

**THE DETERMINANTS OF HEALTH AND
NUTRITION OF CHILDREN UNDER
FIVE IN GHANA.**



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A Thesis submitted to the Department of Agricultural Economy and Farm Management, Faculty of Agriculture, University of Ghana, Legon, in partial fulfilment of the requirements for the Degree of Master of Philosophy (MPhil.) Agricultural Economics

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DECLARATION

I, Felix Ankomah Asante, author of this project report do hereby declare that the work presented in the thesis:

**"The Determinants of Health and Nutrition of Children
Under Five in Ghana"**

was done entirely by me in the Department of Agricultural Economy and Farm Management, University of Ghana.

This work has never been presented in whole or in part for any other degree of the University or elsewhere.



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DEDICATION

To my parents



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I extend my sincere thanks to the Almighty God for helping me to complete this work successfully.

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ABSTRACT

This study examines the determinants of health and nutrition of children under five in Ghana using data on 2127 children and their households drawn from the Ghana Living Standards Survey in 1987/88 (GLSS I).

The study reveals that Ghanaian children of 0 to 59 months obtain 82.7 percent of the recommended required daily allowance of calorie intake. Also the children weighed 9.9 percent higher than the recommended weight of 12.0 kg. It was further shown that the level of undernutrition of children under-five has not changed since 1980. About 29.5 percent of children are chronically undernourished, 27.2 percent are underweight and 7.1 percent are acutely undernourished.

Empirical results show that a 10 percent increases in income (proxied by total expenditure), household size in adult equivalent, relative prices of millet, garri, cocoyam and plantain to maize result in an increase of 9.56 percent, 0.73 percent, 5.45 percent, 6.04 percent, 3.33 percent and 3.45 percent of food available to the household, respectively. Similarly, a 10 percent increase in the relative prices of yam, cassava and guinea corn to maize result in a decrease in food availability to the household by 21.29 percent, 10.46 percent and 2.97 percent, respectively.

The study further shows that food intake of the child and the genetic factors of parents have important roles in the determination of the health condition of children with elasticities of 0.019

and 0.445 respectively.

Policy experiments with household expenditure, household size in adult equivalent, price of cassava and price of maize showed that percentage changes in the mean expenditures give the greatest impact on the food available to the child while percentage changes in the mean household size in adult equivalent give the least impact.

CHAPTER ONE

INTRODUCTION

1.1 Background

Economists generally assume that changes in household incomes are unambiguous indicators of changes in the welfare of the household. However planners and government officials consider health and nutritional status as better indicators of social welfare.

Information on the nutritional status of a population provides information on the health of the economy. Moreover, insights into the causes of undernutrition assist planners in effectively meeting their social objectives.

In this respect, malnutrition as well as the policy instruments available to improve the nutritional status of populations, have distinctive features that deserve separate analysis (Reutlinger and Selowsky, 1978). First, nutrition is one of the main determinants of health. A society may generally respect the sovereignty of family units in respect of the allocation of their earnings but still take deliberate measures to affect allocations which ensure better nutrition for all or some members of the family. Second, health and nutrition interventions have an impact on human capital formation, with implications for the future earnings of individuals and the growth in Gross National Product (GNP). The nutritional status of an infant is the most important

determinant of the individual's initial physical condition, which in turn determines the effectiveness of further investment in human capital (Reutlinger and Selowsky, 1978). However, during the working years, malnutrition has a crucial influence on an individual's level of productivity.

There is clearly a basis for concern for health and nutrition in Ghana. Life expectancy at birth in 1990 was only 55 years (UNDP, 1993). This is identical to the average for all low income countries, excluding India and China. Infant mortality rates in Ghana are 83 deaths per 1,000 births (World Bank, 1993) as compared to 71 deaths per 1000 births average for low income economies. Ghana's current infant mortality rates do not represent appreciable progress relative to estimates from two decades before when it was 111 deaths per 1000 births.

The World Development Report for 1989 indicates that food availability per capita in Ghana in 1986 was not only one of the lowest in the world, but it was also appreciably lower than it was 10 or 20 years before. Although there has been a decrease in mortality at all levels of the population there is a severe case of under-nutrition and malnutrition in Ghana. The daily calorie supply decreased from 87 percent of the suggested 2400 calories per day in 1965 to 76 percent in 1985 and by 1990, had increased to 93 percent (UNDP, 1993). There are 27 percent of children who are malnourished. These statistics have a lot of consequences for human capacity building, productivity and poverty of individuals, households and communities.

On health, between 1987 and 1990, about 76 percent of the Ghanaian population had access to health services (UNDP, 1993). Due to absence of modern facilities many people in the rural areas do get access to health care through herbalists and other unorthodox health care facilities. About 40 percent of all births are attended to by health personnel. Through an intensive campaign (Expanded Programme on Immunisation) the proportion of one-year-olds immunised has increased from 34 percent in 1981 to 64 percent between 1989 and 1991. This has drastically reduced the incidence of some childhood killer diseases and has therefore contributed to the reduction in infant mortality.

The fast growing population of the country which is estimated to be between 2.6 and 3.2 percent per annum, requires consistently higher growth in food production to reduce food insecurity. At the high rate of 3.2 percent per annum, food production must grow, at least, by 4 percent per annum to ensure adequate food supplies and a modest economic growth. Large families are more vulnerable not only to food insecurity but to the insecurity of housing, education for children, health and other basic needs. Haddad and Kanbur (1991) have observed that intrahousehold food insecurity increases with household size. In such large households, invariably children under 5 years, who are more vulnerable to infection are more food insecure than others.

On the policy side, the effectiveness of nutrition interventions depends heavily on the behaviour of households in relation to such policies. Households make the ultimate decision on

production and consumption and these decisions affect nutritional intake which in turn affects the health of its members. It is therefore important that public policies are designed in the context of the behaviour of households.

1.2 Problem Statement

Under the Economic Recovery Programme (ERP) which was launched in April 1983, policies and programme were implemented by the Government of Ghana in an attempt to resuscitate the economy after a period of economic decline (see Appendix 1 for discussion on health and nutrition related policies and programmes for children).

Despite the economic improvements in the last decade, infant mortality rates remain high in Ghana; in 1991, the rate was estimated at 83 per 1,000 live births (World Bank, 1993), a figure which is much higher than in China (29), Sri Lanka (19), or Kenya (67) (Alderman and Garcia, 1993).

Undernutrition is a serious problem among preschoolers (0 to 59 months) in Ghana. According to the findings of the 1988 Ghana Demographic and Health Survey and Africa Nutrition Chartbooks (1993), nearly 1 in 3 children aged 3 to 36 months are chronically undernourished. In other words, they are too short for their age or stunted.¹ The proportion of children stunted is 13 times the level expected in a healthy, well-nourished population. About one in

¹ A stunted child has a height-for-age Z-score that is below -2SD based on the NCHS/CDC/WHO reference population.

three children are underweight² for their age. Similarly, acute undernutrition, manifested by wasting³ which results in a child being too thin for his or her height, affects nearly 1 in 13 children.

Comparing undernutrition among children aged 3 to 36 months in Ghana and other sub-saharan African countries between 1986 and 1991, Ghana is in the middle range for the proportion of children who are stunted and third after Mali and Nigeria in terms of level of acute malnutrition (Africa Nutrition Chartbooks, 1993)

Undernutrition of children which also has consequences for their poor health is a result of both inadequate intake of food and poor environmental sanitation. An inadequate intake of food result from improper feeding practices and/or insufficient food at the household level. Improper feeding practices include both the quality and quantity of food offered to young children. Poor sanitation puts young children at risk of increased illness, in particular diarrhoeal disease, which adversely affects a child's nutritional status. Both inadequate food intake and poor environmental sanitation reflect underlying social and economic conditions.

From the foregoing, the economic growth achieved by Ghana in the last decade is not easily reconciled with the health and

² An underweight child has a weight-for-age Z-score that is below -2 SD based on the NCHS/CDC/WHO reference population. This condition can result from either chronic or acute undernutrition.

³ A wasted child has a weight-for-height Z-score that is below -2 SD based on the NCHS/CDC/WHO reference population.

nutrition status of children. Thus this study seeks to address the following issue: What are the determinants of health and nutrition of children under-five in Ghana. Knowledge of the determinants will be useful input into policies that seek to improve human capacity development which begins from infancy.

1.3 Objectives of the Study

The general objective of the study is to determine the factors that affect the health and nutritional status of children under 5 years old in Ghana.

The specific objectives are:

- (1) to determine the inputs (privately and publicly provided) which are the principal determinants of health and nutritional status of children under 5 years old.
- (2) to determine the responsiveness of indicators of children's health and nutritional status to consumption input.

1.4 Relevance of the Study

Very little or no study has been conducted in Ghana to determine the dual role of the determinants of health and nutrition of children under-five years. Most recent studies conducted either concentrate on the health or nutrition aspect separately. Alderman (1990), in a study of the nutritional status of Ghana and its determinants concluded that there is a positive relationship between income and nutritional levels. Thus, policies that tend to increase the income of households tend to have an effect on the

nutrition of Ghanaians.

Studies have rather directly or indirectly concentrated on poverty disparities and nutritional status in Ghana (see for instance Ewusi 1984; 1976; Boateng *et al.*, 1990; Awusabo-Asare, 1981/82; Alderman, 1990). This present study tries to fill part of this gap by addressing the determinants of health and nutrition of one important cohort of the society, the under-five years old in Ghana.

Children are more vulnerable to the consequences of under and/or malnutrition than adults. Poverty level of a household can therefore be easily linked to the nutrition and health status of a child. Also, mortality rates tend to be high for this age group that is, risk of preventable mortality reduces considerably after age five. The interconnections between the health and nutrition of a household is better understood by considering children in the early stages of their life. It is in these formative years that good nutrition gets translated into visible signs of health and ill-health on the body of the individuals and can be measured quantitatively (anthropometry). Such visible signs also help determine the health status of the individual. This and the vulnerability of children under five years to consequences of malnutrition are the motivations for basing the health and nutrition study on children under 5 years of age.

1.5 Source of Data - The GLSS

Data for this study was drawn from the first round of the

Ghana Living Standards Survey (GLSS I) which was conducted by the Ghana Statistical Service in conjunction with the World Bank. The GLSS comprises a comprehensive set of data culminating from three rounds of surveys conducted in 1987/88, 1988/89 and 1990/91, and designated as GLSS I, GLSS II and GLSS III, respectively.

The objective of the surveys is to provide data on a continuous basis to the government of Ghana for measuring the living standards of the population and the progress made in raising them.

The GLSS is currently planned to be undertaken over a five-year period. This five-year time horizon will provide a set of panel data which can be used for policy planning, monitoring and evaluation in a dynamic sense so that interventions like the Programme of Actions to Mitigate the Social Costs of Adjustment (PAMSCAD) can be avoided and internalised into the overall development programmes. The surveys are therefore expected to lead to more effective formulation and implementation of policies designed to improve the welfare of the Ghanaian population.

The GLSS I covers a nationally representative sample of 3200 households from 200 enumeration areas and involving 15,648 individuals. It provides data on various aspects of the Ghanaian household economic and social activities and the interactions between these activities. Data were collected at three levels:

- (i) the household level;
- (ii) individual level; and
- (iii) the community level.

A household as defined by the GLSS is a group of individuals who live and eat together for a period of at least three months of the 12 months preceding the interview. Household data include income, expenditure, housing, household enterprises and assets. Data on individual household members cover demographic characteristics, education, health, employment and time use, migration and anthropometrical measurements. For the local community, data were collected on social services availability (education, health), communication, transportation, food commodity prices, and general economic and social characteristics.

Sampling Technique

A two-stage stratified sample design was used. The aim of GLSS I was to arrive at a final sample of 200 interviewer workloads consisting of 16 households each, giving a total sample of 3200 households. To ensure that workloads were of equal size and that each household in the final sample had an equal probability of being selected, it was necessary to select the 200 enumeration areas (EAs) with probability proportional to size. The measure of size used for each EA was the number of households counted in the 1984 population census, with an allowance for changes in the size of the selected EAs since the time of the census.

Before selecting the 200 EAs, the 12,969 EAs from the 1984 population census was first arranged in order according to local councils, which were in turn ordered according to ecological zone (coastal/forest/savannah). Within an ecological zone, the EAs were

further ordered according to the size of the locality; rural localities (those with a 1984 census population of less than 1500), then semi-urban localities (those with a census population of at least 1500 but less than 5000) and finally urban localities (those with a census population of at least 5000).

Finally within each group the EAs were then listed in order according to their EA number. This ordering provided an excellent geographical stratification since the first digit of each EA number represented the region in which the EA was located.

At the next stage of sample selection, 20 households were systematically selected to make up each workload. Four of these households (obtained by taking a 1 in 5 systematic sample from the 20 selected households) were kept as reserves, to be used only if one or more of the original 16 households could not be covered in the survey.

Survey Organisation

The survey was carried out by ten teams. Each team included a supervisor, two interviewers, an anthropometrist, a data entry operator and a driver. Each team was assigned a landrover.

The data collection was organised in two rounds. During the first round, data on household composition, housing characteristics, education, health, economic activities, migration and anthropometric measurements (height and weight) of household members were collected. In addition the household head or the persons best informed about the household's enterprises and

expenditures was identified and interviewed. During the second round, the team collected data on farm economic activities, non-farm self employment, food and non-food expenditures, fertility, other incomes, credit, savings, and assets. Also, another set of anthropometric measurements of height and weight of some selected household members were taken to correct errors from the first round of data collection.

For each household, the two rounds of interview took place at two weeks intervals. Before the first interview was conducted an appointment was sought with the respondent during an initial visit. At the end of the first interview the respondent was informed about a second visit two weeks later. To obtain a reliable recall data the respondent was asked to note types and levels of expenditures and incomes for the next two weeks for which responses will be sought in the second interview. During the visit, if a respondent was not available (travelled or died) or refused to cooperate then a replacement was taken from the replacement list.

Organisation of data

The questionnaires were almost entirely pre-coded; therefore, data in digital form were directly entered into the computer, thus skipping the usual coding step. Data entry operators on the team who were based at the regional offices of Statistical Service started to enter the data one week after the interview to allow for corrections of any omissions or errors. Data entry programmes specially designed for the purpose of the survey was used.

The Questionnaires

Three types of questionnaires were used in the GLSS: (1) a household questionnaire; (2) a community questionnaire; and (3) a price questionnaire.

The household questionnaire comprised 16 sections which allowed the collection of a total of 800 pieces of information on the households. The community questionnaire, used in the rural areas, was administered to the persons best informed about the community (village chief and teachers, among others). The price questionnaire was filled out by visiting markets and asking about food commodity prices. The information collected allowed price comparison between different parts of the country and estimation of the value of consumption of home produced goods.

1.6 Scope and Limitation of the Study

This study is restricted to the use of GLSS I data which was carried out in 1987/88. Household expenditures were used in the computation of food quantity. A food intake survey technique would have been the best in estimating the quantity of food consumed (Bouis et al., 1992). Food quantity information collected from expenditure surveys have measurement errors which are often systematically correlated with income, such that the responses of food intakes to increase in income is seriously overstated (Bouis et al., 1992). This may be, firstly, because food quantities are not measured independently of income if total expenditures are the proxy used for income, and secondly, because food transfers in the

form of guest and hired worker meals are under-recorded.

1.7 Organisation of the Thesis

The thesis has five chapters. Chapter one is the Introduction. It consists of some background information, the problem statement, the objectives and relevance of the study and source of data.

Chapter two presents the literature review and it covers studies conducted in both Ghana and other countries. Chapter three outlines the conceptual framework and specification of the under five health and nutrition model.

Chapter four presents the estimated results, validation and policy experiments of the model. Chapter five contains the summary and policy implications of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Review of Studies Conducted outside Ghana**2.1.1 Determinants of Nutritional Status**

The determinants of nutrient consumption can be looked at in two ways: the demand for nutrients and the production of nutrients (Behrman and Deolalikar, 1988). They hypothesise that the nutrient intake of an individual (demand) is presumed to be determined by prices, income and given endowments of the individual; while the production of nutrients is assumed to be determined by the food consumption of the individual, the education, and time of the household food preparer. Unobserved variables, such as metabolic rates, play an important role in both functions.

2.1.1.1 The Demand for Nutrients

Most studies that analyse nutrient intake do so in a demand framework. Two approaches are usually followed: (i) estimating food demand/expenditure systems and then converting the price and income elasticities obtained from these to nutrient elasticities using fixed food-nutrient conversion factors (Strauss, 1984; Pitt, 1983 and Pinstруп-Andersen, *et al.*, 1975); (ii) estimating directly the demand for nutrients as a function of food prices, household size and income/expenditure (Wolfe and Behrman, 1983; Ward and Sanders, 1980; Timmer and Alderman, 1979; Pitt and Rosenzweig, 1985).

Most studies that analyse the relationship between the income elasticity of nutrient demand and the level of income have found it to be negative (Timmer and Alderman, 1979 and Pinstrup-Andersen *et al.*, 1975). Such an inverse association between the income elasticity of nutrients and the level of income according to Behrman and Deolalikar (1988), is consistent with the possibility that income ceases to play an important role in the marginal determination of nutrients at high incomes but the inverse may be the case at low incomes.

Behrman and Deolalikar (1987b) argue that calorie (more generally, nutrient) income elasticities which are derived from aggregate food demand equations tend to be overestimated, since with increasing income households switch purchases among disaggregated foods to higher priced, but not necessarily nutritionally better foods.

A common set of determinants of nutrient demand explored by empirical studies, is food prices. Strauss (1984) obtained negative food price effects on the demand for calories when he controlled farm profits in his sample of Sierra Leonean farm households. However, the majority of the food price elasticities turned positive when farm profits were allowed to vary (that is, when it was assumed that food prices had a positive impact on farm profits and thereby on consumption). On the other hand, Pitt (1983) found that, even after controlling for income, calorie demand in Bangladesh had positive elasticities with respect to the prices of (pulses, fish, mustard oil, onions and spices) five of the nine

foods he considered. Behrman and Deolalikar (1987c) in their study, also found a large number of positive food price effects on the unobserved nutrient consumption status of all household members, even after controlling for income and individual-specific fixed effects.

A survey of 15 nutrient demand studies by Alderman (1984) notes that own-price elasticities of food demand decline in absolute values with income or expenditure. Williamson-Gray (1982) observed a pronounced trend of a compensated own-price elasticity of cereals demand of -0.74 for the poor, -0.16 for the middle income and not significantly different from zero for the rich in Brazil. Few studies (Timmer and Alderman, 1979; and Williamson-Gray, 1982) also observed an inverse relationship between the absolute value of cross-price elasticities and the level of income or expenditure. Thus, there is compelling evidence that the poor are more responsive to income, own prices and cross prices than the rich in the demand for food. This has important distributional implications for food prices in poverty alleviation policies and programmes.

Behrman and Wolfe (1984) argue that when household size is entered as a determinant of nutrient demand, it is not only the sign but the magnitude of the household size elasticity relative to the household income elasticity that is important since it reflects the extent of returns to scale with respect to household size. In addition to them Wolfe and Behrman (1983); and Ward and Sanders (1980) obtained statistically significant negative effects of

household size on nutrient demand. These studies are likely to be biased since fertility and hence household size are endogenous variables that are jointly determined along with nutritional status choices, but not treated as such in these studies. Pitt and Rosenzweig (1985) did not include household size as a determinant of per capita nutrient intake, but included household composition (treated as an endogenous variable), and found it to be a significant determinant of per capita nutrient intake. Per capita consumption of calories, protein, carbohydrates, and phosphorous in particular were all found to increase with mean household age.

With the inclusion of the education of the food preparer in the household nutrient demand function, Wolfe and Behrman (1983) and Behrman and Wolfe (1987; 1984) reported significant effects of women's schooling on household nutrient composition. These studies revealed that Nicaraguan households in which women have more schooling tend to be significantly and substantially better nourished, ceteris paribus.

Another determinant of nutritional status which is important in the rural areas of Least Developed Countries (LDCs), is seasonality (Chambers et al., 1981). The wet season in these countries is often the most difficult time of the year when shortages of food are coincident with high energy demand for agricultural activities. Food is very scarce and most expensive at this time of the year. Exposure to infections and diseases, like diarrhoea, malaria, cholera and dengue fever are most common at this period.

Behrman and Deolalikar (1987a) incorporated seasonality in the determination of nutrient demand. They estimated separate nutrient and health demand equations for individuals for the lean and the surplus seasons of the year in rural south India. They obtained significantly negative food price elasticities of calorie and protein demand for the lean season, but elasticities were close to zero or even slightly positive in the surplus season.

2.1.2 Determinants of Health Status

Most of the demand studies on health and health-care are based on cross-sectional data, few of them explicitly include market prices as explanatory variables. Most studies include household characteristics, income and availability of health care, interpreted as the price of health care services.

Among the micro studies, Blau (1984) estimated a demand function for standardised height-for-age scores using 1977-78 data on children under five years of age in Nicaragua to determine the utilisation of health-care. He included the mother's age, education, location (urban or rural), income and formal and informal sector wage rates (corrected for selection bias) as independent variables. Blau's rationale for separating the two types of wage rates is that female informal-sector jobs in developing countries may be consistent with own childcare in a way that formal-sector jobs are not, since childcare often can be combined with informal-sector jobs. He found the mother's formal-sector wage rate to have a significant positive effect on child

health and the informal-sector wage not to have any significant effect.

Merrick (1985) used infant mortality as a proxy for health outcomes in his analysis of the effect of pipe borne water supply in Brazil on health outcomes. Mortality determination process was formulated in a multi-equation framework with husband's education influencing household income; husband's and wife's education, household income and community water availability influencing the household utilisation of pipe borne water; and husband's and wife's education, household income and pipe borne water utilisation affecting child mortality. He estimated the system by ordinary least squares (OLS) methods, arguing for recursivity among the three relations. He also produced reduced-form estimates for mortality, which were preferable to the OLS estimates. He revealed that while availability of pipe borne water supply had a negative impact on infant mortality, the effect of parental education on mortality was much greater. This therefore reinforces the importance of parental education on nutritional and health status of infants.

A study by Rosenzweig and Schultz (1982), on the joint determinants of fertility and child mortality in Colombia included a very comprehensive list of community level infrastructural variables, most of which can be interpreted as health-care price variables, in explaining the household demand for health outcomes. Among the independent variables included in their mortality equation were the woman's age and schooling and the per capita

number of hospital beds and clinics, family planning expenditures per capita, transportation time to the capital city, average daily temperature, price of food and the regional schooling variable. Separate equations were estimated for women residing in rural and urban areas.

The study concluded that, in the urban areas, child mortality in families with less-educated mothers is strongly affected by public health and family planning programmes. It was also found that, in the urban areas, clinics are a more cost-effective means of lowering child mortality than are hospitals. In the rural sector, there is little effect of health and family planning programmes on child mortality. According to Rosenzweig and Schultz, for urban and rural areas, maternal education had a strong negative effect on child mortality.

Most studies, as discussed above, neglected the fact that a large proportion of households are farm households in many less developed countries and thus the omission of farm input prices and farm assets from the health demand functions is a major deficiency in the models. Also there are very restrictive assumptions about product and labour markets and about the lack of links between health and nutrient inputs on one hand, and productivity on the other. Pitt and Rosenzweig (1985) and Behrman and Deolalikar (1987c) are two recent studies that incorporated these concerns.

Pitt and Rosenzweig (1985) using data on 2,347 farm households in Indonesia estimated separate health outcome demand (called "illness demand") functions for husbands and wives. These functions

have as arguments, prices of thirteen consumption goods (food and non-foods); source of drinking water; availability of hospitals, family planning clinics, public lavatories; owned land; farm profits; and the age and education of the husband and wife. The authors found relatively few significant determinants of health using ordered probit equations. According to the authors, this result was attributed to the lack of precise definition of illness in the survey.

Using panel data on rural South India, Behrman and Deolalikar (1987a) estimated joint reduced-form health and nutrient consumption status relations. The method used allowed for differing price and income responses by different household members (adult males, adult females, male children and female children). A latent variable representation of unobserved health status was used, (see for instance Behrman and Wolfe (1987)) which had three observed anthropometric indicators: standardised arm circumference (age-gender specific), triceps fatfold, and weight-for-height. It was revealed that three of the six prices (namely rice, milk and male labour) had significant positive effects on health status, even when income was controlled. They however found neither a significant income effect nor significant differences in prices or income responses across household members.

A few studies (Bairagi, 1981; Chen *et al.*, 1980) have established a link between anthropometric measures and mortality. These studies show that severely, mild and moderately malnourished children (that is, those with low and lower-than-average

anthropometric readings) have greatly increased mortality risks relative to normal children. Arm circumference was found to be an excellent predictor of mortality.

On the link between nutrient and other health-related intakes and anthropometry or morbidity, Clark (1981), using data from Guatemala, found that the physical growth (weight gain of infants 0-12 months) was associated significantly with the number of calories of atole⁴ consumed and length of breastfeeding.

Taylor et al., (1978) using the Narangwal project data, found that (controlling for factors such as age, gender, caste, season and number and composition of siblings) children in villages receiving nutritional care, whether alone or in combination with medical care, had higher weights and heights than those in control villages. Chernichovsky and Kielmann (1977) used two-stage least squares with the same data as Taylor et al. to measure the impact of calorie intake on the weight of children aged between 6 and 36 months. They also found a significant positive effect of calories on weight after controlling for age and gender.

2.2 Review of Studies in Ghana

2.2.1 Health Status

Health services are accessible to about 60 percent of the population (World Bank, 1989). Many people in the rural areas do

⁴ Atole is a high-protein-high-calorie supplementary diet.

get access to health care through herbalists and other unorthodox health care sources. In 1984, the number of persons per doctor was 14,890 and 640 per nurse. Through an intensive campaign (Extended Programme on Immunisation), the proportion of one-year-olds immunised has increased from 34 percent in 1981 to 64 percent between 1989 and 1991.

When human deprivation is considered, out of a population of 15 million Ghanaians in 1990, there were about 6 million without access to health services, 6.5 million without access to safe water and 10.4 million without access to sanitation (UNDP, 1991).

2.2.1.1 Life Expectancy

Life expectancy at birth has increased from 47 years in 1960 to a recent estimate of 55 years (GOG/UNICEF, 1990). Table 2.1 gives figures by sex and total population for 1985-2000 indicating a projected continuous improvement in life expectancy at birth.

2.2.1.2 Mortality Rate

Mortality rate for infant and children in Ghana has been declining over the years (GSS, 1989b). Infant mortality rate estimated at around 100 deaths per 1000 in 1973-77, has declined by approximately 22 percent to 77 deaths per 1000 births between 1983-1987. Mortality during childhood has also declined during the

Table 2.1 Life Expectancy at Birth

Gender	1985	1988	1990*	2000**
Male	50.3	52.0	53.0	59.0
Female	53.8	56.0	57.0	61.0
Average	52.0	54.0	55.0	60.0

Source: World Bank, 1988.

* Estimated

** Projected

period under consideration. The probability of a child dying between birth and age 5 has dropped from 0.187 in 1973-77 to 0.155 in 1983-88 (GSS, 1989b).

2.2.1.3 Access to Sanitation

Sanitation facilities of critical concern in the household environment include:

- (a) excreta or human waste disposal
- (b) garbage disposal; and
- (c) liquid household waste and storm water disposal.

Amonoo (1988), indicated that only 50 percent of the urban and 15 percent of the rural population have adequate sanitation installations. The report of GLSS I (GSS, 1989a) shows a sharp contrast between rural and urban areas in terms of the availability of human excreta disposal facilities. It reveals that urban areas rely on a range of toilet facilities including flush toilets while rural areas primarily depend upon pit latrines (improved or

ordinary).

Using the Ghana Demographic and Health Survey (GSS, 1989b) carried out in 1988, undernutrition among children aged 3 to 36 months, shows that one-quarter of households have no toilet facilities, over two-thirds have pit latrines and less than one in ten has a flush toilet. Also irrespective of the type of toilet about one in thirteen children are too thin.

The capability to handle household and municipal garbage in urban areas has deteriorated except in Accra where the Metropolitan Assembly has been able to improve the situation modestly with assistance from the Federal Republic of Germany. There is hardly any workable sanitation system in the rural areas. Refuse dumps are sited haphazardly and pose health problems to children playing in such environment, and this has led to quick spread of diarrhoeal diseases.

The disposal of liquid wastes from households in both urban and rural settlements poses serious problems. Open drains are clogged in urban areas, creating standing pools of water which are unsanitary and often serve as breeding spots for mosquitoes. Liquid waste add to the pollution of water bodies, especially in rural areas without any drains nor potable water supply.

2.2.1.4 Access to Potable Water

The sources of water supply for households include the following:

- (a) pipe-borne water supply from treated water sources;

- (b) untreated pipe -borne water based on ground water sources;
- (c) non pipe-borne water supply from shallow boreholes;
- (d) supply from dug-wells; and
- (e) supply from ponds, springs, lakes, rivers and streams.

According to the Ghana Water and Sewerage Corporation (GWSC, 1986) and the Ghana Population Census (1984), the situation of domestic and municipal water supply is as follows:

- i. 93 percent of the population living in communities with more than 5000 inhabitants (defined as being urban) have access to potable water supply; communities of this size represented 30 percent of the national population.
- ii. 70 percent of the population residing in communities with between 500 and 5000 have access to good drinking water mainly from pipe-borne supplies and boreholes fitted with hand pumps. These communities constituted 20 percent of the national population.
- iii. 15 percent of the people residing in rural communities with population below 500 have access to potable water. They form about 46 percent of the population in 1984.

The quality of water available to rural households is unsatisfactory as most communities rely on ponds and streams as their sources of water supply (GSS, 1989a). About 50 percent of Ghanaian households obtain water from open-air sources, almost 20 percent use a community water supply (well or borehole), and only 33 percent have access to piped water. Similar to the type of toilet facility in household, irrespective of the source of water

about one in thirteen children is too thin.

Water-borne diseases including guinea worm, bilharziasis, cholera, typhoid and infectious hepatitis are common in the rural areas and urban slums with poor sanitation. Unsafe water supply also contributes to diarrhoea, hookworm, yaws and scabies. Therefore water affects the health status which in turn affects the nutrition status of households.

2.2.2 Nutritional Status

In Ghana, malnutrition takes its greatest toll on young children and pregnant nursing mothers. The problem is a combination of two inter-related phenomena: protein-energy malnutrition and associated micronutrient deficiencies among the vulnerable groups, and pre-harvest hunger affecting predominantly the rural population (World Bank, 1989).

Although there has been a decrease in mortality at all levels of the population and slight improvement in daily calorie supply, there are still cases of under-nutrition and malnutrition in Ghana, especially in children. The daily calorie supply declined from 87 percent of requirements in 1965 to 76 percent in 1985 and increased to 93 percent between 1988 and 1990 (UNDP, 1993). The improvements in the latter 1980s were due to the ERP. However, there is still an estimated 27 percent of children who are malnourished. This has substantial consequences for child health and human capacity development.

2.2.2.1 Nutritional Status of Children

A study by Ewusi (1978), on nutritional status of children in six villages in the coastal savanna plains and in the forest zone in the mid-seventies summarised the incidence of malnutrition in the study area. Using anthropometric measurements based on changes in the upper arm circumference, the survey showed that for most of the villages, more than two-thirds of the children could be considered as being undernourished. He further concluded that on the average 70.3 percent of the children were under-nourished with 21.5 percent being seriously under-nourished.

Orraca-Tetteh and Watson (1977) in another study of the nutritional status of Bafi, a village in the Brong-Ahafo region in 1976, had a result which was similar to Ewusi (1978).

A nation wide nutrition survey of 14,000 children conducted jointly by the Nutrition Department of the Ministry of Health and UNICEF in 1986 found that 58.4 percent of pre-school children fell below 80 percent of the U.S. National Center for Health Statistic (NCHS) weight-for-age standards (World Bank, 1989b). This was roughly twice the level obtained in the first national survey carried out in 1961-62. About 8 percent of children in the country were clinically classified as suffering from marasmus or kwashiorkor. Malnutrition levels were highest in the northern zone (64 percent) and lowest in the coastal zone (48 percent).

Alderman (1990) using the GLSS data found that 31.4 percent of children fell below 80 percent of the weight-for-age standard. This implies, then that malnutrition has declined since 1986 but remains

above the levels reported for the early post-independence years.

Another indication of the changing pattern of malnutrition in the 1980s comes from data collected by the Catholic Relief Service for children attending maternal child health centres (CRS, 1987). The data shows a slightly better pattern. It indicates that, even in a 'good' agricultural and nutrition year 1980, 35 percent of children were below 80 percent weight-for-age standard; in the severe drought of 1983, 51 percent; and by 1986, after the recovery of agricultural production, about 35 percent again.

The GLSS data which is the most current national survey which groups the nutritional status in Ghana by age, gender and agro-ecological zone, reveals that the acute malnutrition for boys is appreciably higher than that for girls in the 6 - 24 month age bracket. The gap closes and reverses in the older age bracket which incidentally has relatively little malnutrition.

Malnutrition is observed to be severe in the savanna agro-ecological zone. This is consistent with earlier studies which reported higher levels of malnutrition in the northern regions (Levinson, 1988; 1961-62 and 1986 National Nutrition Surveys). Defining chronic malnutrition as the height-for-age z score of less than -2.0 and acute malnutrition as the weight-for-height z score of less than -2.0, Greater-Accra has the lowest levels of both acute and chronic malnutrition. The remainder of the coastal agro-ecological zone has appreciably less chronic malnutrition than the forest or savannah regions.

The Demographic and Health Survey (GSS, 1989b) reports levels

of malnutrition among 1,841 children between the ages of 3 - 36 months. Chronic malnutrition constitutes 30 percent of the sample reported and this is comparable to the level in the GLSS data reported for children in the same age bracket. The survey further indicated high levels of malnutrition in the north, and the two upper regions which were comparable to the savanna zone. It was also found that children who recently had diarrhoea have high rates of malnutrition and also there was a pronounced improvement in the rates of malnutrition of those whose mothers have had more than a middle school level (10 years of schooling) of education.

According to the survey, stunting and underweight occur among almost one in three children aged 3 to 36 months in rural areas, where over two thirds of the Ghanaian population lives. Nearly one in three urban children are stunted and nearly one in three urban children is underweight.

Maternal education, related to both knowledge of good child-care practices and household wealth, just over one-third of Ghanaian mothers of children aged between 3 and 36 months has never attended school. There are large regional variations; over 80 percent of mothers in Upper West, Upper East and Northern region have never been to school while between 20 and 50 percent of mothers in the other regions have never been to school. Undernutrition is considerable higher among children of mothers with no education or only primary school education than among children of mothers with secondary or higher education. One in six children of mothers with secondary or higher education is stunted,

whereas one in three children of mothers with no education is stunted.

2.2.2.2 Nutritional Status of Adults

Few studies have been done on the nutritional status of adults in Ghana. Alderman (1990) attributed this partly to, adults being less vulnerable to severe consequences of under-nutrition. This is because nutrition status of adults especially height, to a large extent is determined during childhood. According to Martorell, et al., (1987) the nutritional status of women as well as possible consequences for birth outcomes and subsequent infant mortality are of particular concern in studying nutritional status of adults. Clinical signs of malnutrition for mothers have been found to be 50 percent higher among pregnant than non-pregnant women of reproductive age (CRS, 1987).

Using the GLSS data, the nutritional status for adults were classified based on Body Mass Indices (BMI) for females (excluding pregnant or lactating women) for urban and rural populations following the classification of the Royal College of Physicians. It was found that generally, rural residents were thinner than their urban counterparts, males were leaner than females and a larger number of females had BMIs in the higher brackets and therefore indicated overweight or obesity (Alderman, 1990).

CHAPTER THREE

CONCEPTUAL FRAMEWORK AND MODEL SPECIFICATION OF THE UNDER FIVE
HEALTH AND NUTRITION MODEL3.1 Conceptual Framework3.1.1 Utility Function

A household's decision on consumption of commodity bundles involves the maximisation of the utility function, U , subject to the income of the household. Thus, a household maximises

$$U = U (X_i) \quad \dots\dots\dots(1)$$

subject to the budget constraint

$$Y = \sum P_i X_i \quad \dots\dots\dots(2)$$

where X_i is a vector of consumption bundles, P_i are the prices of the bundles and Y is the income of the consumer. Transforming equations (1) and (2) into the Langrangian function, V , we obtain,

$$V = U (X_i) + \lambda (Y - \sum P_i X_i) \quad \dots\dots\dots(3)$$

where λ is the langrangian multiplier. The first order conditions are obtained by setting the first partial derivatives of (3) equal to zero. Thus,

$$\frac{dV}{dX_i} = U_i - \lambda P_i = 0 \quad \dots\dots\dots(4)$$

$$\frac{dV}{d\lambda} = Y - \sum P_i X_i = 0 \quad \dots\dots\dots(5)$$

The equations of (4) may also be written as

$$\frac{U^i}{P_i} = \lambda \quad \dots\dots\dots(6)$$

This ratio gives the rate at which satisfaction would increase if an additional unit of income were spent on a particular commodity. For example, if more satisfaction could be gained by spending an additional unit of currency on health, H, rather than nutrition, N, the consumer would not be maximising utility. Satisfaction could be increased by shifting some of the expenditure from H to N.

The second-order conditions as well as the first-order conditions must be satisfied to ensure that a maximum is actually reached. The second-order condition for a constrained maximum requires that the relevant Bordered Hessian determinant is positive. This is generally written as

$$(-1)^n \begin{vmatrix} U_{ij} & U_i \\ U_j & 0 \end{vmatrix} \approx 0 \quad \dots\dots\dots(7)$$

where n is the number of commodities in utility function and i and j are the commodities under consideration. From equations (4) and (5) the following demand function is obtained.

$$X_i = X_i (P_i, Y) \quad \dots\dots\dots(8)$$

The demand functions obtained in (8) have two important properties (Henderson and Quandt, 1980);

- (i) the demand for any commodity is a single-valued function of prices, P_s , and income, Y and,

(ii) the demand functions are homogeneous of degree zero in prices and income; that is, if all prices and income change in the same proportion, the quantities demanded remain unchanged.

In actual fact, other characteristics of the individual and his environment affect the demand for the commodity and these can be represented by Z . Hence, the demand function is represented by:

$$X_i = X_i (P_i, Y, Z) \quad \dots\dots\dots(9)$$

Individuals or households make decisions on the consumption of health and nutrition. This depends among other factors, on the level of the community's infrastructure, the prices that they face and the technology for producing nutrition and health.

If transfer programmes and other policies aimed at poverty alleviation are promoted as likely to have major nutritional impacts, the understanding of the interactions among the income transfers, the publicly provided inputs, and the household's response among the poorest segments of the target population is needed (Schiff and Valdes, 1990c). Also the design of welfare policies depend on the social costs and benefits of the alternative public policies, where benefits relate to the response in terms of the production of nutrition and health.

3.1.2 Nutrition and Health Production Functions

In the production of nutrition and health, the issue of the complementarity of the publicly provided inputs and of those inputs provided by the household are crucial. Schiff and Valdes (1990a, 1990b) disaggregated the nutrition and health status into a

production function.

At the household level, "producing" nutrition (a nutrition production function) gives an indication of the nutrition status of the household. The nutrition status (N) is a function of (1) the inputs of nutrients (r) such as calories, protein, vitamins, (2) the input of non-nutrient food attributes (q) which affect nutrition, such as freshness of the foods purchased, their cleanliness, their storability, (3) the privately provided inputs (p) which affect nutrition, such as the time and care to prepare food including cleaning, cooking, boiling water and other inputs that ensure that the food does not get contaminated or spoiled and (4) the publicly provided inputs (k) which include potable water, sewerage, electricity, nutritional information, among many others. The production of nutrition (N) is also partly determined by the individuals' health status, as well as by age (A), sex (S) and locality (L), either rural or urban.

Essentially, using the above defined notation, the nutritional status production function can be written as (Schiff and Valdes, 1990c),

$$N = N (r, q, p, k, H; S, A, L) \dots\dots\dots(10)$$

An important component of the household's welfare is the health status (H) of its members. This depends in part on their nutritional status (N). As with nutrition at the household level, a health production function is a function of the nutritional

status (N), privately provided inputs (p), publicly provided inputs (k), and (m) which represent current and lagged values of additional inputs affecting health. The variable m consists of both privately provided inputs such as amount and quality of child care and hygiene, and of publicly provided inputs such as medical services, information on hygiene and child care among others. The health production function also depends on age (A), sex (S) and location (rural or urban) (L) of the individual.

Mathematically, the health production function can be written as,

$$H = H (N, p, k, m; S, A, L) \dots\dots\dots(11)$$

The reduced-form equations for nutritional and health status can be derived for a farm household whose decisions on the consumption and production of health and nutrition are basically made by individuals or by the households in which they reside, given their assets, level of the community's infrastructure, the prices that they face, and the technology for producing nutrition and health. In general, a household makes decision on the quantity of a commodity that will be purchased based on commodity prices and income.

Empirical estimates of health status have been obtained by Behrman and Deolalikar (1988) through micro studies. Their specification involved (i) clinical measures of bodily attributes; (ii) anthropometric measures of height, weight, triceps skinfold thickness, arm circumference, among others; (iii) respondent-

reported disease symptoms, mortality histories, and general health evaluation; and (iv) reports on capacity for undertaking normal respondent activities.

3.1.3 Anthropometric Indicators

Weight and height are the two anthropometric measurements most often taken in health and nutrition surveys and used in conjunction with each other or with age to explain health and nutrition conditions on individuals. These measurements, in combination with age, can be used to derive three indicators: weight-for-height, height-for-age, and weight-for-age. To obtain a particular indicator, a z-score is computed from the vital measurement, its sample mean and its standard deviation. Essentially, the z-score statistic is calculated as,

$$z = \frac{X - \bar{X}}{\sigma}, \text{ where } z \text{ is the z-score, } X \text{ is the measurements}$$

(either the weight or height), \bar{X} is the mean of the respective measurements of X and σ is the standard deviation of X .

Each of these anthropometric indicators gives different information about health and nutritional status. The interpretation of this information is possible through comparisons with a reference population and usually makes use of cutoffs in order to imply a value judgement of acceptable or unacceptable levels.

The anthropometric measurements and their associated indicators have been used to measure the extent of malnutrition in children (under 18 years) which in turn gives an indication of the

health status of a population.

An allied indicator, the body mass index (BMI), which is a ratio of the weight in kilogrammes and the square of the height in meters has been used to give an idea of the nutritional and health status of adults (18 years and above).

3.1.3.1 Weight-for-height

Weight-for-height can be used as an indicator for either "wasting" or obesity. The individual with a weight-for-height below a specific cutoff may be considered wasted, or emaciated. High weight-for-height values can be used to denote obesity in an individual or a population group.

Based on the Harvard Standards, individuals with weight-for-height levels which are below 80 percent of the standard median are said to have been "wasted" and their situation reflects current malnutrition (United Nations, 1990). Severe wasting occurs when the score is 70 percent of the standard median.

One known cause of low weight-for-height levels is a food intake inadequate to meet the energy needs of the individual, as in the case of starvation or in a situation such as infection in which energy requirements are not met. Another cause of low level of weight-for-height is the inadequate utilisation of available energy because of malabsorption of foods, fever, or diarrhoeal diseases, indicating a clear link between nutrition and health.

3.1.3.2 Height-for-age

Low height-for-age indicates "stunting". Under the Harvard Standards a case of stunting occurs when height-for-age is below 87.5 percent of the standard median and severe stunting is when the value is less than 80 percent of the standard median (United Nations, 1990).

While wasting can generally be attributed to inadequate food intake or utilisation or serious infection, the causes of stunting are less clear. This indicator is not as sensitive to serious inadequacies of food intake as is weight-for-height, and seems to be the last indicator to be affected, in acute starvation.

In individual cases, the arrest or slowing of linear growth, that is, height-for-age, has been detected following a decrease in weight-for-height due to limited energy availability or utilisation. Non-nutritional causes such as genetic effects, infectious diseases, and socio-economic conditions are often cited as causes of stunting.

3.1.3.3 Weight-for-age

Weight-for-age has been until now the most commonly used anthropometric indicator; but recently a number of disadvantages of using only this indicator when evaluating the nutritional status of populations have been documented (United Nations, 1990). Weight-for-age gives the least clear picture of a population's nutritional status, because it is a composite indicator of both weight-for-height and height-for-age. A short child with a normal weight-for-

height may have a low weight-for-age, or, conversely, a tall wasted child may have a normal weight-for-age. In a population, weight-for-age would not indicate whether the malnutrition was due to stunting or due to wasting.

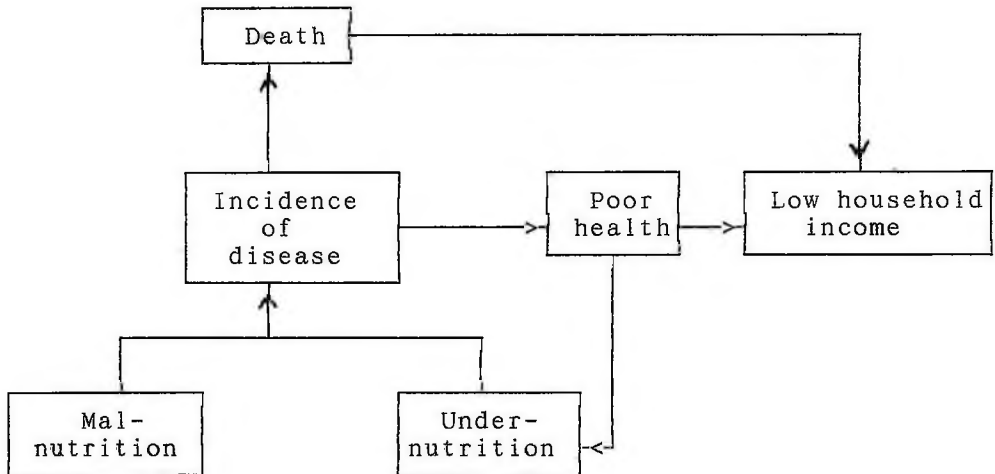
Despite these problems, this indicator is still necessary for comparisons with earlier surveys, as weight-for-age was the first anthropometric indicator in general use and it is the indicator used on individual "Road to Health" cards.

Of the three anthropometric indicators used, weight-for-height is the best indicator of current and acute malnutrition (United Nations, 1990). When food intake is significantly reduced, or infection is sufficiently serious, weight-for-height would be the first indicator to be affected.

3.1.4 Health-Nutrition Dichotomy

The link between poverty and one of the main root causes of rural poverty in Ghana is low agricultural productivity which is caused by inefficient input distribution, inadequate extension services, inefficient marketing system, lack of credit, lack of appropriate technology and rigid and outmoded institutions. Low agricultural productivity results in inadequate food supply and low household incomes. Since most of the people in the rural areas are subsistent farmers, their livelihood depends on their farms. Low agricultural productivity results in inadequate amounts of food and therefore renders the people food insecure. The health and nutrition status of individuals is thus affected which in turn

Figure 3.1 The Health-Nutrition Dichotomy. The Poverty Trap.



leads to a fall or deterioration of standard of living (Figure 3.1).

Health status has an exceptional place among the determinants of undernutrition. It has a direct effect on nutrient utilisation. Individuals suffering from poor health tend to eat less because of their illness and consequent loss of appetite. When an infection occurs to children, mothers often cease feeding the children, either because of simultaneous food shortages (Nabarro, 1984) or because of cultural beliefs regarding illness (Bos *et al.*, 1993). The ability to digest food and actually absorb nutrients into the

blood during infection is decreased during illness, especially in diarrhoea (Bos *et al.*, 1993). However, during infection there is the need to increase nutrient utilisation to combat the infection and restore any damage done to body tissues.

Infectious agents which reduce the health of an individual, are influenced by other environmental conditions or factors. These include the access to clean drinking water, type of toilet facility available, care of the individual, the way food is prepared and stored, hygiene, household size. For instance, the influence of the quality of sewerage on nutritional status can be explained from its effects on infection (Wolfe and Behrman, 1982).

3.1.5 Nutritional Status of Children (under 5 years)

The strong relationship between health and nutritional status has already been emphasised in earlier sections. The stock of health and nutrition is valued both as investment and a consumption commodity (Reutlinger and Selowsky, 1978; Alderman and Garcia, 1993). The stock of health and nutrition is part of a person's human capital (the productive stock embodied in human beings) and this appreciates at an increasing rate at the early stages of the life cycle and depreciates over time at an increasing rate after some stage of the life cycle. The stock of health and nutrition can be increased by investments in health and nutrition, for example, eating a nutritious diet, seeking medical care or keeping hygienic or sanitary conditions.

Bos *et al.* (1993) define nutritional status as the pool of

nutrients in the body that is or can become available to metabolism. During early years of life, when organs are still developing, low nutrient intake can impair organ growth and function. Martorell (1989) finds that children who grow poorly are likely to be severely ill when infected and more likely to die than children who grow well.

The nutritional status of a household depends not only on its nutrient intake level, but also on other privately and publicly provided goods and services (Schiff and Valdes, 1990c). The nutrient intake of the body is directly determined by the quantity of the food available to the individual (Bos et al. 1993). It is not only how much food the individual obtains that determines the nutrients actually absorbed in the body, but also the quality of that food, for example, nutrient content, digestibility, additives and toxicity. This combination of quality and quantity is the result of external influences. An external influence occurs when for example, after obtaining a certain quantity of food with certain qualities, foodstuffs undergo changes, due to preparation or conservation. For instance, cooking can reduce vitamin content and at the same time increase digestibility. Thus, individual food availability, define what and how much food is at a person's disposal.

Haddad and Kanbur (1991) have observed some disparities in the allocation of the available food to household members. Similar individuals are treated dissimilarly in the allocation of consumption within households. Thus, understanding intrahousehold

inequality gives an idea of the food intake of an individual in a household.

The issue of intrahousehold inequality arose in the literature out of dissatisfaction with "unitary" models of the household, especially in explaining observed inequality in consumption and achievements of different household members, even after making an allowance for relevant differences among them (Sen, 1984). Sen (1984) also summarised a number of studies on outcome variables which argued that girls within households are discriminated against relative to boys. One such case is that, boys are given more food than girls. Some evidence of calorie intake inequality presented by Harriss (1986) and Haddad and Kanbur (1990) have shown that, standard measures of inequality in calorie adequacy would be understated by 30 to 40 percent if intrahousehold inequality was ignored.

Studies indicate that mother's schooling may play an important role in determining household nutrition and health (Behrman and Wolfe, 1984; Heller and Drake, 1979; Rosenzweig and Schultz, 1982; Wolfe and Behrman, 1982; and the World Bank, 1980). This is because an increased level of education of women may imply knowledge of better nutrition and health which can be applied to the benefit of the whole household.

3.2 Specification of the Under-Five Health and Nutrition Model

(UFHNM)

The under-five health and nutrition model for this study is

based on the household as the unit of analysis. The behavioural model takes into consideration both publicly and privately provided inputs as already elucidated upon.

3.2.1 Behavioural Model

The nutritional status, proxied by food intake, of a child in a household depends on a number of privately and publicly provided goods. It also depends directly on food available to the individual in the household. The privately provided inputs include food availability, care, health condition (status), age and body weight. The publicly provided inputs on the other hand, include sanitation.

1. Food availability. The food available in the household (Kcal) is the amount of food available for all members of the household in kilocalories. This is obtained by converting food expenditure information to weight (in kg) using prices. The conversion involved 45 food commodities whose prices were available through the Price and Community Survey.

Bouis et al. (1992) have pointed out that the use of food expenditure surveys has led to severely upwardly biased estimates, and that food intake survey techniques give more accurate estimates of nutrient demand parameters. Summers (1959) has also explained that for econometric reasons, it is better to use income instead of expenditure in explaining food consumption since expenditure may be significantly correlated with the error term. However, Friedman (1957) suggests that permanent income, which may be represented more accurately by total expenditure, may reflect the purchasing

power of a household better than measured current income which may be distorted by transitory components such as windfall income.

Food availability to the household is cast in the framework of a demand function and so it is assumed to depend on income, relative prices, the household size in adult equivalent, the quality of care available to the child from the household and the level of sanitation in the child's immediate environment (the house in which the child lives). The household is assumed to have a definable utility function, a known income or expenditure for a set of prices and other characteristics of the individual and his environment. The apriori expectations are that households with higher income per capita tend to have more food available to its members; the prices of normal food commodities are expected to be inversely related to food availability. Since these foods include substitutes, complements and neutral commodities it may be difficult to apriori hypothesise the signs for the food prices in the equation.

The level of education of mother of child is expected to positively affect nutritional status. Similarly the larger the household size in adult equivalent, the larger the food available to the household (via the production function).

Households with higher food available per capita would have a higher nutrition status. In order to know the food intake, that is food available per capita (kcali), attention must be paid to intra-household food allocation. Therefore average food availability per person should be corrected for age of the household member, that

is, adult equivalent consumption unit, and household size in adult equivalent. For simplicity, it is assumed that children consume less food than adults.

2. Body weight. The body weight, which also measures the health condition of the child, is a function of food intake, the health status of the child, the age of the child, genetic factors of the parents and the gender of the individual. The amount of food consumed has a positive impact on body weight since excess calories over and above the energy requirement and other needs are converted into body mass. The body frame and metabolic factors of a person also depend upon the source of the genetic material of the person.

When the weight of a child is normal then it can be assumed that the child has a normal growth or an acceptable health status. This implies that there are no health inhibitions in the ability of the child to consume and convert food to nutrients for normal functioning of the body. Thus, the higher the weight of a child the higher the food intake and the better the nutritional status.

The health status, weight-for-height standardised score (whzp), depends on the weight and height of the child. A function is estimated recursively for the whzp,⁵ where it is assumed to depend upon the weight and height of the child. This is then used as a proxy for health status in the body weight function.

Finally, instead of estimating separate functions for the

⁵ The results obtained for the whzp are sufficient to use the estimated function as an approximation of reference curves (Albersen, 1993).

rural and urban areas because of expected behavioural differences, a dummy variable for location was included in the food availability and body weight formulations.

The behavioural model can be summarised as follows:

$$\text{Whzp} = g (\text{Weight, Height}) \dots\dots\dots(12)$$

$$\begin{aligned} \text{Food availability} = h (\text{Income, Relative Prices, Care, Sanitation,} \\ \text{Household size in adult equivalent,} \\ \text{Location}) \dots\dots\dots(13) \end{aligned}$$

$$\begin{aligned} \text{Body weight} = I ([(\text{Adult equivalent consumption unit*food} \\ \text{available})/\text{household size in adult} \\ \text{equivalent}], \text{Age, Genetic factor of parents,} \\ \text{Health status, Gender, Location}) \dots\dots\dots(14) \end{aligned}$$

$$\begin{aligned} \text{Food intake} = J ([\text{Adult equivalent consumption unit*food} \\ \text{available})/\text{household size in adult} \\ \text{equivalent}]) \dots\dots\dots(15) \end{aligned}$$

3.2.2 The Structural Model

In determining the structural model to be used, various forms of estimation procedures were employed before selecting the best model based on a priori expectation.

1. The specification of the under-five health and nutrition model in Ghana is algebraically presented in cubic formulation as follows:

$$\begin{aligned} \text{Whzp} = (\text{Wt} - (\alpha_0 + \alpha_1\text{Ht} + \alpha_2\text{Ht}^2)) / (\beta_0 + \beta_1\text{Ht} + \beta_2\text{Ht}^2 + \\ \beta_3\text{Ht}^3) \dots\dots\dots(16) \end{aligned}$$

where

Whzp is standardised weight-for-height Z-score,

Ht is height of the child in metres and

Wt is weight of the child in kilogrammes.

2. Food availability is cast in a Cobb-Douglas form (double-log). Price of maize is used as a deflator to convert nominal prices and total expenditures into real terms. This is because maize is one of the main contributors to calories in Ghana. Price of maize is used as a deflator to reduce inflationary tendencies in the data collected over a number of seasons in a period of one year.

$$\begin{aligned} \log(\text{Kcal}) = & a_0 + a_1(\text{Em}) + a_2(\text{Sw}) + a_3 \log(\text{sizeq}) + a_4 \log(\text{Te/Pmaize}) + \\ & a_5 \log(\text{Pcas/Pmaize}) + a_6 \log(\text{Pgcorn/Pmaize}) + \\ & a_7 \log(\text{Pmil/Pmaize}) + a_8 \log(\text{Pgarri/Pmaize}) + \\ & a_9 \log(\text{Pyam/Pmaize}) + a_{10} \log(\text{Pccyam/Pmaize}) + \\ & a_{11} \log(\text{Pptain/Pmaize}) + a_{12}(\text{Durb}) + e_1 \dots\dots\dots (17) \end{aligned}$$

where

Kcal is daily household kilocalories from 45 food commodities,

Sizeq is household size in adult equivalent,

Te is total household expenditure in cedis,

Pcas is price of cassava in cedis per kilogramme,

Pmaize is price of maize in cedis per kilogramme,

Pmil is price of millet in cedis per kilogramme,

Pgarri is price of garri in cedis per kilogramme,

Pyam is price of yam in cedis per kilogramme,

Pccyam is price of cocoyam in cedis per kilogramme,

Pptain is price of plantain in cedis per kilogramme,

Pgcorn is price of guinea corn in cedis per kilogramme,

Em is dummy for educational level of mother $\left\{ \begin{array}{l} Em=1 \text{ for above 10 years} \\ Em=0 \text{ otherwise} \end{array} \right.$

Sw is dummy for treated water $\left\{ \begin{array}{l} Sw=1 \text{ for treated water} \\ Sw=0 \text{ otherwise} \end{array} \right.$

Durb is dummy for urban area $\left\{ \begin{array}{l} Durb=1 \text{ for urban area , and} \\ Durb=0 \text{ for rural area} \end{array} \right.$

e_1 is the error term.

3. The body weight equation is in a mixed log form and it is specified as follows:

$$\log(Wt) = b_0 + b_1 \log([\text{Scale} * \text{Kcal}] / \text{sizeq}) + b_2 (\text{Hm}) + b_3 (\text{Whzp}) + b_4 (\text{Months}) + b_5 (\text{Dsex}) + b_6 (\text{Durb}) + e_2 \dots \dots \dots (18)$$

where

Wt is the weight of the child (kg),

Scale is adult equivalent consumption unit,

Kcal is daily household kilocalories from 45 food commodities,

Sizeq is household size in adult equivalent,

Hm is height of mother of child (in metres),

Whzp is standardised weight-for-height Z-score,

Months is the age of the child (in months),

Dsex is dummy for gender of child $\left\{ \begin{array}{l} Dsex=1 \text{ for female} \\ Dsex=0 \text{ otherwise} \end{array} \right.$

Durb is dummy for urban area $\left\{ \begin{array}{l} \text{Durb}=1 \text{ for urban area , and} \\ \text{Durb}=0 \text{ for rural area} \end{array} \right.$

e_2 is the error term.

4. The individual daily calorie intake is obtained from the household food availability using a conversion factor. The conversion is done as

$$\text{Kcali} = (\text{Scale} \times \text{Kcal}) / \text{Sizeq} \quad \dots\dots\dots(19)$$

where

Kcali is individual daily calorie intake estimate in kilocalories, and Scale, Kcal and Sizeq have the same notation as in equation 18, above.

CHAPTER FOUR

ESTIMATED RESULTS, VALIDATION AND POLICY EXPERIMENTS OF THE UNDER FIVE HEALTH AND NUTRITION MODEL

4.1 Introduction

This section is in three parts. The first part discusses the results from frequency computations, and bi-variate relationships through cross tabulations and the estimation of the econometric model presented in chapter three. The validation of the model then follows in the second part. Results and discussions of policy experiments of the under five model are summarised in the last part. The analysis is based on a sample size of 2,127 children of below five years of age drawn from the GLSS I data set.

4.2 Determinants of Health and Nutritional Status**4.2.1 Privately Provided Inputs**

Some of the important privately provided inputs that determine the health and nutritional status of children of 0 to 59 months old are food intake, care, weight and the anthropometric indicators. Comparison of these inputs will be by locality (rural and urban); agroecological (coastal, forest and savannah and zone); north and south to bring out the distribution of these important variables in Ghana.

The distribution of food intake (kcali), by children of various age groups is presented in table 4.1. When compared with Required Dietary Allowance (RDA), it is found that on the average

Table 4.1 Average Calorie Intake of Children Under Five in Ghanaian Households, 1987/88

	Average calorie intake							
	Infants				Children			
	0-6 months		7-12 months		13-36 months		37-59 months	
	means	std. dev.	mean	std.dev.	means	std. dev.	means	std. dev.
*RDA	702	-	972	-	1300	-	1800	-
Ghana	479	787	947	942	1138	1159	1397	1306
<u>Locality</u>								
Rural	522	914	975	1030	1206	1265	1445	1402
Urban	379	318	880	685	987	862	1275	1016
<u>Region</u>								
Ashanti	287	376	738	525	793	464	1042	727
Brong- Ahafo	410	560	894	817	1058	910	1209	1065
Central	410	396	772	655	870	734	1312	984
Eastern	569	1221	1015	1381	1305	1736	1615	1723
Greater- Accra	545	364	1004	609	1041	631	1466	1111
Northern	448	570	1891	1447	1839	1710	2013	1896
Upper East	864	1198	1174	1090	1407	1692	2400	2064
Upper West	819	1613	1147	1185	1927	1629	1804	1706
Volta	434	464	717	588	992	925	1242	1122
Western	270	248	845	721	1086	848	1140	838
<u>Zone</u>								
North	724	1257	1426	1276	1763	1686	2045	1885
South	429	643	853	833	1016	980	1290	1151
<u>Agroecology</u>								
Coastal	445	390	962	1069	968	833	1359	1071
Forest	421	809	771	614	994	977	1165	1097
Savannah	592	1017	1265	1183	1562	1573	1825	1723

Source: Computed from Ghana Living Standards Survey, 1987/88 data of the Statistical Service, Ghana.

* RDA, 1974. Recommended Dietary Allowances. National Academy of Science, eight edition. Food and Nutrition.

Ghanaian children of 0 - 59 months old receive 82.7 percent of the required dietary allowance, although there are wide geographical differences.

Food intake in the rural areas turns out to be higher than that for the urban areas for all age groups under 5 years. This finding is at variance with the notion that there is more poverty in the rural areas than in the urban areas as reported by Boateng et al. (1990). However, Minhas (1991) obtained similar results as the present study when he compared the average intake of calories of rural and urban people in India.

With reference to the ten political administrative regions of Ghana, the Upper East and Upper West regions have a higher consumption of calories as compared to the other regions. Western region has the lowest calorie intake for children of under five years old.

Dividing Ghana into two zones, the North and South, the North which comprises the Northern, Upper East and Upper West regions has a higher caloric intake than the South in all the age categories of children under five years old. Just like the rural-urban comparisons, the food intake results do not corroborate poverty studies which have concluded that the North is poorer than the South. These differences in caloric intake are possible since lower prices in the rural areas and in the North may imply higher estimates of quantity of food intake via expenditure data than in the urban areas and in the South where food prices are generally higher.

Comparing the average caloric food intake across the

agroecological zones, the savannah has the highest food intake estimate followed by the coastal and then the forest zones with 1490 kcal/child/day, 1046 kcal/child/day and 961 kcal/child/day, respectively.

Table 4.2 shows the mean weight distribution of children under-five years old by age in Ghana, by rural/urban, region, north/south and agroecological zone. The mean weight of children under five years old is 13.19 kg which is higher when compared with the recommended average weight of 12.00 kg for a child under 5 years (RDA, 1974). This represents about 9.92 percent difference over the recommended mean weight of children. The mean weight of children in the rural and urban areas are 13.18 kg and 13.22 kg, implying that children in urban areas are a little heavier than those in the rural areas.

In the ten political regions, Brong-Ahafo, Eastern, Northern and Upper East regions have mean weight of a little above 14.00 kg. The region with the lowest mean weight is the Volta region followed by the Central region with 11.88 kg and 11.95 kg respectively.

Dividing Ghana into two, the north and south, the mean weights are 13.66 for the north and 13.11 kg for the south. Comparing the mean weight and the average food intake of a child 0 to 59 months old, the weight value follows the same pattern as the food intake with children in the north being heavier than those in the south.

In terms of agroecology, children in the savannah zone have the highest mean weight followed by the coastal and forest zones

Table 4.2 Mean Weight of Children Under-Five Years Old
by Age of Children, 1987/88

	Age Group (months)					
	1-12	13-24	25-36	37-48	49-59	Combined
Ghana	10.37	12.67	13.30	15.41	15.57	13.19
<u>Locality</u>						
Rural	10.53	12.91	13.25	15.40	14.93	13.18
Urban	10.03	12.11	13.40	15.43	17.34	13.22
<u>Region</u>						
Ashanti	10.00	12.38	13.67	15.31	14.40	12.74
Brong-Ahafo	11.36	14.79	14.37	17.05	15.16	14.41
Central	7.61	11.09	13.11	13.70	16.30	11.95
Eastern	12.95	13.61	12.50	16.31	17.17	14.18
Greater-Accra	9.62	11.23	13.51	14.88	16.73	12.77
Northern	10.82	15.94	13.13	14.45	16.64	14.09
Upper East	13.16	15.60	16.15	14.74	14.20	14.85
Upper West	8.60	10.91	13.77	15.25	14.71	12.01
Volta	8.10	10.03	12.05	15.19	14.54	11.88
Western	11.26	12.02	12.98	15.77	15.41	13.43
<u>Zone</u>						
North	10.89	14.56	13.93	14.79	15.92	13.66
South	10.28	12.27	13.19	15.52	15.53	13.11
<u>Agroecology</u>						
Coastal	10.46	11.62	13.31	15.30	16.74	13.21
Forest	9.53	12.26	13.19	14.97	14.37	12.60
Savannah	11.67	14.43	13.45	16.18	16.49	14.14

Source: Computed from Ghana Living Standards Survey, 1987/88 data of the Statistical Service, Ghana.

with 14.14 kg, 13.21 kg and 12.60 kg, respectively.

Years of formal education of mother of children under 5 years old, which is used as a variable to explain the care given to a child shows that about 52.7 percent of the children under 5 years have mothers who have no formal education (table 4.3). About 32.4 percent of the mothers had 7 to 10 years of formal education that is, up to middle school education, and 12.0 percent of them had 1 to 6 years of formal education, that is primary school education. Only 0.2 percent of the mothers had been able to attain 18 to 25 years of education, which is equivalent to tertiary or university education. About 78 percent of the mothers in the rural areas had never been to school as compared with about 22 percent in the urban areas.

The distribution of undernutrition among children, 0-59 months reveals that 29.50 percent of children are chronically undernourished, that is, they are too short for their age or stunted (height-for-age z-score that is below -2 standard deviation of the reference population). This shows that about 1 in 3 children aged 0-59 months are chronically undernourished (table 4.4). About 27.20 percent of children in Ghana are underweight (weight-for-age z-score that is below -2 standard deviation of the reference population). This implies that about 1 in 3 children in Ghana are underweight.

Acute undernutrition, which is manifested by wasting (weight-for-height z-score that is below -2 standard deviation of the reference population) is about 7.10 percent of children in Ghana

Table 4.3 Distribution of Years of Formal Education of Mothers' of children Under 5 Years in Ghana, 1987/88 (in percentages).

	Years of Education				
	0	1-6	7-10	11-17	18-25
Ghana	52.70	11.99	32.36	2.76	0.19
<u>Locality</u>					
Rural	77.69 (58.51)	70.55 (12.09)	61.51 (28.45)	22.54 (0.89)	20.00 (0.06)
Urban	22.31 (39.15)	29.45 (11.76)	38.49 (41.47)	77.46 (7.11)	80.00 (0.52)
<u>Agroecology</u>					
Coastal	25.70 (44.74)	32.04 (12.69)	35.13 (37.56)	50.70 (4.62)	60.00 (0.38)
Forest	36.52 (44.05)	53.72 (14.74)	52.40 (38.81)	35.21 (2.22)	40.00 (0.18)
Savannah	37.78 (76.45)	14.24 (6.56)	12.47 (15.50)	14.08 (1.49)	0.00 (0.00)

Source: Computed from Ghana Living Standards Survey, 1987/88 data of the Statistical Service, Ghana.

Figures in parenthesis give the contribution of mothers' years of formal education.

Table 4.4 Distribution of Undernutrition among Children Aged 0-59 Months in Ghana, 1987/88 (in percentages)

	Chronically undernourished	Underweight	Acute undernutrition
Ghana	29.50	27.20	7.10
<u>Locality</u>			
Rural	80.22	78.57	76.96
Urban	19.78	21.43	23.04
<u>Region</u>			
Ashanti	16.18	17.41	20.10
Brong-Ahafo	13.97	13.54	9.31
Central	10.10	9.97	7.31
Eastern	11.76	10.42	11.35
Greater-Accra	7.61	6.85	9.31
Northern	7.61	8.48	10.78
Upper East	3.73	3.27	4.41
Upper West	6.82	7.29	7.84
Volta	9.82	9.82	9.31
Western	12.31	12.95	10.29
<u>Zone</u>			
North	18.26	19.05	23.04
South	81.74	80.95	76.96
<u>Agroecology</u>			
Coastal	24.07	23.96	24.51
Forest	47.16	47.32	42.16
Savannah	28.77	28.72	33.33

Source: Computed from Ghana Living Standards Survey, 1987/88 data of the Statistical Service, Ghana.

aged 0-59 months. Thus, approximately 1 in 13 Ghanaian children are wasted. The distribution of undernutrition is thus consistent with results obtained from the Demographic and Health Survey carried out in 1987.

The rural areas turn out to be more undernourished (high percentages of chronically undernourished, underweight and acute undernutrition) than the urban areas (table 4.4). This confirms earlier findings (Boateng *et al.*, 1990) that poverty in Ghana is a rural phenomenon. The Southern part of Ghana have more children undernourished than the Northern part. This is not consistent with other revelations that levels of poverty are higher in the North than in the South. Undernutrition of all forms is severe in the forest area followed by the savanna and coastal areas.

4.2.2 Publicly Provided Inputs

Sources of drinking water and light are some of the important publicly provided inputs which affect the health and nutritional status of children especially those under 5 years of age.

When the source of drinking water is disaggregated into untreated and treated water, about 75.62 percent of the children are raised in households with untreated source of drinking water (table 4.5). This has a serious repercussion on the health and nutritional status of the children, who tend to be vulnerable to all types of diseases especially, in these formative years of their lives.

Only 24.4 percent of the children under 5 lived in households

Table 4.5 Distribution of Source of Drinking Water in Ghana, 1987/88

	Source of drinking water	
	Untreated	Treated
Ghana	75.62	24.38
<u>Locality</u>		
Rural	86.35 (93.63)	18.22 (6.37)
Urban	13.64 (34.10)	81.78 (65.90)
<u>Agroecology</u>		
Coastal	19.77 (48.51)	65.06 (51.49)
Forest	48.57 (84.82)	26.96 (15.18)
Savannah	31.67 (92.48)	7.98 (7.52)

Source: Computed from Ghana Living Standards Survey, 1987/88 data of the Statistical Service, Ghana.

Figures in parenthesis give the contribution of source of drinking water in Ghana.

which has treated drinking water. Of this group, 81.8 percent of them were in the urban areas. The coastal areas are better endowed with potable drinking water, with 65 percent of children having access to treated drinking water as compared with 27 percent in the forest zone and 8 percent in the savanna zone (table 4.5).

In Ghana, 79.36 percent of the children under 5 years of age live in households without electricity. Most of these households are in the rural areas. About half of the sample which had electricity were in the coastal areas and about 44 percent were in the forest zone. Availability of electricity was negligible in the savanna zone (table 4.6).

Table 4.6. Distribution of Source of Light in Ghana, 1987/88

	Source of light	
	No electricity	Electricity
Ghana	79.36	20.64
<u>Locality</u>		
Rural	83.66 (95.21)	16.19 (4.79)
Urban	16.34 (42.84)	83.81 (57.16)
<u>Agroecology</u>		
Coastal	25.68 (66.15)	50.53 (33.85)
Forest	43.08 (78.97)	44.13 (21.03)
Savannah	31.24 (95.74)	5.34 (4.26)

Source: Computed from Ghana Living Standards Survey, 1987/88 data of the Statistical Service, Ghana.

Figures in parenthesis give the contribution of source of light in Ghana.

4.3 Estimated Results of the Under Five Model

Using the Statistical Analysis System (SAS) a non-linear ordinary least squares (NOLS) estimation procedure was used in the estimation of the system of equations presented in chapter three for the Under-Five Health Nutrition Model (UFHNM). Appendix 2 gives a description of the selected variables along with their means and standard deviations. The estimated equations are presented in tables 4.7 and 4.8. The standardised weight-for-height Z-scores equation estimated earlier on is also presented in table 4.9.

1. Food availability. The food availability equation in double-log form had an R^2 of 0.649 and an F-value of 307.26, signifying a good fit. All the price ratios were significant at least at the 0.05 level, except the ratio of guinea corn price to the price of maize which was significant at the 0.1 level. Whereas price ratios of cassava, guinea corn and yam to maize had negative signs, those of millet, garri, cocoyam and plantain to maize had positive signs (table 4.7). The positive signs between these food commodities and food availability imply that when the relative prices increase, households may substitute for cheaper calorie sources of food.

Level of education of mother (E_m), which was used as a proxy for care of the child entered as a dummy variable. It was found that even though this is significant at less than 0.1 percent level, more than 10 years of education had a negative relationship with food available to the household. A plausible explanation for this negative result is that with education, mothers are able to

Table 4.7 Dependent Variable: Log(Kcal)

Variable	Coefficient	t-value	Probability	Elasticity
Constant	-0.0699	-0.21	0.8345	-
Log(Te/Pmaize)	0.9555***	47.81	0.0000	0.9555
Em	-0.1138*	-1.83	0.0668	-
Sw	-0.1888***	-5.35	0.0001	-
Log(sizeq)	0.0733***	2.91	0.0036	0.0733
Log(Pcas/Pmaize)	-1.0459***	-5.42	0.0001	-1.0459
Log(Pgcorn/Pmaize)	-0.2970*	-1.74	0.0825	-0.2970
Log(Pmil/Pmaize)	0.5445**	2.20	0.0281	0.5445
Log(Pgarri/Pmaize)	0.6043***	2.64	0.0084	0.6043
Log(Pyam/Pmaize)	-2.1290***	-4.79	0.0001	-2.1290
Log(Pccyam/Pmaize)	0.3329**	2.05	0.0404	0.3329
Log(Pptain/Pmaize)	0.3454**	1.89	0.0595	0.3454
Durb	-0.1594***	-5.09	0.0001	-

Sample size = 2000
 F-value = 307.26
 R^2 = 0.649
 Adjusted R^2 = 0.646

*** Significant at < 0.01 percent level
 ** Significant at < 0.05 percent level
 * Significant at < 0.1 percent level

substitute less expensive but nutritious diets for more expensive ones.

Source of drinking water, dummy for treated water (Sw), has a negative and significant impact on food available in the household. This implies that treated water has negative influence on the food available in the household and to the child.

The household size in adult equivalent (Sizeq) which is significant at less than 5 percent level, has a positive relationship. A 10 percent change in the household size leads to a less than the proportionate change in food available to the household (0.7 percent).

2. Weight of the child. In table 4.8, all the explanatory variables are significant at less than 5 percent except location (durb). The weight of the child under-five years old, which also determines the health condition of the child, is influenced by the food intake of the child ($\frac{\text{scale} \times \text{kcal}}{\text{sizeq}}$). When the food intake increases by 10 percent the weight increases by only 0.19 percent. Thus, when the nutrient level of the food intake of the child increases, the weight of the child improves by increase in the weight ceteris paribus.

Standardised weight-for-height z-score (whzp), which is recursively determined has a positive sign in the weight equation. This means that there is a direct relationship between weight of a child and his/her weight-for-height anthropometric score. A healthy child has a normal increase in weight as he/she grows and the

height increases.

The genetic factors of the parents, proxied by the height of the mother of child (mht) and the age of child (months) both play important roles in the weight of the child and thus the health condition of the child. Both of them positively affect the weight of the child (elasticities of 0.445 and 0.405 for mother's height and age of child in months, respectively). Thus, although food intake and environmental factors affect the weight of the child, genetic factors also have significant influence on it.

Table 4.8 Dependent Variable: Log(Wt)

Variable	Coefficient	t-value	Probability	Elasticity
Constant	1.4198***	8.02	0.0001	-
Log([Scale*Kcal]/ Sizeq)	0.0195**	2.05	0.0406	0.0195
Mht	0.2825***	2.67	0.0076	0.4452
Whzp	0.0448***	13.66	0.0001	-0.0143
Months	0.0145***	30.01	0.0001	0.4053
Dsex	-0.0359**	-2.41	0.0162	-
Durb	-0.0002	-0.01	0.9885	-

Sample size = 2000
 F-value = 201.89
 R^2 = 0.378
 Adjusted R^2 = 0.376

*** Significant at < 0.01 percent level
 ** Significant at < 0.05 percent level

3. Standardised weight-for-height z-score (whzp). Results in table 4.9 was estimated using a quadratic specification for the reference height in metres and a polynomial of degree three for the standard deviation. It shows that all parameters are significant and the R^2 shows a very good fit. Albersen, 1993 thus concluded that the results could be used in an estimated function as an approximation of the reference weight-for-height z-score.

Table 4.9 Dependent variable: Whzp⁶

Variable	Coefficient	t-value
α_0	-3.8806**	-7.25
α_1	9.8633**	7.36
α_2	10.2190**	12.95
β_0	-6.5529**	-8.83
β_1	25.7169**	9.75
β_2	-30.5348**	-10.03
β_3	12.8457**	11.21

Sample size = 2927

** Significant at < 0.05 percent level

$R^2 = 0.9725$

4.4 Validation of the Under-Five Model

To be able to generate confidence required in the model specified and estimated it is necessary to validate it. Johnson and Rausser (1977) define validation as the process of evaluating the

⁶ Adapted from Albersen, 1993.

ability of a model to duplicate the characteristics of the system required to fulfill the modeling objectives.

A model can be validated by using some of the data used in estimating it to see how the model reproduces the data (historical simulation). An ex-post simulation can be carried out using a subset (historical) of the data that was not used for the estimation. When future values of the exogenous variables are available an ex-ante

simulation can be carried out. The problem with ex-ante simulation is that the exogenous variables have to be predicted before the simulation can be carried out.

For historical and ex-post simulations the model can be examined to find out how well it reproduces the data (through plots of the actual and predicted/simulated values or by calculating errors of prediction) and how well it performs at turning points.

Data splitting and simulation is an ex-post simulation exercise and it involves setting aside some of the data and using it to investigate the model and its predictive ability. This technique was used in validating the estimated under-five health and nutrition model.

The data set for estimating the model of the under-five health and nutrition model was split into two parts using random selection. Thus the estimation was carried out using 2000 observations and the remaining 127 was used for ex-post validation of the model.

Figures 4.1 and 4.2 show the simulated and actual values of

the food available to the child (kcal) and weight of the child (wt). It can be seen from the plots of the ex-post simulations that the model tracks quite well (figures 4.3 and 4.4) with most of the values of the endogeneous variables (Log kcal and Log wt) correctly predicted.

In quantitative terms, the predictive ability of the model can be measured by computing the mean squared error of the predictions. The mean squared error (MSE) of the predictions is given by:

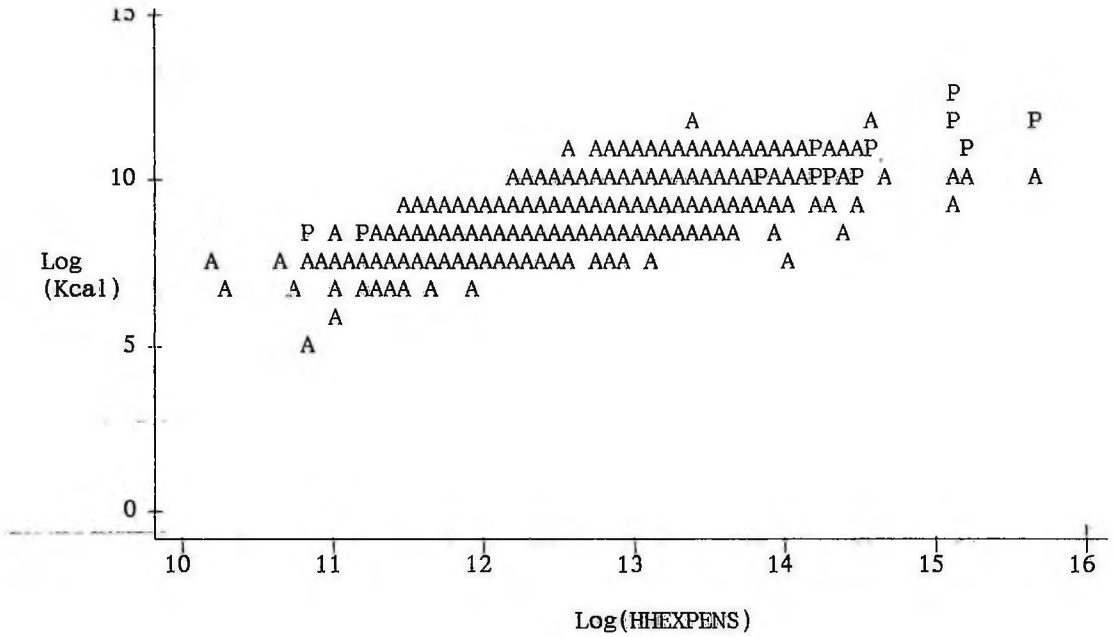
$$\text{MSE} = \frac{\sum (Y_i - \hat{Y}_i)^2}{n}$$

where Y_i is the value of the response variable, \hat{Y}_i is the predicted value for the i th case (child), and n is the number of cases in the validation set. Low MSE denotes a reliable predictive model. Comparing the MSEs estimated for the food available and weight equations (0.223 and 0.110, respectively) using historical data (historical simulation) and that obtained for the ex-post simulation of the model (0.319 and 0.109, respectively) the differences in the MSEs are negligible. Thus, the models have good predictive power outside the data used for estimation.

4.5 Policy Experiments

In a dynamic world static models are of little use. Due to the uncertainty that surrounds policy instruments and other exogenous variables it is necessary to subject a model to some changes and determine the resilience of the endogeneous variables. It should be

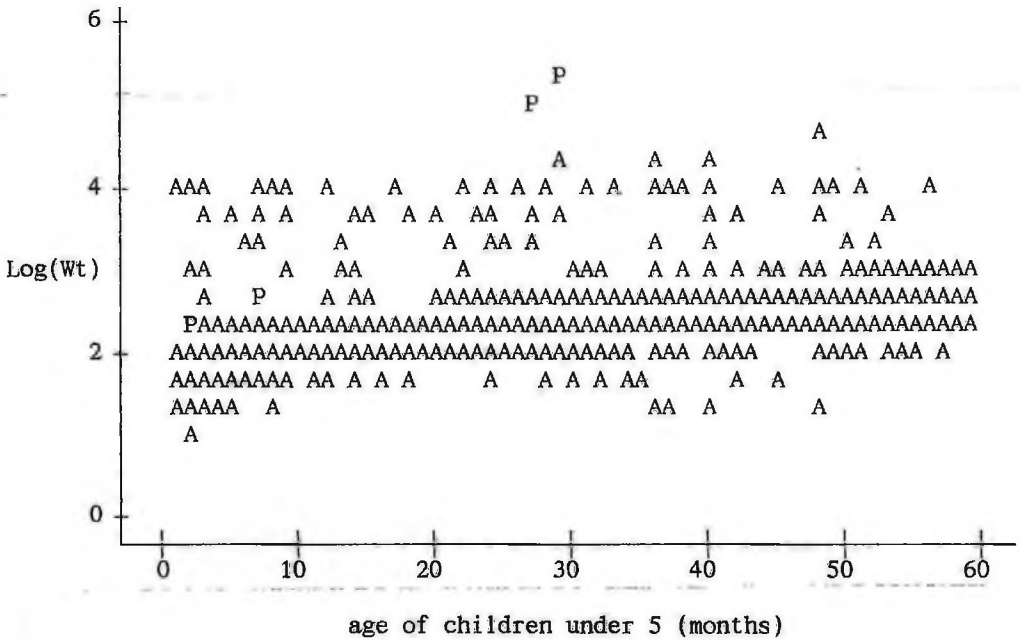
Figure 4.1 Simulated and Actual Values of Food Available to the Child (Log) versus Household Expenditures (Log) (Historical Simulation)



Predicted = 'P'.
 Actual = 'A' (also when actual=predicted).

NOTE: 3839 obs hidden.

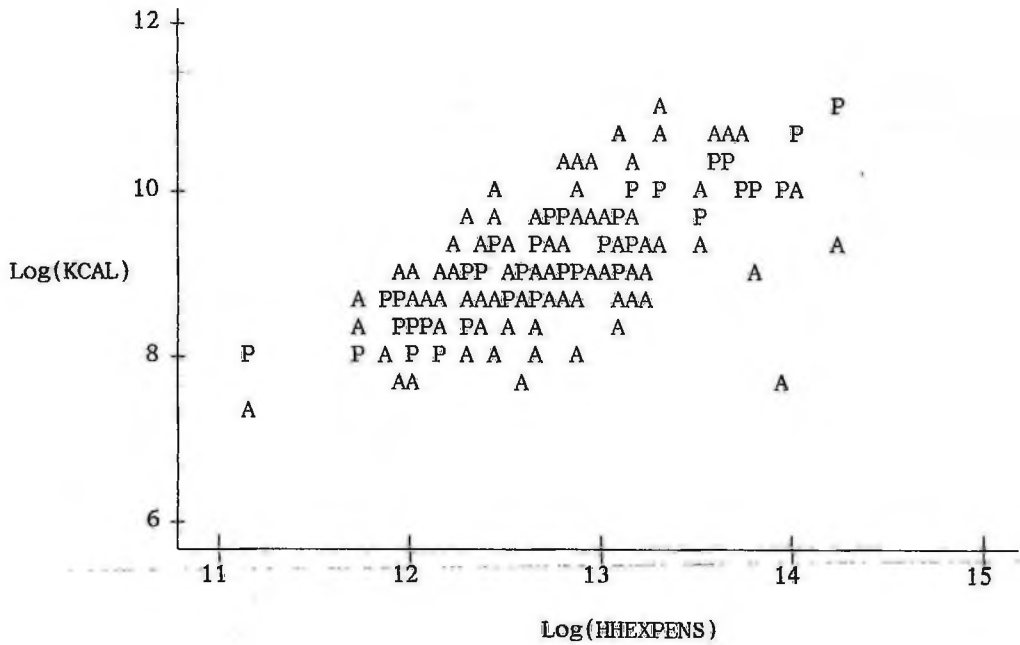
Figure 4.2 Simulated and Actual Values of the Weight (Log) versus Age of the Child (Months) (Historical Simulation)



Predicted = 'P'.
 Actual = 'A' (also when actual=predicted).

NOTE: 3732 obs hidden.

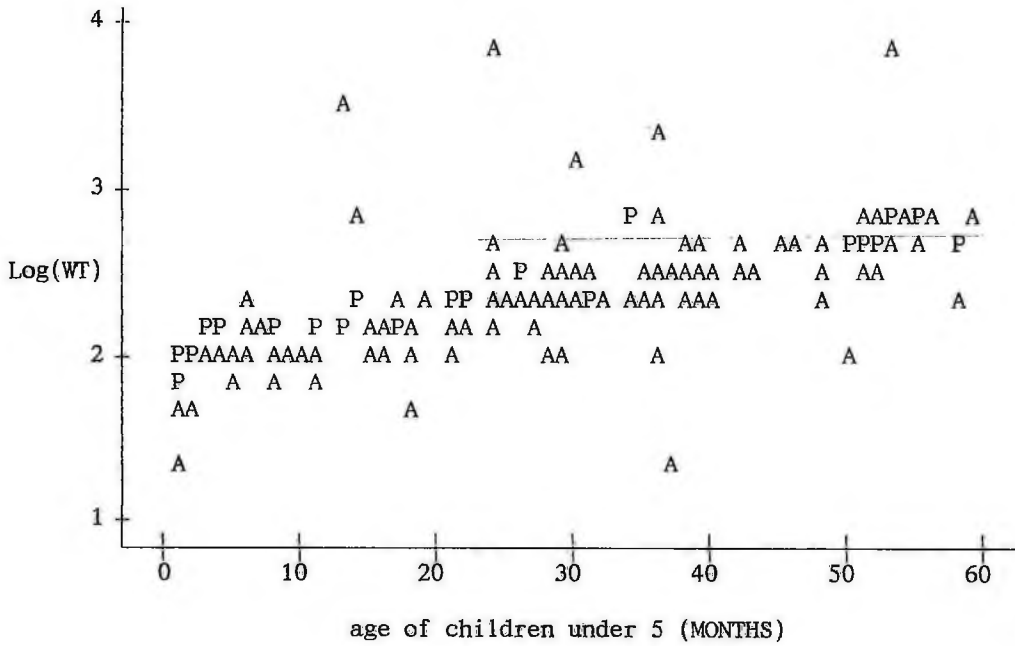
Figure 4.3 Simulated and Actual Values of Food Available to the Child (Log) versus Household Expenditures (Log) (Ex-post Simulation)



Predicted = 'P'.
 Actual = 'A' (also when actual=predicted).

NOTE: 146 obs hidden.

Figure 4.4 Simulated and Actual Values of the Weight of the Child (Log) versus Age of Child (months) (Ex-post Simulation)



Predicted = 'P'.
 Actual = 'A' (also when actual=predicted).

NOTE: 143 obs hidden.

possible to assess the effect on the system of a shock or disturbance through autonomous changes in the policy or exogenous variables. Policy experiments or sensitivity analyses have proved useful in examining these effects (Okyere, 1982).

In order to carry out the policy experiments, a base solution of the model was obtained by simulating it at the mean values of the exogenous variables. The exogenous variables that seemed to have the greatest impact on the model performance were identified and the value for each of these exogenous variable was changed within a reasonable range to observe its effect on the model outcome.

Policy experiments were conducted using four exogenous variables. Each experiment consisted of four parts. The mean value of the exogenous variable was increased by ten percent and twenty percent and then decreased by ten percent and twenty percent. Exogenous variables used were price of maize (Pmaize), Price of cassava (Pcas), household expenditure (hhexpens) and household size in adult equivalent (Sizeq). Results of the experiments are reported in table 4.10.

Changes in household size produced the least sensitive responses in these policy experiments. The most sensitive results were obtained for household expenditure. A ten percent increase and twenty percent increase in the household expenditure results in 66.23 percent and 71.91 percent of the recommended required daily allowance (RDA) of food intake for a child, respectively. Similarly, a ten percent and twenty percent decrease in household

Table 4.10 Response to food intake by autonomous changes in selected exogenous variables in the Under-five Health and Nutrition Model

Individual food intake* (Kilocalories)	10% increase	20% increase	10% decrease	20% decrease	Percentage needed to meet RDA
Household Expenditure					
720.29 (60.35)	790.43 (66.23)	858.84 (71.96)	652.40 (54.66)	583.23 (48.87)	42.18
Household Size in Adult Equivalent					
720.29 (60.35)	727.48 (60.95)	734.85 (61.57)	713.13 (59.75)	706.03 (59.16)	464
Price of Cassava					
720.29 (60.35)	651.75 (54.61)	595.66 (49.91)	804.05 (67.37)	906.57 (75.96)	-37.92
Price of Maize					
720.29 (60.35)	772.52 (64.73)	820.29 (68.73)	671.60 (56.27)	619.97 (51.95)	34.51

* This was obtained by converting the food available to the child in the household obtained in the base solution of the model to individual food intake in kilocalories. Base solution is obtained by simulating the model at the mean values of the exogenous variables.

Figures in parenthesis are percentage of recommended required daily allowance for a child 0 to 59 months (1194 kcal/child/day).

expenditure results in a 54.66 percent and 48.87 percent of the recommended RDA to the child in the household. For the child to meet the recommended RDA, then average household expenditure will have to increase by 42.18 percent (table 4.10).

A ten and twenty percent increase in the mean price of cassava results in a reduction of food availability from 60.35 percent of requirements for the base solution to 54.61 percent of requirements. When the mean price was increased by 20 percent, the food available to a child in the household fell to 49.91 percent of the RDA.

However, a ten percent and twenty percent increases in the mean values of the price of maize led to a percentage increase in the RDA available in the households (64.73 percent and 68.73 percent, respectively). Similarly, cassava and maize decreases induced opposing changes in the proportion of RDA available in the households (see table 4.10).

The average price of cassava will have to decrease by 37.92 percent so as to meet the recommended RDA for a child 0 to 59 months whereas the mean price of maize will have to be increased by 34.51 percent so as to move children aged 0 to 59 months to the recommended RDA.

CHAPTER FIVE

SUMMARY, CONCLUSION AND POLICY IMPLICATIONS

5.1 Summary and Conclusion

To date most health and nutrition studies undertaken in Ghana have focused on either nutrition and calorie consumption aspects or health and illness aspects of nutrition without linking nutrition and health simultaneously. To bridge the gap this study has tried to find out the factors (publicly and privately) which are the principal determinants of health and nutrition of children under-five in a simultaneous context.

The study used econometric modelling technique to specify and estimate the determinants of the health and nutrition status of children under-five years in Ghana. The estimation was based on a sample of 2,127 children between the ages of 0 and 59 months from the first round (1987/88) of the Ghana Living Standards Survey conducted by the Statistical Service of Ghana with World Bank assistance.

Results presented in chapter four reveal that over three-quarters of Ghanaian children of 0 - 59 months are raised in households which do not have access to treated water and about the same proportion also do not have electricity supply in their homes. Low levels of undernutrition and educational achievements of mother of child were all biased towards the rural areas with majority of children in rural areas being disadvantaged in this respect.

Contrary to popular belief, results obtained for calorie availability was higher with rural children than their urban counterparts. This seemingly surprising result may stem from the fact that food prices are lower in the rural areas than in the urban areas. Thus computation of calorie availability to a child in a household using the expenditure approach is likely to have higher quantity of food availability in the rural than urban areas, although actual intake may indicate different relativities. On the average, Ghanaian children aged 0 to 59 months obtain 82.7 percent of the required dietary allowance, which is lower than the 93 percent for all Ghanaians between 1988 and 1990 reported by the UNDP (1993). Undernutrition at all levels (chronically undernourished, underweight and acute undernutrition) is still severe for children under-5 years old.

In an attempt to characterise the nutrition and health of children under five years in the GLSS data (first round), an econometric model was specified and estimated. Results indicated a positive relationship between food available to the child in a household and the level of income (total expenditure of the household). Dummies for treated source of drinking water and level of education of mother above 10 years were found to have a negative relationship with food available to the child in the household. This departure from prior expectations may be due to the possibility of educated women substituting more nutritious but less expensive food commodities in the household food basket. The negative relationship between treated drinking water and the food

available may be due to the low availability of treated water in rural areas when at the same time food availability is greater there than the urban areas as a result of lower rural prices as previously conjectured. As expected the weight of a child, which also measures the health condition, has a positive relation with the food available to the child.

There were indications that a price increase for a number of food commodities relative to the price of maize would lead to an increase in food available in kilocalories to the household. This is the case for millet, garri, cocoyam and plantain. These are relatively expensive sources of food energy. Hence, when these relative prices increase, households may substitute for cheaper calorie sources of food. The resulting income effect may lead to a net increase of calories.

5.2 Policy Implications

In assessing the relative merits of various public policies to deal with malnutrition among the poor, a better understanding of the household behaviour is the starting point (see chapter three). It is in this context that public policies must be designed, that is, they must take into account the fact that households make the ultimate decisions concerning the family's expenditure on nutrition and health.

One of the main causes of death among children under 0-59 months is malaria (ISSER/SOW, 1993). This is conditioned mainly by the absence or availability of basic facilities of treated water

supply and basic child care services. Bivariate relationships confirmed the importance of the publicly provided input, drinking water, in the health and nutritional status of children. Castaneda (1989) also found this relationship using data from Chile. It was found that the most important variable explaining the remarkable reduction of infant mortality in Chile from 107 per 1,000 in 1965 to 19.4 per 1,000 in 1986 was the increase in the urban coverage of potable water and sewerage. Thus, the government will have to increase the provision of good drinking water and other publicly provided inputs to have a lasting impact on health and nutrition.

As already postulated, educated mothers may use their knowledge to substitute cheaper but higher quality food for more expensive ones. This is in line with the expectation that education plays an important role in the process of raising nutrition. Not only can it raise the quality of food intake but it can also reduce household expenditure on food. One might also expect the nutrition-related and health-related child care to improve with the level of the mother's education. Garcia and Pinstруп-Anderson (1987), in their study on the Phillipines found that the mother's education directly affects the food consumption and nutritional status of pre-schoolers in a strong way. The improvements in the education of women is likely to bring dramatic improvements in the long-term nutrition of children.

The level of nutrition, measured by the use of anthropometric indicators (weight-for-height, weight-for-age and height-for-age) of children 0 - 59 months old have to be improved. On the average

29.5 percent, 27.20 percent and 7.10 percent of children are chronically undernourished, underweight and acutely undernourished, respectively. A national nutrition strategy and related programmes (including a surveillance system) must be put in place in order to address the serious nutritional deficiencies which have been identified. Also the food security objectives of the Ministry of Food and Agriculture's, Medium Term Agriculture Programme (MTADP) have to be translated into concrete programmes which will address existing problems in credit availability, input pricing and distribution and marketing which will help improve the food supply situation at levels which would be affordable to many people.

Also policies designed to raise nutrient content of some food ingredients, such as food fortification programmes, can lead to an increase in the level of nutrition of children.

It was shown that households with children do decrease (increase) their food availability as the relative price of cassava to maize increases (decreases). Cassava is a good source of energy and so shifting from it to another food commodity which is cheaper may not necessarily be cost effective since the cost per unit of kilocalories for the substitute may be higher than that of cassava. Increases in the relative prices are likely to lead to a reduction of food available to the household. While there is little likelihood that the government can directly influence the price of cassava through market stabilisation or price subsidies, programmes that reduce the cost of transport, or the amount of spoilage, will have significant effect on the food available to the child.

Simulation of total expenditure in the under-five health and nutrition model indicates that 10 percent increase (decrease) in income results in a 9.55 percent increase (decrease) in food available to the child. Some of this increase may be allocated to quality improvements instead of just quantitative increase in food. According to Schiff and Valdes (1990a), as income increases, a larger proportion of food expenditures is spent on non-nutrient food attributes such as diversity of products consumed, freshness, taste, convenience foods which save time in their preparation and others. Similar results were found in low-income households in Pakistan by McCarthy (1977), who found that as income rises, increase in food expenditures are allocated mostly to quality rather than quantity of food. Thus, raising income may have little to do with caloric increases although in general, nutrition may rise through qualitative adjustments in the food provided.

Therefore, programmes that tend to increase the incomes of poor households have a good chance in improving the nutrition of members of these households since there will be both qualitative and quantitative response in food availability.

The positive relationship between household size in adult equivalent and food availability gives an indication that large household sizes are preferable to smaller ones. This is at variance with family planning teaching which advocates for reduction in family sizes. However, if it is considered that many rural households are both producers and consumers of food, then an increase in the farm family size may not be harmful in the

production process. Whatever the situation is, the optimum rural household size is the one that can produce enough food for the household with some marketable surplus to earn cash income to cater for some other needs. In this case, the size of the household labour force vis-a-vis the dependents is very important in considering the food security needs of the household.

Finally, priority should be placed on closing the gap between rural and urban areas in the availability of social infrastructure, such as water and sanitation facilities, through low-cost and technologically appropriate interventions. This will include the local manufacture and maintenance of basic equipment such as handpumps for rural water supply.

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APPENDIX 1

HEALTH-RELATED POLICIES AND PROGRAMMES TO ALLEVIATE POVERTY

1.1 Introduction

Health and nutrition interventions have an impact on human capital formation, through their impact on schooling and labour productivity and have implications for the future earnings of individual and the growth in Gross National Product (Reutlinger and Selowsky, 1978). Specific investment policies in nutrition and health increase the endowment of human capital of the poor by increasing their earning capacity. Such programmes do not necessarily imply a trade-off between economic growth and poverty alleviation.

The decisions on health and nutrition are basically made by individuals and households in which they live, given their income, the price structure they face, and the level of services and infrastructure in the community, and the nutrition and health production technology. It is in this context that public policies and programmes must be enacted and designed, with the full cognisance of the households which will make the ultimate decisions concerning the family's expenditures on nutrition and health. It is therefore important to devise prudent policies to promote reduction of poverty and improve upon the living standards of the people.

1.2 Health Policy

The health policy of Ghana revolves around a Primary Health Care (PHC) programme and an Expanded Programme on Immunisation (EPI) to accelerate the expansion of out-reach services and strengthen immunisation activities for children and pregnant women. Six problems have been identified as priority areas to form the basis of maternal and child health policy. They are:

- (a) diarrhoeal disease control;
- (b) immunisation of children against vaccine - preventable diseases;
- (c) control of malaria;
- (d) maternal and prenatal mortality;
- (e) malnutrition; and
- (f) uncontrolled spacing and a high number of pregnancies resulting in a high birth rate.

As a policy of cost sharing the government introduced a user-fee scheme under the Hospital Fees Regulations (1985). Under the scheme there is a full cost recovery for drugs, but user fees are differentiated by type of user, type of procedure and type of facility.

The health services of Ghana have been plagued with many problems with funding and management being the major ones. Inadequate budgetary allocations have rendered the PHC programme ineffective. In real terms the Ministry of Health (MOH) budget declined by 27 percent per capita in the first two years after the introduction of economic reforms (Okyere et al., 1992). Health

expenditure has generally been less than 3 percent of 1987 GDP.

Increased proportions of the inadequate budget have been allocated to strengthen the predominantly urban-based, curative health care system where only 30 percent of the population live. Whereas the PHC programme normally receives about 20 percent of the MOH budgetary allocation, in 1987 the urban-based health care system was allocated 59 percent of the MOH budget (Okyere, 1991). This is inconsistent with the policy objectives of expanding coverage of PHC, particularly to the under served rural areas.

1.3 Food and Nutrition Policy

The major thrust of Ghana's food policy is to provide enough food to the people of Ghana at affordable prices. If this can be achieved then there will be a reduction in food insecurity. However, the dilemma in the policy is that as food prices decrease there will be a concomitant reduction in food production as farmers will not be motivated enough to increase production when profits decrease. Therefore a cheap food policy must be accompanied by cost-saving and productivity-enhancing technology if it should succeed. Nevertheless, observation of seasonal and annual food prices in Ghana indicates that there are wide swings in the data and also there are regional differences which imply that Ghana is far from implementing a successful cheap food policy.

The provision of enough food can be done through domestic sources and/or foreign sources. The food policy of Ghana allows individuals and firms to bring in food imports to augment domestic

supplies. Under this policy, large amounts of rice and maize are imported into the country. The government also imports occasionally to forestall any anticipated food shortage and these commercial imports are sold at market prices.

Another dimension of the food policy of Ghana is to stabilise prices over the whole season through a storage programme. In this respect the Ghana Food Distribution Corporation has expanded its storage programme to about 70,000 tonnes to hold both the strategic reserves and farmers' grains. However, the cost of the programme can be reduced if farmers are encouraged to store some of their produce through the use of narrow cribs either on the farm or in the village.

In order that prices do not fall extremely low during seasons when there is a surge in production, there are provision for exports under Ghana's food policy. However, to control the situation, especially in normal and bad years, an exporter needs the permission of the Ministry of Food and Agriculture before food can be exported.

Ghana's nutrition strategy has combined encouragement of agricultural production with Ministry of Health programmes addressing malnutrition. The latter range from monitoring to facilities for treating acute malnutrition cases. The nutrition policy cover both preventive and curative aspects. The most important component quantitatively is supplementary feeding.

1.4 Primary Health Care (PHC) and Expanded Programme on Immunisation (EPI)

Due to the problem of reaching rural areas and neglected urban communities with modern health care, the government is pursuing PHC initiatives in the hope of providing basic health care to the disadvantaged population in their communities. The PHC has eight components: maternal child health/family planning (MCH/FP), health education, immunisation, control of locally endemic diseases, environmental sanitation, nutrition and food supplementation, treatment for minor ailments and supply of essential drugs.

Special training for Traditional Birth Attendants (TBAs) and "Wansams" (specialists in circumcision) has also been in progress. With the TBAs, the special training is an extended programme involving pre and post-natal care, health education, oral rehydration therapy and some other aspects of child health and family planning.

Even though the MOH is the pivot around which are PHC-related. Prominent among the government institutions are the Ministry of Local Government, Social Welfare and Employment, Food and Agriculture, Works and Housing and Education, the Ghana Water and Sewerage Corporation (GWSC), and the Ghana National Family Planning Programme. The NGOs include the Christian Health Association of Ghana (CHAG), World Vision International, the Catholic Secretariat and the Red Cross.

Despite attempts to improve PHC there are persistent problems in its implementation. These can be classified as follows:

- (a) inadequate communication;
- (b) poor organisation and delivery at peripheral levels;
- (c) improper referrals;
- (d) paucity of data to serve as the basis for further planning;
- (e) lack of logistical support;
- (f) insufficient funding;
- (g) scarcity of necessary equipment and supplies; and
- (h) staff unavailability.

Even though official policy is PHC-based, rural health coverage still remains below 50 percent with only 10 percent of smaller communities benefiting from the services of trained health workers.

The Expanded Programme on Immunisation was launched in 1978 with the objective of fully immunising 80 percent of children aged 0-23 months by 1983. In 1988, the target group was modified to differentiate between children aged 0-11 months and 12-23 months.

Prior to 1985, the programme experienced a variety of difficulties due to managerial problems and insufficient supplies and equipment. In 1985, the MOH took the decision to reactivate the programme with the objective of strengthening static immunisation activities and accelerating expansion of outreach services.

EPI operations were intensified in 1988 with the adoption of a revised schedule for immunisation, regionalised/decentralised strategy formulation and implementation and reaffirmation of the objective of 80 percent coverage. As a result, routine immunisation services were considerably extended and mass campaigns (up to three

times a year in each of the ten regions) reinforced.

Assessment of achievements to date indicates that the quality of immunisation services has improved significantly. The strategy adopted have proven that 90 percent of the nation's children can be reached by vaccinations during a twelve month period. Estimated coverage prior to the reactivation of the programme in 1985 was as follows: BCG, 19.8 percent; DPT, 3-10 percent; OPV, 3-7.4 percent; and Measles, 12.6 percent. National EPI coverage data indicate a significant improvement in programme performance since 1988, as shown in Table 1.

In spite of the success of the programme in reaching the country's children and women and thereby spearheading the enhancement of PHC, achievement in terms of third dose vaccinations is still low: only 50.7 percent of DPT-3 and 51.2 percent of OPV-3, indicating a drop out rate of about 40 percent. This clearly suggests the need for regularising outreach services to reduce the drop out rate between campaigns. Such a development would not only ensure full immunisation of 80 percent of infants every year, but more importantly, contribute to the establishment of an effective PHC.

Table 1. National EPI Coverage, Children 0-11 Months
1985-89 (Percentages)

Vaccine	1985	1988	Dec. 1989
BCG	19.8	56.0	100.3
DPT3	10.0	32.0	50.7
OPV3	7.4	32.0	51.2
Measles	12.6	45.0	65.3

Source: MOH, 1989. Epidemiology Division

Appendix 2
Description of Variables used and their Summary Statistics
(children of 0 - 59 months old)

Variable	Description	Mean	Standard deviation
whzp	Standardised weight-for-height score	-0.32	2.28
Wt	Weight of child (kg)	11.87	7.60
Ht	Height of child (m)	0.84	0.18
kcali	Individual daily food intake (kilocalories)	1046.46	868.45
Sizeq	Household size in adult equivalent	4.96	2.64
Scale	Adult equivalent consumption unit	0.42	0.12
Mht	Height of mother (m)	1.58	0.07
Em	Dummy for level of education of mother (above middle(1) below(0))	0.03	0.18
kcal	Total daily calories available to child (kilocalories)	11647	11068
Ac	Age of child (months)	27.96	16.52
Pmaize	Price of maize (cedis/kg)	80.38	22.99
Pcas	Price of cassava (cedis/kg)	33.12	9.92
Pmil	Price of millet (cedis/kg)	97.58	21.33
Pgar	Price of garri (cedis/kg)	121.16	18.22
Pyam	Price of yam (cedis/kg)	87.39	34.79
Pccyam	Price of cocoyam (cedis/kg)	89.03	73.58
Pptain	Price of plantain (cedis/kg)	129.65	156.83
Pgcorn	Price of guinea corn (cedis/kg)	93.16	24.35
Te	Total household expenditure (cedis)	403381	341995
Sw	Dummy for treated water	0.24	0.43
Dsex	Dummy for gender (male=0, female=1)	0.50	0.50
Durb	Dummy for urban area	0.30	0.46