritional values using the *Uganda Nutri-Guide System.* However, the nutritional equivalents of some food items such as mutton and pumpkin were not included; these were converted using *The Composition of Foods Commonly Eaten in East Africa* by West et al. (1988).

Let x_{ij} denote quantity of the j^{th} food item consumed by the i^{th} household; d_j^n the n^{th} nutritional value per unit derived from the consumption of the j^{th} food item; and A_i^n the actual n^{th} nutritional daily food intake by the i^{th} household expressed as in Equation A5.

$$A_i^n = \frac{\sum_j d_j^n x_{ij}}{7} \quad \text{(A5)}$$

Equation A5 converts the actual food intake to a daily basis, since the data on consumption were collected over a period of seven days. In converting food quantities into their nutritional value, assumptions were made in addition to those mentioned above: First, that food losses during the preparation process up to the consumption stage were negligible. Second, that no quality differences existed between different types of the same food item. Third, that household daily food intake was the same over the seven-day period. Fourth, that households had no lactating mothers.

The weighted actual daily food intake of the n^{th} nutritional value for the i^{th} household was expressed as in Equation A6.

$$DA_i^n = \prod \left(\left(\frac{S_{ij}^n}{h_{ij}} . (A_i^n . p \right)^{S_{ij}^n} \right)^p \quad \text{(A6)}$$

Like the weighted recommended daily food intake, the weighted actual daily food intake took into account the heterogeneous nature of household composition in terms of age and sex.

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