FACTORS AFFECTING HEALTH AND NUTRITIONAL STATUS OF CHILDREN IN ETHIOPIA

By

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ABSTRACT

In attempt to identify the factors that affect health and nutritional status of children in Ethiopia, this thesis focused on children in the age group 3 to 59 months. The thesis used data gathered by Central statistical Authority (CSA) of 1998 Welfare Monitoring, Health and Nutrition Survey. From analysis of the data it was found that the most important socioeconomic and demographic determinants of health and nutritional status of children in Ethiopia are individual, parental, household and community factors. To indicate the outcome measures of health and nutritional status immunization, diarrhea episode and nutritional status (anthropometric measures) were taken as dependent variables. Results further indicated that household size, household income, parental literacy status, distance to nearest health center, parental employment status, number of children less than 5 years in the household, type of toilet facility, source of drinking water and means of disposal facility are some of the factors that affect health and nutritional status of children directly or indirectly. The low health and nutritional status of children in Ethiopia seems to be addressed by policies which decrease poverty, control household size, control endemic diseases through extensive and sustainable health police measures.

CHAPTER I

1. BACKGROUND AND OBJECTIVE OF THE STUDY

1.1 Background

Health and nutrition are important as ends in themselves and often are emphasized as critical components of basic needs in developing countries. In addition they may be channels through which productivity and distribution goals of developing societies may be pursued effectively. As is often hypothesized the productivity of low-income persons in work and in human capital formation is positively affected by health and nutritional status.

In recent years economists have directed increasing attention toward exploring the factors and impact of health and nutrition in development process. In most of the developing countries the level of health status is very low and because of this various international and regional conferences were held in the last twenty years to find ways and means of improving health conditions.

Since socioeconomic and health problems are closely interrelated, efforts made in developing countries to improve health conditions are not encouraging. For the developing countries of Africa limited available information about mortality, morbidity and nutritional status level reveals that the health of the people is extremely poor. Ethiopia cannot be exceptional to the kind of problems occurring in African countries. Information from different surveys indicates that health condition in Ethiopia continued to be poorer than most developing countries of Africa. Ethiopia, with over 85 percent of the people living in rural areas, with economy based on subsistence agriculture and with high rate of illiteracy, requires tremendous efforts to overcome health-shattering factors and to make progress in improving the health of the people.

1.2 Motivation

According to Reutlinger and Selowsky (1976) the nutritional status of the labor force of a country is of fundamental importance for the socioeconomic development of that country. Nutrition is a main determinant of health, and nutritional interventions by governments can have a significant impact on human capital formation. In Ethiopia, malnutrition is widespread, and has been recognized as one of the most challenging development problems of the country facing policy makers. One of the characteristics of poor health and poor nutrition in Ethiopia is that a significant number of the victims, are children. Children are the group most vulnerable to deprivations and can be affected more easily by adverse circumstances than other members of the same household since they depend on others.

The National Rural Nutrition Surveys 1982/1992 and the Rural Health Survey 1982/83 conducted in Ethiopia showed that health and nutritional status of rural children in Ethiopia is one of the lowest in the world, and actually worsening (see Table 3).

In light of the above, this thesis will attempt to identify the determinants of health and nutritional status of children in Ethiopia. This will be done through statistical analysis based on the 1998 Welfare Monitoring, Health and Nutrition Surveys. Because children are dependent on other household members, their health and nutritional status will reflect the care-taking level of the household, and thus the nutritional and health status of children can be seen as a proxy for the health and nutritional status of the country.

1.3 Objectives

The main objective of this thesis is to identify the determinants of the health and nutritional status of children between the ages of 3-59 months in Ethiopia.

Specific objectives of this study are as follows

i) to identify the important determinants of health and nutritional status,

ii) to examine the extent to which health related variables discriminate between those with various types of health and nutritional problems,

iii) investigate inter-regional and gender differences in health and nutritional status,

iv) to indicate socioeconomic and demographic determinants of health and nutritional status,

v) to examine the nature of relationship among the different groups of factors affecting health and nutritional status.

1.4 Hypothesis

This thesis attempts to identify the determinants of health and nutritional status of children aged 3-59 months in Ethiopia, and it is hypothesized that these children's health and nutritional status depends on socioeconomic and demographic factors, especially, on household, parental, community and individual factors.

CHAPTER II

2. CONCEPTS AND DEFINITIONS

2.1 Introduction

Before proceeding to identify the factors that are affecting health and nutritional status, it is necessary to define the concepts and terms used in this thesis. In this chapter, the various terms and concepts used in the thesis will be explained.

2.2 Factors that Affect Health and Nutritional Status

A determinant of health and nutritional status can be defined as a variable (factor) that would change the health and nutritional status level if its own value were altered. Many of the determinants of health and nutritional status of children are characteristics of the household in which the child grows up.

The most important factors that influence the health and nutritional status of children, according to Caldwell (1979), are knowledge of health practices and caring level, education level of parents, age of mother, access to health facilities, and resources allocation level to most vulnerable groups in the family.

There is a difference between nutritional status and anthropometric indicators of nutritional status even though they are sometimes used interchangeably. Pelletier (1991) defines nutritional status as the internal state of the individual as it relates to the availability and utilization of energy and nutrients at the cellular level. Anthropometric indicators of nutritional status, on the other hand, are the measurable indicators of the state, for the state cannot be directly observed.

2.3 Undernutrition and Malnutrition

Berg (1981) states that undernutrition is related to inadequate quantities of food and hence too inadequate intake of calories or food energy. Malnutrition is, on the other hand, the pathological condition brought about by inadequacy of one or more nutrients.

Undernutrition and malnutrition are intertwined and undernourished children are malnourished in almost all cases. Malnuorishment is the term popularly applied to all nutrient deficiencies.

The concept of malnutrition in this thesis refers to the level of the health and nutritional status of children expressed by anthropometric indicators (weight and height) which may result from Protein Energy Malnutrition (PEM), and higher levels of malnutrition (low height-for-age, low weight-for-height and low weight-for-age) are indicated using the ratios. Protein Energy Malnutrition (PEM) seems to have been accepted as a more reliable indicator of state of nutrition, since the interaction between protein and caloric energy in human metabolism is well-established (Colman and Nixson, 1986, Pelletier, 1991).

Malnutrition has different stages of severity and any type of malnutrition is a threat to health, some types increasing the risk of death. Severity of malnutrition is labeled normal, acute or chronic on the basis of comparisons with international standards. In this respect, an international reference most often used and recommended by the World Health Organization (WHO) is the standard that has been developed by the United States National Center for Health Statistics (NCHS). Differences in severity of malnutrition can be distinctly measured and identified (Waterlow, 1977). For instance, chronic malnutrition is measured by height-for-age and indicates long-run nutrition deprivation. A child with chronic malnutrition is also labeled "stunted". Acute malnutrition measured by weight-for-height, shows a child's recent nutritional disturbances. A child with acute malnutrition is labeled "wasted". Weight-for-age, on the other hand, indicates the presence of a mixed outcome of past and present nutritional deprivations (Pelletier, 1991).

Pelletier (1991), argues that low height-for-age has little relevance to the child's current nutritional status and finds that rather to contribute directly to high mortality in older children. Low height-for-age is believed to reflect chronic poor health and nutrient intake that may have long-run effects. Low weight-for-height (wasting) is relevant for a child's current nutritional status. Wasting is said to predispose a child to death in a short follow-up interval and a child with acute malnutrition can resume normal values within short time intervals (weeks or months). It is believed that wasting has few or no carry over effects on child mortality in the longer term (Pelletier, 1991).

2.4 Height-for-Age (HA), Weight-for-Height (WH) and Weight-for-Age (WA)

The World Health Organization (WHO, 1983) defines HA and WH as "less than the value corresponding to two standard deviation (SD) below the median of the respective frequency distribution, for healthy children". The median standard is taken from the United States National Center for Health Statistics. The classification identifies low weight-for-height as "acute" malnutrition and low height-for-age as "chronic" malnutrition. The mixed outcome of these is "underweight" (Waterlow et al., 1977).

2.5 Health Status

The WHO (1947) constitution formally defined health as " a state of complete physical, mental and social well-being, and not merely the absence of disease and infirmity". The intent was to move away from the traditional medical view of health as the absence of disease to a more positive concept of well being. Unlike disease which manifests itself through a host of varied symptoms ranging from headache to complete loss of consciousness, an individual's health status is defined as the outcome of a process described by a health production function that relates health status to various health inputs, such as medical services, diet, and environmental sanitation. The level of use of each health input is determined by the individual who, by combining market goods and time resources available to him, "produces" these inputs in the traditional household production (Becker, 1965).

Health status is often identified with nutrition status. The linkage is so tight that one does overlap with the other and hence makes the drawing of a demarcation line between the two difficult.

2.6 Immunization (Vaccination)

Any incurable immunizing agent or a preparation containing bacteria so treated as to give immunity from specific diseases when injected in the subject.

2.7 Protein–Energy malnutrition (PEM)

Under-nutrition that results in an individual not receiving adequate protein or calories for normal growth, body maintenance, and the energy necessary for ordinary human activities.

2.8 Urban Center

Is in principle defined as a locality with 2000 or more inhabitants. However for practical purposes an urban center includes the following

a) All administrative capitals

   (i) Regional capitals

   (ii) Zonal capitals

   (iii) Woreda capitals not included in (i) and (ii)

   (iv) Localities with urban dwellers associations not included in (i) _ (iii)

b) Municipal towns not included in (a).

c) All localities which are not included either in (a) or (b) above having a population of 1000 or more persons, and whose inhabitants are primarily engaged in non-agricultural activities.

2.9 Welfare monitoring survey

It is a survey undertaken annually for the purpose of improving the social and economic condition of the people of Ethiopia.

CHAPTER III

3. REVIEW OF THE LITERATURE

3.1 General Background

The proximate determinants of an individual's health and nutrition usually are decisions made by the individual or by the household in which he or she lives in given assets, prices and community endowments (some of which may be determined in part by governmental actions). For purpose of this thesis the health and nutritional status of children will be measured by diarrhea, immunization and anthropometric outcomes such as height-for-age, weight-for-height and weight-for-age. There are two major approaches used to identify the determinants of health and nutritional status.

According to the first approach [see for e.g. Zlotkin (1991)] under-nutrition can already take place during pregnancy and the "combined foetal and neonatal nutritional insults" will have adverse effects on health in later life. For instance reduced intelligence, low enrolment, and low productivity in later life are ascribed to low health and nutrition during early childhood. Behrman and Deolalikar (1988) have confirmed that, among children health and nutrition may influence scholastic result in much the same way as they affect labor productivity among adults. Zlotkin (1991) found that infants who have suffered combined foetal and neonatal nutritional insults might still develop normally if placed in a "stimulating environment". But creating a stimulating environment is difficult task in developing countries. The probability is thus high that children nutritionally injured or deprived in their early stages will remain affected for a significant period afterward. Ballwag and Webb (1990) found in a study conducted in Haiti a statistically significant relationship between nutritional stunting (low height-for-age) and wasting (low weight-for-height) on the one hand, and the mental maturity level of children on the other hand.

Similarly Martorell et al. (1991) found that in Guatemala not only cognitive development, but also low productivity during adult, might be ascribed to poor nutrition and health in early childhood. This seems to imply not only that stunting could have a long-run effect but also that underweight, which is a mixed outcome of stunting and wasting, may have a long-run effect when the deprivations occur in early childhood.

According to the second approach, the determinants of health and nutritional status are investigated using theoretical framework, which relate the determinants of malnutrition to long-run economic policy objectives. This approach focuses on the decision-making process of the household, which depends on both observed and unobserved factors that exist within and outside the household. When this approach is applied anthropometric outcomes can be modeled as a function of mother's height and age, parental education levels, health service availability, use of curative services, immunization, water and sanitation, service availability, prices of food, health services and drugs, age and sex of individual and whether the mother of a child is a senior or a junior wife of the household head. The use of anthropometric indicators, however, may sometimes lead to over and/or underestimation of the effects of health and nutritional status on mortality.

3.2 Literature on other Countries

A study by Calloway et al. (1988) found a mother's height to be more significant indicator of infant size than parental weight. Weight seems to become more important for later growth. This finding seems consistent with the general view that height reflects genetic factors, and weight, nutritional environment. It is also confirmed that better nutrition of the foetus through the mother's improved nutritional status increases the number of cells and the potential for future growth (Zlotkin, 1991).

Strauss (1990) in his study found that the educational level of parents to be a strong explanatory variable of children's anthropometric outcomes (weight-for-height). This study suggested that educational levels of parents have effects on weight-for-height and that educational level of parents (both father and mother) also have a significant positive effect on height-for-age and strong effect on intra-household distribution, particularly for children of household heads and their senior wives. Although both children of the senior and junior wife showed the same impact on short-run anthropometric outcomes, the senior wives were associated with better long-run outcomes, indicating an advantage of being children of a senior wife.

Wolfe and Behrman (1987) found in their study that maternal education effects can be eliminated as a determinant of anthropometric outcomes after controlling for family background variables such as the number of the "mother siblings" and her parent schooling. They further pointed out that a reduced form of estimation might overstate the impact of parental education on anthropometric outcomes if family background variables are not held constant. Strauss (1990), Horton (1988), Thomas, Strauss and Henerigue (1991) used a reduced form equation in which they controlled for parental height in their estimation for height-for-age and weight-for-height. In all studies, "stronger effects" of parents' education on height than most previous studies, were found.

Among the micro studies, Blau (1984) estimated a demand function for age standardized height using 1977-78 data on children under five years of age in Nicaragua. He included the mother's age, education, other income and predicted formal and informal sector wage rates (corrected for selection bias) as independent variables. After allowing for a positive income effect, the gross impact on child health of the informal-sector wage rate is greater in magnitude than that of the formal-sector wage rate. Blau's results, however, indicated the opposite, he found the mothers' (predicted) formal-sector wage rate to have a significant positive effect on child health and informal-sector wage rate not to have any significant effect.

Garcia and Anderson (1987), in a study on the impact of subsidies on the anthropometric outcomes of children in the Philippines, found that household income had a positive effect on weight, weight as a percent of standard weight-for-age.

Horton (1988) examined the influence of the order of birth on a child's anthropometric outcomes, using a reduced form equation. Testing for short and long-term outcomes, more serious inequalities were observed in the long-run (stunting) outcome. This is mostly because of the limited resource that could be allocated to the younger child. Horton (1986), in a study on the demand for individual health outcomes, using rural children aged 15 years or less from Philippines, suggested that birth order had a significant adverse effect on both height-for-age and weight-for-height (such that later born children have poorer health than earlier-born children). However, the maternal education significantly weakens these adverse effects of birth order and the difference in weight-for-height and height-for-age among children within a single family is in terms of differences in their age and gender.

The positive impact of nutrition education on both anthropometric outcomes implies a significant role for the mother in nutrition and health status beyond producing income. FAO/WHO (1992) suggested that an increase in income could have a positive effect on weight-for-age of children.

Using data on farm households from Indonesia, Pitt and Rosenzweig (1985) found that source of drinking water, availability of hospitals, family-planning clinics, public lavatories and clinics have no significant effect on anthropometric outcomes. Churchill (1987) also stated that "there is only a very thin link" between improvement in health and sanitation services and anthropometric outcomes. These two results indicated that observed and unobserved parental, household and individual factors may have more important effects on anthropometric outcomes of children.

In a study by Akin et al.(1985) on the determinants of a household's decision to use medical services and its choice of a medical practitioner (i.e. whether public, private, or traditional), including the cash price of using the facility, the transport time, and cost of reaching the facility, and the drug costs and urban location of the patient were included as explanatory variables in the demand functions for health services. The author obtained an almost total lack of statistical significance of any of these economic (price, time) variables.

Rosenzweig and Schultz (1982) using the community-level variables such as per capita number of hospital beds, and clinics, family planning expenditure per capita, transportation time to the capital city, average daily temperature and temperature squared, interacted with the women's schooling and region of residence, found that, in urban areas, child mortality in families with less-educated mothers was strongly affected by public health and family planning programs. They also found that, in the urban areas, clinics were a more cost-effective means of lowering child mortality than were hospitals. In urban and rural areas, Rosenzweig and Schultz observed a strong negative effect of maternal education on child mortality. Diseases may, however, affect anthropometric outcomes negatively. Widely occurring diseases such as diarrhea, vomiting, and whooping cough can be caused by community-related factors. Poor nutritional status may, depending upon the disease, increase the incidence, severity, and/or duration of morbidity. The combination of poor nutritional status and morbidity, therefore, believed to increase the risk of death.

A study from Java, Indonesia, by Katz et al.(1989), indicated that, in terms of relative risk, severe and moderate stunting was found to be more closely related to mortality in children younger than 24 months, severe wasted, on the other hand, carries a higher relative risk in children older than 24 months.

Behrman and Wolfe (1984) indicated that, not only the sign but the magnitude of the household size elasticity relative to the household income elasticity is important, since it reflects the extent of returns to scale with respect to household size.

Cumper (1984) in a study of determinants of health levels in developing countries indicated the relationship between health and a wide range of factors such as national income per capita, health service inputs (hospital beds, physicians, other health workers), biological factors (fertility, nutrition), environmental factors (climate, population or density), inputs to social services other than health (school population, number of teachers, water supply, sanitation), political variables (type and degree of socialism), and economic structure of the health sector (methods of financing, payment for services remuneration). In that study the variables were divided into four groups: indicators of health levels; factors which are independent (at least in the short term) of both economic development and specific human interventions (climate, cultural history, population density) but which may condition the processes connecting development and health; variables which represent aspects of development which are intrinsic to economic change; and factors connected with development but largely controllable through human interventions (inputs to health services and to education, levels of water supply, and sanitation). The factors were significant in most cases.

Wolfe and Behrman(1982) investigated the determinants of child mortality and health and nutritional status in Nicaragua using economic models of household behavior. The results indicated that income is not an important factor. There was an inverse relation with number of siblings, and there were positive associations with calorie intake, schooling, the availability of refrigeration, and the quality of sewage systems.

A study by Kamalamma (1996) examined the socioeconomic determinants of mortality, morbidity, and nutritional status in Andhra pradesh, India. Findings indicated that food grain production and protected drinking water were significantly associated with variation in infant mortality. Variation in nutritional status were significantly explained by caste, occupation and type of housing. Protein intake was related to per capita income, average size of household and protected water supplies. The determinants of both caloric and protein intake were size of household, household expenditure and parents' education. He finally indicated that the number of diseases, caloric and protein intake, size of household and parents' education were the significant determinants of child mortality, health and nutritional status.

Lamontagne et al. (1998) considered comparison of the relative effects of maternal work for income and child-care adequacy on infants' anthropmetric status. Findings indicated that infants in poor child-care were significantly younger than those in good child-care. Infants of working mothers had significantly higher scores on weight-for-height, even controlling for maternal differences, wealth, and gender. Infants in extended families had higher scores of weight-for-age. The result showed that the association between maternal employment and infants' nutritional status for infants of working mothers had higher weight-for-age scores. Infant hand wasting, amount of animal protein total feeds, and immunization were significantly associated with weight-for-age score.

Haga and Kenrick (1985) used weight-for-age as a measure of nutritional status to assess the global magnitude of nutritional deficits in young children for 22 countries and the result differs from several other studies which relied on estimates of food intake to generate prediction. Using multivariate model their findings suggested that average calorie intake (food availability) was more of a constraint on child growth in the South Asia than in other developing regions, but income distribution didn't contribute to the explanation of prevalence of low weight-for-age. On the other hand the study showed a fairly clear negative relationship between the proportion of the population with safe water and the proportion of children with low weight-for-age. Their study revealed the importance of water quality and quantity, along with food intake, as the determinants of nutritional status in children. They observed positive correlation between the illiteracy rate among woman and proportion of children who were malnourished.

Brugha and Kevany (1994) studied children aged 12-18 months to identify the determinants of the immunization status. They used birth weight as dependent variable with other important socioeconomic variables such as monthly income of child's father, level of father's monetary contribution to child, mother's possessions, mother's farming activities, mother's ownership of TV, cooker, and refrigerator. The finding suggested that socioeconomic factors have more influence on birth weight of children than they do on the subsequent growth of children.

Phimmasone et al. (1996) studied nutritional status of children in the Lao. The study was focused on the assessment of protein-energy malnutrition (PEM). The result indicated that significant differences were observed in the prevalence of both stunting and wasting when comparing subgroups of children. Urban children were less stunted and wasted than rural children, children of the low land majority less than children of ethnic minorities, and children whose mothers had completed primary education less than children whose mothers had never been to school. The study also showed that girls are less malnourished than boys.

Han-Am and Sleigh-A (1995) conducted a retrospective study of the records of children admitted to hospitals in Papua-New-Guinea with diarrhea and determined the morbidity, mortality and risk factors associated with persisted diarrhea under five years of age. Using logistic regression analysis they found that poor nutritional status was a significant factor for persisted diarrhea.

Table 1 compares the health and nutritional status of children in Ethiopia with those in selected Sub-Saharan African countries. The Table also shows information of the health and nutritional status of children in Ethiopia to facilitate comparisons with other selected Sub-Saharan African countries.

Table 1: Prevalence of nutritional among children in selected sub-Saharan Africa

Year	Country and age in months	Sample Size	Health/Nutritional Status		
			H/A (<-2SD) < 90%	W/H (<80%)	W/A (< 80%)
1983	Swaziland 0-59	4791	29.3	0.9	9.6
1976	Liberia 0-59	3479	18.2	1.6	-
1976	Lesotho	1502	23.9	1.0	22.9
1983	Ethiopia 6-59	9437	56.0	4.4	47.6
1995	Ethiopia 6-59	20,230	64.2	8.0	55.0
1996	Ethiopia 3-59	6927	65.7	7.3	45.4
1997	Ethiopia 3-59	8947	67.2	7.6	46.6
1998	Ethiopia 3-59	30601	51.4	9.5	41.9

Source: Suedberg, 1987 and CSA, 1992, 1993 and raw data.

3.3 Literature on Ethiopia

Lindtjorn and Alemu (1997) conducted a study based on intra-household correlation of nutritional status in rural Ethiopia with the objective to test whether the households in a given population were relatively homogeneous with respect to nutritional status and occurrence of diseases. The authors examined how anthropometric measurements were correlated between different household members in famine-prone Ethiopian communities. Anthropometric measurements conducted on 268 children under the age of 5 years, 417 children aged 6-17 years, 265 adult women, and 197 adult men in Rift Valley's Elka village identified only weak correlations between the state of nutrition among household individuals. Their finding indicated that anthropometric indices of children, older children, and adult men are inefficient ways of screening for maternal malnutrition.

Eshetu and Ashagre (1997) used the 1992 Rural Nutritional Survey which was conducted by the Central Statistical Authority to estimate the levels and identify factors associated with chronic malnutrition among children in the southern part of the country. In their analysis, they stated that both demographic and non-demographic variables such as household size, birth order, and sex of the child are important factors associated with chronic malnutrition. The number of under-five children and sex of the head of the household were not found to have significant effects. Moreover, among the non-demographic factors, substantial variation was also found with regard to mother's religion, source of household income, zone of residence, and type of agricultural system adopted in the area.

The 1983 Rural Health Survey(CSA, 1983), considered the health status of rural Ethiopia by including morbidity, duration of illness and restricted activity, sanitary facilities and practices and their impact on health, reasons for not seeking treatment from health institution or community health agent, delivery practices of mothers and some socioeconomic variables.

The 1983 and 1992 National Rural Nutrition Surveys (CSA, 1983 and 1992) indicated that the nutritional status of the rural children under the age of 5 years in Ethiopia is one of the lowest in the world. Furthermore, the nutritional status of children worsened in 1992 compared to the 1983 survey result.

Table 2 The percentage of vaccination of children under-five years by country.

Table 2: Percentage of children 12-23 months old who are vaccinated and with no vaccination

Country (year)	**Percentage fully vaccinated**		**Percentage with no vaccination**	
	Male	**Female**	**Male**	**Female**
Burkina Faso (1992-93)	35.40	33.80	11.10	15.00
Ghana (1993)	56.70	53.20	16.60	14.00
Kenya (1993)	78.20	78.10	3.50	3.10
Zimbabwe (1994)	80.90	79.20	3.50	4.70
Zambia (1992)	66.90	66.30	4.70	3.50
Nigeria (1990)	28.00	30.00	34.00	37.80
Malawi (1992)	81.90	81.80	1.50	3.40
Sudan (1989-90)	50.20	52.90	22.20	20.00
Cameroon (1991)	38.60	41.30	22.90	20.40
Ethiopia 1995/96	39.38	36.98	51.33	53.94
Ethiopia 1996/97	32.52	34.64	48.32	45.02
Ethiopia 1998	40.07	39.84	21.01	22.53

Source: Demographic and Health Survey Comparative Studies, No. 23 and CSA, from raw data.

A study was undertaken by Policy and Human Resource Development Project Office(PHRD PO) in 1998 with the objective of assessing the quality of health care provision and management in public sector's health facilities in Ethiopia. It assessed the delivery of services, management aspects and consumer statistics. A different study undertaken by PHRD PO (1998) indicated that the health services delivery system also has significant deficiencies in coverage, efficiency, as well as effectiveness. Diseases of communicable nature that result from poor personal hygiene, improper waste disposal practices, and lack of adequate and safe water supply are among the major health problems of the country.

PHRD PO (1996) investigated the socioeconomic determinants of child nutritional status, child and adult morbidity and treatment and non-treatment of illness and immunization in Ethiopia using CSA Urban/Rural Household Income, Consumption and Expenditure Survey (HICES) and Welfare Monitoring Survey of 1995/96. Linear and logistic regression analysis were used to investigate these socioeconomic determinants. The result indicated that age of the child is negatively but strongly related with reporting illness episodes (Morbidity), and male children had positive and statistically significant relationship. Household size and expenditure per capita had no significant relationship with children's illness episodes. Mothers' and household head educational status showed significant negative effect on children illness episodes. Household expenditure per capita, mothers with primary schooling, and household head with primary or post primary schooling were positively related to children's immunization of any or all immunities (Measles, BCG and DPT). The result also indicated that older children are more likely to take all the three immunities . Using multiple regression analysis the nutritional status of children was assessed and the result suggested that some of explanatory variables have strong relationship with Height-for-Age (H/A), Weight-for-Age (W/A) and Weight-for-Height (W/H).

On Baseline Nutrition Survey of Region 13, Harari, for children under-five years, Jemal and Woldemariam (1995) applied descriptive statistics and analysis of variance to estimate the effects of the associated factors. They found that breast feeding, time of weaning, literacy of the mother, access for safe water supply, childhood illness and consumption of mixed supplementary feedings had close association with children's nutritional status at different p-values.

Lulu(1996), based on a one-year weekly home surveillance study, measured morbidity patterns of children five years of age in a rural Ethiopian community together with nutritional and health behavioral determinants using Poisson regression models, The study showed that nutritional and health care factors make a significant impact on morbidity. The result indicated that infections were particularly associated with nutritional factors, lack of immunization, low birth weight and pre-term delivery were not found to have any independent effect on morbidity.

A study by Adane Mekonnen (1988) on health status of children in resettled and indigenous population (Keto settlement in Kelem Awraja, Wellega Region) revealed that breastfeeding had a significant effect on diarrhea. In the study it was observed that over half of the children were either nutritionally wasted, or stunted, or stunted and wasted. This situation was explained by many factors, which might have directly or indirectly accounted for malnutrition. The important factors include late starting of supplementary food, insufficient attention given to children in their feedings, food taboos, the high proportion of the younger vulnerable groups, low rate of food production due to primitiveness of farming practices, ignorance about health, family planning, nutrition, and the prevalence of infectious disease. These and others were the major factors in predisposing children to malnutrition.

Seyoum, Kidane and Gebru(1983), in a preliminary study of income and nutritional status indicators in two Ethiopian communities which were chat producing area with high income and non-chat producing area with low income, used regression analysis using height-for-age, weight-for-age and weight-for-height anthropometric variables as a single dependent variable and various indicators of economic status as independent variables. The result indicated that the two communities showed marked differences in the type of house owned, source of light used, radio ownership, and livestock owned. It was also observed that nutritional status of children in chat producing farm families was similar to that of children in the other farm families. None of the indicators used to express cash income or the financial resources of the household predicted nutritional status of children in practical sense.

Table 3: Nutritional Status of Ethiopia

Decade	**Health/Nutritional Status in %**			
	Wasting (WH) < 80%	**< 90 % Stunting/HA**	**WA < 80% under weight**	**Survey area**
1980's	7-10	28-31	40-65	Rural
1993	8.0	64.2	47.6	Rural
1995/96	10.1	55.9	35.0	Urban
	11.1	68.4	50.2	Rural
1996/97	8.6	52.1	31.2	Urban
	8.0	64.3	42.3	Rural
1998	7.2	36.5	26.6	Urban
	9.9	54.3	44.8	Rural

Source: For 1980's World Bank Mission Report 1990. For 1993 CSA 1993 National Rural Nutrition Survey for 1995/96 – 1998 from CSA survey raw data.

Table 3 indicates that the prevalence of low height-for-age (stunting or chronic malnutrition) in Ethiopia has increased in less than two decades and both low weight-for-height (wasting) and underweight did not improve. When the level of nutritional status of rural Ethiopia is compared with the previous National Rural Nutritional Surveys(1982/83, 1992/1993 and 1995/1996) the changes show that the health and nutritional status of children has worsened from that of 1982/83 and 1992.

3.4 Summary

It was observed from the literature review that health and nutritional status can be modeled as a function of parental factors such as mother's age, and parental education; household factors such as month of breast feeding, child-care, income, household size and wealth; community factors such as health-care, service availability, water and sanitation and prices of food, health services and drugs; intra-household factors such as senior and junior wives; and individual factors such as age and sex of the child.

CHAPTER IV

4. THE DATA AND METHODOLOGY USED

4.1 Introduction

The purpose of this thesis is to quantify the effect of different determinants of health and nutritional status in Ethiopia for children under five years using the 1998 Welfare Monitoring, Health and Nutrition Survey conducted by CSA.

4.2 The Data

4.2.1 Source of Data

The data on which this thesis research is based on the 1998 Welfare Monitoring Survey conducted by the Central Statistical Authority (CSA), Government of Ethiopia. According to CSA survey design report, this survey was designed to collect information for the purpose of the preparation of socioeconomic policy assessment of the overall welfare situation in the country with the objectives of providing baseline data on existing poverty situation and establish a system of information gathering on relevant key indicators, identify poor and vulnerable groups that could be the focus of targeted intervention programs, undertake periodic surveys and researches to evaluate targeted programs, assess the short and medium term effects of microeconomics and sectoral policies and programs on the poor and produce conclusive reports and suggestions needed for the attention by the government and concerned implementing agencies. The survey was conducted throughout the country in selected rural and urban areas.

The selected rural and urban Enumeration Areas (EAs) for this survey were 1380 and 447, respectively. The survey covered more than 16500 households in the rural and 6700 households in the urban EAs. Households from rural EA included both agricultural and the non-agricultural sedentary population. The number of EAs actually covered were 1357 and 445 in rural and urban, respectively.

For the purpose of this survey the country was divided into different reporting levels in both urban and rural domains. Only 1808 EAs were covered in the survey. As it is true from the survey done by CSA, the minimum number of EAs required to get reasonable estimates and cost of survey were taken into account for determining the number of sample EAs in both the rural and urban domains.

Two-stage stratified sample design was used for sample selection in rural domains. That is, EAs and households served as primary and secondary sampling units, respectively.

Urban centers were divided into two, i.e. ten major urban and other urban centers. In the ten major urban centers a two-stage stratified sample design was used and in each Keftegna/Wereda, EAs and households served as primary and ultimate sampling units, respectively. For the other urban centers, three-stage stratified sample design was applied for the sample selection, where urban centers, EAs, and households served as primary, secondary and ultimate sampling units, respectively.

The sample selection of EAs in all domains was carried out using systematic sampling techniques. In each selected EA, a fresh list of households was prepared during the fieldwork, and 15 households from each sampled urban EA and 12 households from each sampled rural EA were selected. In the Welfare Monitoring Survey (WMS), data on educational and health status of household members, housing facilities, household assets were collected while health and anthropometric measurements were collected separately. Both surveys used the same listing and the same households.

This thesis uses data from this survey for analysis of the socioeconomic factors affecting health and nutritional status of children aged 3-59 months in Ethiopia.

4.2.2 Limitation of the Data

One of the outcome measures of health is mortality. In this survey births and deaths in the last year, child survival data or reference-period child survival data (Sullivan and Cochrene, 1982) was not gathered, therefore, information about mortality was not available.

4.3 Variables used in the study

Describing the study variables is very important in order to understand the application of the methodology and to make a proper usage of the results. Hence, the dependent variables are characterized as dichotomous (binary) type, assuming zero and one and the explanatory variables are grouped into household, parental, individual, community and regional dummies.

A. Dependent variables

1. Nutritional Status (**NUT-STAT**): -

   It is a binary variable which assumes the value 0 if a sampled child is free from stunting, wasting and underweight otherwise 1, (i.e. NUT-STAT = 0, if stunting = 0, wasting = 0 and underweight = 0, otherwise NUT-STAT = 1).

2. Diarrhea (**DIARRHEA**): - It is a binary variable, which assumes the value 1 if a sampled child has got diarrhea, otherwise 0.

3. Immunization (**IMM-ST**):-

   It is a binary variable, which assumes the value 1 if a sampled child gets at most one type of immunization or only one type, otherwise 0. Those children who get one type of immunization are considered not immunized, because they probably got vaccination during delivery time only.

B. Independent variables

I) Individual variables

1. Age in completed months (**N50-AGE**): Age seems ambiguous in its sign. Health being age sensitive in most cases, for instance young children (less than one year) are prone to health hazards

than other age groups in household. Age is expected to have a negative coefficient.

2. Sex **(H13-SEX)**: The gender male is anticipated to have a negative coefficient.

   1= male   0 =Female

3. Age squared **(AGE-SQR)**. It is applied in the analysis to take care of nonlinear effect of age. The variable is expected to have a negative coefficient.

4. Religion of the child **(H15_RLG)**

   0 = Others   1 = Christian

5. Child order **(N51-ORD)**

6. Food given after birth **(N59_GIV)**

   0 = mother's milk   1 = others

7. Age at which breast feeding started **(N60-BRS)**

8. Breast feeding now **(N61 -BEG)**

   0 = yes   1 = no

9. Food given in the last four weeks **(N63-FOD)**

   0 = mothers milk   1 = others

10. Stunted **(STUNC)**:- Children whose height-for-age Z-score is below minus two standard deviations (-2SD) from the median of the reference population are considered short for their age, stunted, and chronically malnourished and given the value 1,

otherwise 0. This is expected to have a positive association with children's diarrhea episode.

0 = normal 1 = stunted

11. Wasted (**WASTC**):- Children whose Z-scores are below minus two standard deviations (-2SD) from the median of the reference population are considered thin, wasted, and are acutely malnourished and given the value 1, otherwise 0. Expected to have positive coefficient with diarrhea episode.

0 = normal 1= wasted

12. Underweight (**UNDC**): Children whose weight-for-age is below minus two standard deviations (-2SD) from the median of the reference population are classified as underweight, and given the value 1, otherwise 0.

0 = normal 1 = underweight

ii) Household variables

1. Family size (**HH-SIZE**): The hypothesis that larger households face resource problem is taken in to consideration. An increase in household size, therefore, is expected to lead to decrease in health status, since large households may lack resources to allocate for health. As a result the variable is expected to have a negative coefficient. It does not mean that members in larger households have more health problems than in smaller household members.

2. Number of children under 5 years (**CHILD-05**): If the number of children under five years increases, there would be a problem of feeding and this would lead to poor health condition. As the result the variable is expected to have a negative coefficient.

3. Natural logarithm of yearly income (**LNINC-12**): Health being a household wealth, a household with a better income is expected to have relatively better health condition than lower income household, therefore, it is expected to have a positive coefficient.

4. Own dwelling unit (**OWN-DWL**) is defined as the possession or having own-dwelling unit, the household who has its own housing units is expected to have better health condition.

5. Type of latrine (**LATRINE**): Safe latrine is expected to have a positive impact on health and nutritional status

   0 = safe 1 = unsafe

6. Boil-water (**BOIL-WAT**): Boiled water is expected to have a positive impact on health. 0 = yes 1 = no

7. Type of waste disposal (**DISPOS**): Safe disposal facility is expected to have positive impact on health.

   0 = safe 1= unsafe

iii) Parental variables

1. Head's age (**HD-AGE**)

2. Literacy status of household head (**HD_EDUC**): Education, measured as literacy status is generally expected to have positive influence on the children's health.

   0 = literate 1 = illiterate

3. Head's occupation (**HDOCCO**)

   0 = agriculture 1 = non-agriculture

4. Head's employment (**HD-EMPL**)

5. Health (**HD- HLT**): Father is the decision-maker of the household and can bring better income. Therefore a healthy father can manage every thing in the household; hence the variable is expected to have positive influence on health. 0 = healthy 1 = not healthy

6. Spouse/Mothers age (**SPAGE**)

7. Spouse/Mothers employment (**SPEMP**)

   0 = others 1 = self employed

8. Spouse/Mothers literacy status (**SPEDUC**): Mothers play a major role in taking care of children. It is hypothesized that the health and nutritional status of children mostly depends on the care-taking (giving) educational level of the household, especially of mothers. Education of mothers, therefore, is believed to have a positive influence on health.

   0 = literate 1 = illiterate

9. Spouse / Mothers health (**SPHLT**)

   0= healthy 1= not healthy

iv) Community variables

1. Health distance (**HEAL-DIS**): The longer the distance, the more the cost and time it takes for the children to reach the facility. As a result, distance affects determinants of household health factors, such as choice of health provider treatment of diarrhea episode and immunization.

   0 = less or equal to 5 kms 1 = above 5 kms

2. Source of water (**SOUR_WAT**): Protected source of drinking water is expected to have a positive impact on health.

   0 = safe water source 1 = unsafe water source

3. Location of residence (**URB_RUR**): Households residing in urban areas are assumed to have more advantages over the rural residents due to the availability of health facilities and other services.

   0 = urban 1 = rural

v) Regional Dummies

The variables used are **Tigray**, **Afar**, **Amhara**, **Oromiya**, **Somali**, **Benishangul-Gumuz**, Southern Nations, Nationality and Peoples **(SNNP)**, **Gambela**, **Harari**, **Addis Ababa** and **Dire Dawa**. The regional dummies assume the value 1 if the child sampled is from the respective region, otherwise 0.

Interactions: Diarrhea

INT_1	URB_RUR by H13_SEX
INT_2	HD_EDUC by H13_SEX
INT_3	SPHL by HD_HLT
INT_4	URB_RUR by HH_SIZE
INT_5	UNDERC by STANC by WASTC

Interactions: Immunization

INT_1	URB_RUR by H13_SEX
INT_2	URB_RUR by HD_EDUC
INT_3	URB_RUR by SPEDUC
INT_4	SPEDUC by H13_SEX
INT_5	HD_EDUC by H13_SEX
INT_6	HD_EDUC by N51_ORD
INT_7	SPEDUC by N51_ORD
INT_8	URB_RUR by SOUR_WAT

Interactions: Nutritional status

INT_1	N50_AGE by N59_GIV
INT_2	N50_AGE by N51_ORD
INT_3	URB_RUR by SPEDUC
INT_4	SPEDUC by H13_SEX
INT_5	HD_EDUC by H13_SEX
INT_6	SPEDUC by N63_FOD
INT_7	HD_EDUC by N51_ORD
INT_8	URB_RUR by HDOCCU

4.4 Methodology

Predicting whether an event will or will not occur, as well as identifying the variables useful in making the prediction is important.

There are different types of multivariate statistical techniques that can be used to predict a binary dependent variable from a set of independent variables. Amongst them multiple linear regression analysis and discriminant analysis are two related techniques that quickly come to mind. However, these techniques bring difficulties when the dependent variable can have only two values, an event occurring or not occurring, present or absent and success or failure. When the dependent variable can have only two values, the necessary hypothesis testing in regression is violated.

It is unreasonable to assume that error is normal and it is difficult to interpret predicted values as probabilities.

Even if linear discriminant analysis does allow direct prediction of group membership, the assumption of multivariate normality of the independent variable as well as equal variance- covariance matrices in the two groups is required for the prediction rule to be optimal.

Different types of multivariate statistical techniques can be used to predict a dichotomous dependent variable from a set of independent variables. Amongst these techniques the logistic regression model is used for this data analysis.

Many distribution functions have been proposed for use in the analysis of dichotomous outcome (response) variable. Cox (1970) discusses some of these. There are two primary reasons for choosing the logistic distribution.

These are

(1) from a mathematical point of view it is an extremely flexible and easily used distribution, and

(2) it lends itself to a biologically meaningful interpretation. This model requires far fewer assumptions than discriminant analysis, and even when the assumptions required for discriminant analysis are satisfied, logistic regression still performs well. (see Hosmer & Lameshow, 1989, for an introduction to logistic regression.).

4.5 Logistic Regression

Relationships between the probability model and the independent variables are usually nonlinear rather than linear. If we correctly specify the model as linear, the statistical properties derived under the linearity assumption will not, in general, hold. In this case it is proper to specify a non-linear probability model in place of the linear probability model (Aldrich and Nelson, 1984; John and Forrest, 1984).

For a binary response Y_j and a quantitative explanatory variable X_{ij}, $i = 1,2,...,m$ and $j = 1,2,..,n$, let $\Pi_j = P(X_{ij})$ denote the "success probability" when X_{ij} takes the values x_{ij}. The problem with linear model is that the probability model $E(y) = X\beta$ (where β is the vector of parameters to be estimated) is used to approximate a probability value, Π_j =P

$(Y_j = 1)$ within the interval 0 and 1, while E (Y_j) is not so constrained. Therefore, we apply the logit transformation where the transformed quantity Ln $(\Pi_j /(1-\Pi_j))$ lies in the interval $(-\infty, \infty)$ and it is modelled as

$$\text{logit}(\Pi_j) = Ln\left(\frac{\Pi_j}{1-\Pi_j}\right) = \beta_0 + \beta_1 X_{1j} + \beta_2 X_{2j} + \ldots + \beta_m X_{mj}$$

This implies

$$\Pi_j = \frac{\exp(\beta_0 + \beta_1 X_{1j} + \beta_2 X_{2j} + \ldots + \beta_m X_{mj})}{1 + \exp(\beta_0 + \beta_1 X_{1j} + \beta_2 X_{2j} + \ldots + \beta_m X_{mj})}$$

where the parameter β_i determines the rate of increase or decrease of X_{ij} on the log of odds that Y_j=1, controlling for other X's. Furthermore, $\exp(\beta_i)$ is the multiplicative effect on the odds of unit increase in X_{ij}, at fixed levels of the others X's.

In the linear regression we estimate the parameters of the model using the method of least squares. That is, we select regression coefficients that result in the smallest sums of squared distances between the observed and the predicted values of the dependent variable, while in logistic regression the parameters of the model are estimated using maximum-likelihood method. That is, the coefficients that make our observed results most " likely" are selected. Since the logistic regression model is non-linear, an iterative algorithm is necessary for parameter estimation.

4.6 Statistical Inference

In the previous section it is shown that the logistic regression model helps us to describe the effects of the predictors on a binary response. Statistical inference of the model parameters helps us to judge the significance and magnitude of the effects. Stating the null hypothesis one can test the significance of the effect of X on the binary response

$H_{0:}$ $\beta = 0$ (the probability of presence is independent of X).

$H_{1:}$ $\beta \neq 0$ (the probability of presence is not independent of X).

For large sample size assuming normality of maximum likelihood estimates (i.e., the Wald statistic $(Z^2) = [\beta/se(\beta)]^2$ has chi-squared distribution with one degree of freedom), it is possible to test the hypothesis under consideration. But the Wald statistic, which divides the parameter estimate by its standard error and then squared, takes the right tail chi-squared probability above the observed value as its p-value. The likelihood ratio test uses the likelihood function through the ratio of the maximum of the function over the possible parameter values given by the null hypothesis (β=0) to the maximum over the large set of possible parameter values for the full model, permitting the null or the alternative hypothesis to be true.

But for large sample size both these test statistics have the same behavior (Agresti, 1996). Unfortunately, the Wald statistic has a very undesirable property. When the absolute value of the regression coefficient becomes large, the estimated standard error is too large. This produces a Wald statistic that is too small, leading to fail to reject the null hypothesis that the coefficient is 0, when in fact we should. Therefore, whenever we have a large coefficient, we should not depend on the Wald statistics for hypothesis testing. Instead we should build a model with and without that variable and base our hypothesis test on the difference between the two likelihood - ratio chi-squares (Hauck and Donner, 1977). Hence this study uses the ML ratio test statistics. The ML ratio test statistic is more powerful and reliable for sample of sizes used in practice (Agresti, 1996).

4.7 Model Selection

In logistic regression, as in other multivariate statistical techniques, one may want to identify subsets of independent variables that are good predictors of the dependent variable. All the problems associated with variable selection algorithms in regression and discriminant analysis are found in logistic regression as well.

Several model selection procedures exist, none of which is "best". Cautions that apply to ordinary regression modeling of normal data hold for any generalized linear regression model. For instance, a model with several predictors has the potential for multicolinearity. Strong correlation's among predictors makes it seem that no one variable is important when all the others are in the model. A variable may seem to have a little effect simply because it "overlaps" considerably with other predictors in the model.

The logistic regression procedures have several methods available for model selection. Variables can be entered into the model using Enter, Fstep, Bstep and etc. A better, but computationally more intensive criterion for determining variables to be removed from the model is the likelihood - ratio (LR) test. If the null hypothesis is true and the sample size is sufficiently large, the quantity – 2(log of the likelihood - ratio statistic) has a chi-square distribution with k degrees of freedom, where k is the difference between the number of terms in the full model and reduced model. (The model chi - square and the improvement chi - square are both likelihood - ratio tests). When the likelihood-ratio test is used for removing terms from a model, its significance level is compared to the cut off value.

In our case for selection of the model the backward elimination procedure is used, which is the procedure starting with a complex model and successively taking out terms. At each stage, we eliminate the term in the model that has the largest p-value when we test that its parameters equal zero. Here we test only the highest order terms for each variable.

Comparison can be done between different models fit to the data in terms of their predictive power. In general linear models the correlation R between the observed responses (Y_i) and the model's fitted value describes this, where R represents the multiple correlation between the response variable and the predictors; the R^2 describes the proportion of variation in Y that is explained by the predictors. In the case of the logistic regression, R is the correlation between binary y= (0,1) observations on the response and the predicted probability π_i. For such models, R is a crude index of predictive power, and it does not have the nice properties it has for normal general linear model. Nevertheless, R is useful for comparing fits of different models to the same data set (Agresti, 1996).

4.8 Model Checking

After describing and inference about the effects of predictors on binary response in logistic regression, it is good to check that a particular model is appropriate for the data or not.

Fitting logistic regression models provides predicted probabilities that y=1. At each setting of the explanatory variables, one can multiply the predicted probability by the number of subject to obtain a fitted count. The test of the null hypothesis that the model holds compares the fitted and observed counts using a Pearson's X^2 or likelihood-ratio test statistics (G^2). For a fixed number of settings, when most fitted counts are about five, X^2 and G^2 have approximate chi-squared distributions. The degree of freedom (the residual df) for the model, equal the number of sample logit (i.e. the number of settings of explanatory variables) minus the number of model parameters. The large X^2 or G^2 values indicate lack of fit of the model, and p-value is the right-tail probability above the observed value. When the fit is poor, residuals and other diagnostic measures describe the influence of individual observations on the model fit and highlight reasons for the inadequacy (Agresti, 1996).

The X^2 and G^2 is given by

$$X^2 = \sum \left[\frac{(Observed - Fitted)^2}{Fitted} \right]$$

$$G^2 = 2\sum\left[(Observed)\log\left(\frac{Obsrved}{Fitted}\right)\right]$$

$$= -2\,Ln\,\{LLC \;/\; LLS\}$$

LLC= Maximum likelihood of constant model.

LLS= Maximum likelihood of saturated model.

A constant model is a model, which contains only the constant term, while a saturated model is a model which contains all factors selected by the stepwise procedure. Goodness-of–fit statistics such as G^2 and X^2 are summary indicators of the overall quality of fit. Additional diagnostic analysis is necessary to describe the nature of any lack of fit.

It is important to examine the adequacy of the resulting model in logistic regression. There are comparable diagnostics that should be used to identify data problems. The logistic regression provides a variety of such statistics.

The residual is the difference between the observed probability and the predicted probability of the event based on the model. It can be viewed as a component of –2LL, which compares a model to the "perfect " model.

For each case the deviance compares the predicted probability of being in the correct group based on the model to the prediction of 1.

$$Deviance = \sqrt{-2\log\left(\frac{L_0}{L_1}\right)}$$

where L_1 is always 1, since the likelihood of the correct prediction in a perfect model is 1, and L_0 is the predicted probability of membership in the correct group. Large values for deviance indicate that the model does not fit the case well. For large sample sizes the deviance is approximately normally distributed.

The studentized residual for a case is the change in the model deviance if the case is excluded. Discrepancies between the deviance and the studentized residual may identify unusual cases.

The logit residual is the residual for the model if it is predicted in the logit scale.

$$Logit\ residual = \frac{residual}{\Pi_i(1-\Pi_i)}$$

Leverage values are used for detecting observations that have a large impact on the predicted values. Unlike linear regression, the leverage values in logistic regression, depend on the dependent variable scores and the design matrix and bounded by 0 and 1. Their average value is k/n where k is the number of estimated parameters, including the constant, and n is the sample size.

Cook's distance is a measure of the influence of a case. It tells us how much deleting a case affects not only the residual for that case. Cook's distance depends on the standardized residual for a case, as well as its leverage.

$$Cook's\ D_i = \frac{z_i h_i}{(1-h_i)^2}$$

where z_i is the standardized residual and h_i is the leverage.

Another useful diagnostic measure is the change in the logistic coefficients when a case is deleted from the model is DFBETA, and it is given by

$$DFBETA \quad (\beta_j^{(i)}) = \beta_j - \beta_j^{(i)}$$

where β_j is the value of the coefficient when all cases are included and $\beta_j^{(i)}$ is the value of the coefficient when the i^{th} case is excluded.

In summarizing the diagnostic methods the residuals comparing observed and fitted counts are useful for this purpose. So the residuals (used to detect multicollinearity and other inadequacies), the leverage (used for detecting observation that have a large impact on the predicted values), cook's distance (a measure of the influence of a case on the residuals), and DFBETA (a measure of the change in the logits when a case is deleted from the model) are useful for model diagnostics (Montgomery and Peck, 1992).

CHAPTER V

5. STATISTICAL DATA ANALYSIS

5.1 Introduction

The review of the level of health and nutritional status of children in Ethiopia considered in chapter three, indicated that, compared to other Sub-Saharan African countries, the level of health and nutritional status is low and malnutrition is prevalent in both male and female children.

The purpose of this chapter is to quantify the effect of the different socioeconomic and demographic determinants of health and nutritional status of children in Ethiopia. An attempt has been made to provide the estimate of some of health measurements using the 1998 Welfare Monitoring Survey (WMS) and health and nutrition survey data. Estimates of health factors such as diarrhea episodes, immunization and nutritional status are discussed. As it has been mentioned, due to data limitations it was not possible to include some of the health measures such as child mortality. Different sample size are used in three models, i.e., 22583, 22795 and 24964 cases for nutritional status, immunization and diarrhea episode, respectively. In all three models different independent variables are used, but most of the variables selected are identical.

5.2 Variable Selection

To determine factors, which are significantly correlated with nutritional status, immunization and diarrhea episode, preliminary assessment was done using chi-square test. Variables selected for the study were strongly associated with nutritional status, immunization and diarrhea episode (see Tables 7, 8 and 9, respectively).

Further analysis is done by using logistic regression method. Using this method, the models that best describe the nutritional status, immunization and diarrhea episode of children are fitted using the explanatory variables. In each case the backward elimination technique is used to select the best model. The result of logistic regression for the three models is given in Tables 4, 5 and 6. The tables contain the estimated coefficient (ß), the partial correlation (R), the odds change (exp(ß)), and some other statistics. The logistic models predict the chance of being in a level of nutritional status, immunization and diarrhea episode at each level of the explanatory variables listed. For instance, the probability that a child is "malnourished" can be predicted using the variables location of residence, mother's/spouse's employment status, religion of parents, mother's/spouse's literacy status, mother's/spouse's age, sex of child, age of child, food given after birth, age at which breast feeding started, status of breast feeding, food given during the last four weeks, head's age, head's occupation, head 's health, head's literacy status, source of water, and income of household (see Table 4). Determinants of immunization, however, are location of residence, household size, religion of the parents, age of child, birth order of child, head's age, head's occupation, head's employment status, head's illness episode, and head's literacy status, mother's/spouse's age and literacy status, distance to nearest health facility, own housing unit, household income and number of children under five years (see Table 5). Finally the determinants of diarrhea episode are religion of the parents, head's illness episode, mother's/spouse's age, employment, literacy status and illness episode, distance to the nearest health facility, own housing unit, household income, use of boiled water, nutritional status and type of toilet facility (see Table 6).

Some of the interactions are also found to influence nutritional status, immunization and diarrhea episode. The interaction between location of residence and household head's literacy status is such an interaction.

The partial correlation between the dependent variables and the explanatory variables is given under the column R in each model. If the value is positive, as the variable increases in value, the likelihood of the event occurring increases. If R is negative the opposite is true. In the case of nutritional status, location of residence, sex of child, age of child, food given after birth, age at which breast feeding started, food given last four weeks, head's age, head's health, head's literacy status, mother's/spouse's literacy status, source of water supply and some of the interactions have positive correlation, while religion of parents, breast feeding mothers milk, mother's/spouse's age, mother's/spouse's employment status, household income, number of children under five years and few interactions are negatively correlated (see Table 4).

The partial correlations between children's immunization and household size, age of child, head's occupation, head's literacy status, mother's/spouse's age, mother's/spouse's employment status, mother's/spouse's literacy status, household income and the interaction of location of residence and source of water are positive, while location of residence, parents religion, birth order of child, head's age, head's employment status, head's illness episode, distance to the nearest health facility, own housing unit, age-square, number of children under five years of age and the interaction of head's literacy status and birth order of child have negative correlation (see Table 5). In the case of diarrhea episode sex of child, head's employment status, head's illness episode, mother's/spouse's employment status, mother's/spouse's literacy status, distance to the nearest health facility, own housing unit, use of boiling water, nutritional status and the interaction of mother's/spouse's illness episode and head's illness episode are positively correlated, while religion of parents head's literacy status, mother's/spouse's, illness episode, household income and toilet facility have negative correlation (see Table 6).

The column exp(ß) is the value with which the odds change when the i^{th} independent variable increases by one unit. As regards nutritional status (NUT-STAT), almost all factors are found to increase equally the problem of malnutrition except for mother's/spouse's literacy status, head's literacy status, food given last four weeks, location of residence, source of water supply and regions Tigray and Amhara. Similarly parents illness episode, mother's/spouse's literacy status, region Dire Dawa, the interaction of head's and mother's/spouse's literacy status and wasted children have high positive influence on diarrhea episode relative to other variables.

In the case of immunization almost all the variables are found to increase equally except head's and mother's/spouse's literacy status. In regions Tigray, Benshanguli/Gumuz, Harari, Dire Dawa and the interaction location of residence and source of drinking water, that change is high relative to other explanatory variables.

5.3 Model checking and diagnostics

A model should be assessed and diagnosed for model adequacies, if it has to be reliable. The chi–square goodness of fit statistics and the classification power for the criterion variables (i.e., Nutritional status, Immunization and Diarrhea episode) are given in Tables 4, 5 and 6, respectively. A good model is one that results in a high likelihood of the observed results. This translates to a small value of –2LL. If a model fits perfectly, the likelihood is 1 (-2 times the log likelihood is 0). Tables 4, 5 and 6 show that the test for the null hypothesis, that the coefficients for all the terms in the current model, except the constant are zero, to be rejected at p- value less than one percent. This is true in each of the three models.

One way to assess how well our model fit is to compare our predications to the observed outcomes. The classification power for nutritional status indicates that 6532 normal children were correctly classified by the model, similarly, 4663 malnourished children were correctly classified. The off diagonal values indicate children incorrectly classified. A total of 4204 children were misclassified by the model with 1774 normal, and 2430 malnourished. Of the malnourished children, 85.96% and of normal children 78.58% were correctly classified. All in all 83.56% were correctly classified (see Table 4).

In the case of immunization the classification table shows that 85.96% of vaccinated children were correctly classified, while 78.30% of those not vaccinated were correctly classified and the overall rate of correct classification is 81.98% (see Table 5).

As shown in Table 6, for diarrhea episode 84.63 % of those without diarrhea and 70.28% of those with diarrhea were correctly classified, while the overall rate of correct classification is 79.78%.

In all the three models the classification powers are high enough to consider the models reliable. Generally it can be inferred from the results that the fit is good.

After building a statistical model and applying the goodness of fit test, it is important to examine further model adequacy checks and diagnosis. To check multicollinearity linear regression model is fit for each dependent variable. The collinearity diagnostics, variance inflation factor (VIF) showed that age and age squared have significant VIF causing sever multicollinearity in the case of nutritional status. After removing age squared the situation improved. For immunization and diarrhea episode there is no multicollinearity problem.

The residual plots, that is, the graphs of residuals versus the explanatory variables show the presence of some outliers, which can influence the estimates. However, as the sample size is very large and the number of outliers is insignificant, the outliers are discarded from the analysis.

Further residual analysis on the influence measures, DFBETA, Cook's Distance and Leverage, showed that the estimates are free of influential cases.

CHAPTER VI

6. DISCUSSION, CONCLUSION AND RECOMMENDATION

6.1 Discussion

6.1.1 Nutritional status

Location of residence, sex of child, religion of the parents, age of child, type of food given after birth, status of breastfeeding, age at which breastfeeding started, and food given to child during the last four weeks before the survey are some of the explanatory variables which affect children's nutritional status. Household head's age, illness episode, and literacy status are also factors that affect nutritional status of children. Other parental factors which affect nutritional status are mother's/spouse's age and employment status. The significant interactions are location of residence and occupation of household head, children's age and type of food given, location of residence and mother's/spouse's literacy status, head's education and sex of child, mother's/spouse's literacy status and type of food and head's literacy status and birth order.

The results of logistic regression analysis show the determinants of nutritional status (NUT–STAT) as given in Table 4.

As shown in Table 4, the positive value of the location of residence (URB_ RUR=1 if rural) implies that malnutrition is very high in rural area. The probability of being malnourished increases when the location of residence of the child is rural. The same can be said about sex of the child, type food given after birth, status of breastfeeding, food given in the last two weeks, and head's age. Male children are more likely to be malnourished than female children. As regards the religion of the parents negative association implies that children from christian families seem to be in good nutritional status. Age of child is positively related with being malnourished which indicates an increase in probability of being malnourished as age increases. This may be because parents give less care to elder children or the mothers stop breastfeeding.

Parental variables such as head's age, illness episode, literacy status, are associated with children's nutritional status. Health of household head is positively associated with children's nutritional status, as it is expected. Similarly illiterate heads and mothers/spouses have high probability of reporting malnourished children. As it is expected, children from households having safe water supply are less likely to be malnourished.

Table 4 also reveals that household income is negatively associated with malnutrition. This clearly suggests that households with better income group are in better condition than low income households regarding nutritional status of children.

The results also indicate that seriousness of malnutrition varies from region to region. In Tigray and Amhara regions the probability of reporting malnourished children is higher than in other regions.

Some interactions are significantly associated with nutritional status of children. The interactions of age of child and food given after birth, age of child and birth order, location of residence and mother's/spouse's literacy status, location of residence and child sex, household head's literacy status and child sex and literacy status of mothers/spouses and food given in the last two weeks have strong effect on nutritional status.

Table 4: Goodness of Fit Statistics for the Model Selected by Backward (NUT_STAT)

-2log likelihood (Constant Model)	32222.540
-2log likelihood (Saturated Model)	25432.949
Goodness-of-Fit	24775.150
Model Chi-Square	6789.592
Degrees of freedom	27
Percentage of correct classification	
Normal	78.58%
Malnourished	85.96%
Overall	83.56%

---------------------- Variables in the Equation -----------------------

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
URB_RUR	0.4112	0.0623	43.5642	1	0.0000	0.0109	1.5086
H13_SEX	0.2074	0.0599	11.9777	1	0.0005	0.0176	1.2305
H15_RLG	-0.0775	0.0352	4.8429	1	0.0278	-0.0094	0.9255
N50_AGE	0.0577	0.0022	710.8945	1	0.0000	0.1483	1.0594
N59_GIV	0.2129	0.0513	17.2393	1	0.0000	0.0217	1.2373
N60_BRS	0.0952	0.0372	6.5372	1	0.0106	0.0119	1.0998
N61_BEG	-0.8992	0.0447	405.1282	1	0.0000	-0.1119	0.4069
N63_FOD	0.4959	0.0425	136.0690	1	0.0000	0.0645	1.6420
HDAGE	0.0137	0.0025	29.0777	1	0.0000	0.0290	1.0138
HD_HLT	0.0547	0.0322	2.8839	1	0.0895	0.0052	1.0562
HD_EDUC	0.8444	0.0575	215.9736	1	0.0000	0.0815	2.3265
SPAGE	-0.0466	0.0031	225.7233	1	0.0000	-0.0833	0.9545
SPEMP	-0.1027	0.0376	7.4399	1	0.0064	-0.0130	0.9024
SPEDUC	0.3192	0.0772	17.1100	1	0.0000	0.0217	1.3760
SOUR_WAT	0.6216	0.0359	299.3047	1	0.0000	0.0961	1.8620
LNINC_12	-0.2786	0.0151	341.0179	1	0.0000	-0.1026	0.7569
CHILD_05	-0.1287	0.0232	30.8452	1	0.0000	-0.0299	0.8792
TIGRAY	0.7162	0.0683	109.9616	1	0.0000	0.0579	2.0467
AMHARA	0.5301	0.0464	130.5057	1	0.0000	0.0632	1.6991
OROMIYA	-0.1496	0.0362	17.0985	1	0.0000	-0.0216	0.8610
DIRE_DAW	-1.0436	0.0953	119.9197	1	0.0000	-0.0605	0.3522
INT_1	-0.0073	0.0020	13.3521	1	0.0003	-0.0188	0.9928
INT_2	0.0016	0.0003	24.1438	1	0.0000	0.0262	1.0016
INT_3	0.2630	0.0691	14.4978	1	0.0001	0.0197	1.3008
INT_4	0.5380	0.0707	57.8928	1	0.0000	0.0416	1.7126
INT_7	-0.1147	0.0105	119.5915	1	0.0000	-0.0604	0.8917
INT_8	0.4811	0.0575	70.0888	1	0.0000	0.0460	1.6178
Constant	1.1747	0.1457	64.9687	1	0.0000		

6.1.2 Immunization

Religion of the parents, age of child and birth order are some of the explanatory variables which affect children's immunization. Household head's age, occupation, employment status, illness episode, and literacy status are also factors that affect children's immunization. Other parental factors which affect children's immunization, are mother's/spouse's age, literacy status and employment status. Household factors, which affect children's immunization are own of housing unit, household income, household size and number of children under 5 years. Location of residence and distance to nearest health facility are community variables, which affect children's immunization.

The results of logistic regression analysis show the determinants of children's immunization (IMM–STAT), as given in Table 5.

As shown in Table 5 children's immunization is negatively and significantly associated with distance to nearest health facility. The result indicates that as distance to nearest health facility increases the probability of children being immunized decreases. The rural children are less immunized than urban children. This result is expected because accessibility to health facilities is less in rural areas compared to urban areas in Ethiopia. Mother's/spouse's literacy status is positively and significantly associated with children's immunization. Literate mothers/spouses are more likely to take back their children for immunization. As school attendance increases the probability of taking children for immunization increases. The literacy status of household head is positively associated with children's immunization i.e. literate household heads are more probable to bring their children for immunization. Negative association of head's health with children's immunization implies that healthy household heads are less probable to bring their children for immunization, which is against the expectation. Children's immunization is highly age specific i.e., once, one of the four immunities is started within specific age, other's follow. As age of child increases up to a fixed age the probability of being immunized increases and then stops at certain age limit. Household income is positively associated with children's immunization. The probability of children being immunized increases as household income increase i.e., households with high income are more likely to take back their children for immunization. The results also indicate that households with more children under-five years have a problem of taking their children for immunization. Household size, head's occupation, mother's/spouse's age, mother's/spouse's employment status, the interaction of location of residence and source of water are positively associated with children's immunization, while religion of the parents, head's age, head's employment status, birth order of child, age square, number of children less than 5 years, head's health, owning housing unit, mother's/spouse's literacy status and birth order of child have negative association.

The results also indicate that children's immunization status varies from region to region. In Affar and Somali regions the probability of reporting immunized children is low, while in Tigray, Harari and Dire–Dawa regions it is high. Regions Tigray, Amhara, Oromiya, Benshanguli/Gumiz, Harari, and Addis Ababa are more likely to implement immunization program.

Table 5: Goodness of Fit Statistics for the Model Selected by Backward (IMM_STAT)

-2log likelihood (Constant Model)	31345.094
-2log likelihood (Saturated Model)	19458.698
Goodness-of-Fit	25011.484
Model Chi-Square	11886.396
Degrees of freedom	29
Percentage of correct classification	
Immunized for 2-4 types	84.96%
Not Immunized	78.30%
Overall	81.98%

---------------------- Variables in the Equation ----------------------

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
URB_RUR	-6.5869	2.0422	10.4035	1	0.0013	-0.0164	0.0014
HH_SIZE	0.0458	0.0110	17.2543	1	0.0000	0.0221	1.0469
H15_RLG	-0.2448	0.0427	32.9144	1	0.0000	-0.0314	0.7828
N50_AGE	0.0215	0.0026	67.4851	1	0.0000	0.0457	1.0217
N51_ORD	-0.0377	0.0098	14.8948	1	0.0001	-0.0203	0.9630
HDAGE	-0.0070	0.0029	6.0516	1	0.0139	-0.0114	0.9930
HDOCCU	0.2027	0.0738	7.5404	1	0.0060	0.0133	1.2247
HDEMPL	-0.2807	0.0730	14.7968	1	0.0001	-0.0202	0.7552
HD_HLT	-0.2562	0.0369	48.2838	1	0.0000	-0.0384	0.774
HD_EDUC	0.5965	0.0414	207.5068	1	0.0000	0.0810	1.8158
SPAGE	0.0088	0.0040	4.9722	1	0.0258	0.0097	1.0089
SPEMP	0.2725	0.0396	47.4758	1	0.0000	0.0381	1.3133
SPEDUC	2.2751	0.1293	309.6778	1	0.0000	0.0991	9.7286
HEAL_DIS	-3.4802	2.0437	2.8997	1	0.0886	-0.0054	0.0308
OWN_DWL	-0.1726	0.0980	3.1023	1	0.0782	-0.0059	0.8415
LNINC_12	0.2001	0.0182	120.7828	1	0.0000	0.0616	1.2215
AGE_SQR	-0.0002	4.26E-05	18.3402	1	0.0000	-0.0228	0.9998
CHILD_05	-0.0870	0.0296	8.6055	1	0.0034	-0.0145	0.9167
TIGRAY	2.3586	0.0871	733.2841	1	0.0000	0.2460	10.5761
AFFAR	-1.3347	0.1425	87.7089	1	0.0000	-0.0523	0.2632
AMHARA	0.6057	0.0535	128.2483	1	0.0000	0.0635	1.8326
OROMIYA	0.5235	0.0472	122.9139	1	0.0000	0.0621	1.6879
SOMALIE	-0.7256	0.0993	53.3826	1	0.0000	-0.0405	0.4840
BENSHANG	1.4814	0.1752	71.5102	1	0.0000	0.0471	4.3989
HARARI	2.1930	0.1528	206.1050	1	0.0000	0.0807	8.9625
ADDIS_AB	0.3182	0.1368	5.4099	1	0.0200	0.0104	1.3746
DIRE_DAW	2.2867	0.1446	250.1641	1	0.0000	0.0890	9.8420
INT_7	-0.2222	0.0344	41.8371	1	0.0000	-0.0356	0.8007
INT_8	0.6978	0.0531	172.4285	1	0.0000	0.0737	2.0093
Constant	3.4120	2.0512	2.7668	1	0.0962		

6.1.3 Diarrhea

The probability of reporting diarrhea episode is higher in males than in females. The probability of reporting diarrhea episode was found higher in children whose household heads are with health problem. Parental employment status is positively associated with diarrhea episode, which indicates that children of self employed parents, are more likely to contract diarrhea. Children's chance of contracting diarrhea can be predicted by parental literacy status i.e., literate heads are negatively associated, while mother's/spouse's literacy status is positively related to children's diarrhea episode, which is unexpected. Mother's/spouse's illness episode is negatively associated with children's diarrhea episode i.e., contrary to one's expectation, unhealthy mothers are less likely to report children with diarrhea episode. As regards the religion of the parents the negative association implies that children from christian families are less likely to report diarrhea episode.

The results also indicate positive relationship between distance to the nearest health facility and children's diarrhea episode, which implies that as the distance to health facility increases the probability of reporting children with diarrhea episode increases. The probability of children's having diarrhea episode can also be predicted by the status of ownership of housing unit occupied by the household. Table 6 reveals that households who own the housing unit are less likely to report children with diarrhea episode. Household income is negatively associated with children's diarrhea episode i.e., the probability of reporting diarrhea episode decreases as the household income increases. Households with high income are in better condition of health. As it is expected, children from households having safe toilet facility are less likely to contract diarrhea. The probability of reporting diarrhea episode is high in malnourished children and it is positively associated with nutritional status. The probability of children's having diarrhea episode can also be predicted by interaction of the parents illness episode, i.e., parents with health problem are more likely to report diarrhea episode.

The result also indicates that prevalence of diarrhea episode among children varies from region to region. The probability of reporting diarrhea episode is high in Somali, Gambella and Harari relative to other regions except Dire Dawa.

The prevalence is highest in Dire Dawa. As it is expected, malnourished children have high risk of diarrhea.

Table 6: Goodness of Fit Statistics for the Model Selected by Backward (DIARRHEA)

-2log likelihood (Constant Model)	31943.197
-2log likelihood (Saturated Model)	24914.558
Goodness-of-Fit	24467.736
Model Chi-Square	7028.639
Degrees of freedom	28
Percentage of correct classification	
With Diarrhea	70.28%
Without Diarrhea	84.63%
Overall	79.78%

--------------------- Variables in the Equation -----------------------

Variable	B	S.E.	Wald	Df	Sig	R	Exp(B)
H13_SEX	0.1234	0.0310	15.8230	1	0.0001	0.0208	1.1314
H15_RLG	-0.2888	0.0358	65.2291	1	0.0000	-0.0445	0.7491
HDEMPL	0.1430	0.0545	6.8800	1	0.0087	0.0124	1.1538
HD_HLT	1.4817	0.0489	917.9554	1	0.0000	0.1693	4.4003
HD_EDUC	-0.2559	0.0354	52.1922	1	0.0000	-0.0396	0.7742
SPAGE	-0.0269	0.0020	181.8789	1	0.0000	-0.0750	0.9734
SPEMP	0.2927	0.0336	75.7192	1	0.0000	0.0480	1.3401
SPEDUC	0.3743	0.0583	41.1757	1	0.0000	0.0350	1.4540
SPHL	-1.4025	0.0607	534.2785	1	0.0000	-0.1291	0.2460
HEAL_DIS	0.0615	0.0344	3.2063	1	0.0734	0.0061	1.0635
OWN_DWL	0.5573	0.0629	78.5091	1	0.0000	0.0489	1.7460
LNINC_12	-0.0713	0.0150	22.5827	1	0.0000	-0.0254	0.9312
TIGRAY	0.2098	0.0645	10.5916	1	0.0011	0.0164	1.2335
AMHARA	0.2702	0.0476	32.2190	1	0.0000	0.0308	1.3103
OROMIYA	0.2578	0.0427	36.3746	1	0.0000	0.0328	1.2941
SOMALIE	0.3418	0.0802	18.1497	1	0.0000	0.0225	1.4075
GAMBELA	0.3747	0.0713	27.6059	1	0.0000	0.0283	1.4546
HARARI	0.3315	0.1099	9.0914	1	0.0026	0.0149	1.3930
ADDIS_AB	0.2196	0.1081	4.1296	1	0.0421	0.0082	1.2456
DIRE_DAW	2.3640	0.1067	490.6679	1	0.0000	0.1237	10.6337
LATRINE	-0.2841	0.0520	29.8546	1	0.0000	-0.0295	0.7527
BIOL_WAT	0.1549	0.0835	3.4392	1	0.0637	0.0067	1.1675
STANC	0.1662	0.0355	21.8591	1	0.0000	0.0249	1.1808
WASTC	0.8469	0.0470	324.6500	1	0.0000	0.1005	2.3324
UNDC	0.3351	0.0329	104.0041	1	0.0000	0.0565	1.3981
INT_3	1.0145	0.0705	206.9276	1	0.0000	0.0801	2.7580
INT_4	-0.0275	0.0062	19.8401	1	0.0000	-0.0236	0.9729
INT_5	0.1599	0.0657	5.9175	1	0.0150	0.0111	1.1734
Constant	-1.0218	0.1723	35.1654	1	0.0000		

6.2 Conclusion

This thesis discussed in detail the empirical results of the 1998 Welfare Monitoring, Health and Nutrition Survey. The main outcome of this thesis indicates the socioeconomic and demographic determinants of health and nutritional status of children under five years of age in Ethiopia. It observed that children in Ethiopia aged between 3 and 59 months suffer from mild and moderate malnutrition.

The logistic regression results indicated determinants of health and nutritional status of children aged 3–59 months. Age and birth order, mothers' and fathers' literacy status, household income, type of toilet facility, source of drinking water, distance to the nearest health facility, household size, parents' health status, age at which supplementary food started, age of the child, and type of food given are some of the variables. The results of the analyses show that macro policies aimed at reducing poverty, increase the education level of the parents (especially mothers) and health policies that result in a reduction of diseases such diarrhea and increase immunization capacity will increase health and nutritional status of children.

6.3 Recommendation

In Ethiopia malnutrition occurs widely, and has been recognized as one of the most challenging economic development problems facing policy makers. One of the characteristics of malnutrition in Ethiopia is that a significant number of the victims are children.

The poorest people suffer most from protein energy malnutrition (PEM) because they lack the resources. Within the poorest groups, children are the most vulnerable because of absence of extra care and their nutritional needs. Other factors such as large family size, maternal age, birth order, literacy of parents may increase the risks of PEM. The importance of the above mentioned factors also vary from country to country. Generally, it is believed that where there is a significant number of underweight children, household food security is inadequate (FAO/WHO, 1992). It is observed from the previous national nutritional surveys and the 1998 surveys that it is necessary to introduce interventions aimed at improving household food security. Therefore, targeted interventions, which address specific constraints to good health and nutritional status are important.

The fact that there is a general increase in immunization indicates that immunization program is increasingly achieving its goals to reach children. To reach this goal, more effort will be needed to encourage mothers to bring their children for all recommended vaccines and doses, especially for rural mothers.

Health and nutrition are important ends in themselves, and they are also a means through which productivity and population goals are affected. Therefore, it is recommended that future research and policy directives consider the following major and general cases:

(a) population policy to control family size,

(b) nutrition and formal education for parents especially for women or child caring person,

(c) build health facilities, which are accessible in rural areas,

(d) build protected well for latrine use especially in rural areas,

(e) control of endemic diseases through extensive and sustainable health policy measures.

Future policy directives aimed at case (a) to (e) are expected to alleviate the problem of malnutrition and improve the level of health and nutritional status of children aged 3 to 59 months in Ethiopia.

REFERENCES

Adane M. (1988). Health Status in Resettled and Indiginous population (Keto Settlement in Kelem Awraja Wellega Region). *MSc. thesis*, Addis Ababa University.

Agresti, A. (1996). *An Introduction to Categorical Data Analysis* New York, John Wiley.

Aldrich, H. and Nelson, D. (1984). *Linear Probability, Logit and Probit Models.* SAGE Publications, Newbury Park.

Akin. J.S., Griffin, C.C., Guilkey, D.K., and Popkin., B.M. (1985). *The Demand for Primary health care in the third World.* Rowman and Allanheld publishers.

Ballwag, J.A. and Webb, R.E. (1990). Nutritional Status and Mental development in Rural Haiti.*Ecology of Food and Nutrition (An International Journal)* J.R.K Roson (ed.), Vol. 24.No.2:16-27. Gordon and Breach Science Publishers.

Becker, Gray S.(1965). A Theory of the Allocation of Time. *Economic Journal,* 75 no. 299:493-512.

Behrman, J.R. and Deolalikar, A.B.(1988). Health and nutrition. *Hand Book of Development Economics.* H.Chenery and T.N. Srinivasan(eds.) Vol. 1, p.633-704.

Behrman, J.R. and Wolfe, B.L. (1984). More evidence on nutrition demand: Income seems overrated and Women's schooling under emphasized. *Journal of development economics*.14:105-128.

Berg, A. (1981). Malnourished People. A Policy View, World Bank, Poverty and Basic Needs Series, Washington Dc. P.5. In: Coleman, D. and Nixson, F. (1986). *Economics of Change in Less Developing Countries.* P. 246.

Blau, D.M. (1984). A model of child nutrition, fertility, and women's time allocation: The case of Nicaragua. *Research in Population Economics*, 5, 163-184, Green, CT: TAI Press.

Brugha, R. and Kevany, J.(1994). Determinants of nutritional status among children in eastern region of Ghana. *Journal of Tropical Pediatrics.* 40(5):307-311.

Caldwell, J. C. (1979). Education as a Factor in Mortality Decline: An Examination of Nigerian data. *Population Studies* 33, No.3: p.368.

Calloway, D.,Murphy,S. and Beaton,G. (1988). Food Intake and Human Function: A Cross-Project Perspective. Collaborative Research Support Programme: Mimeo. University of California, Berkeley.

Churchill, A. (1987). Rural Water Supply and Sanitation: Time for change. World Bank Discussion paper no. 18.

Colman, D. and Nixson,F. (1986). *Economics of change in Less Developing countries.* Second edition. Philip Allan/Barnes & Noble Books, Great Britain.

Cox, D. R. (1970). *Analysis of Binaray Data.* Methoen, London .

CSA (1983). Analytical Report on Child Nutrition Status Through Anthropometric Measurement, Rural Nutritional Survey, Second Round(1983). *Bulletin N° 102,*Addis Ababa.

CSA (1983). Report on the Rural Health Survey. *Statistical Bulletin 52.* Addis Ababa.

CSA (1992). Analytical Report on Child Nutritional Status. Through Anthropometric Measurements, Rural Nutrition Survey, 1983 Second Round. *Bulletin No 102.* Addis Ababa.

CSA (1993). Report on the National Rural Nutrition Survey, Core Module. *Statistical Bulletin 113.* Addis Ababa.

Cumper, G.E. (1984). Determinants of health levels in developing countries. Letchworth, England, Research Studies Press. Tropical Medicine Series, vii, 152 p.

Eshetu, M. Ashagre, Y.K. (1997). Correlates of nutritional status of under five children in Southern Ethiopia (unpublished).

FAO/WHO (1992). International conference on nutrition: major issues for nutrition strategies.

Garcia, M. and Anderson, P. (1987). The Pilot Food Subsidy Scheme in The Philippines: Its Impact onIncome, Food Consumption and Nutritonal Status. International Food Institute (IFPRI). Research Report No.61. p. 61.

Haaga, J. Kenrick, C. Test, K. and Mason, J.(1985). An estimate of the prevalence of child malnutrition in developing countries. *World Health Statistics Quarterly,* 38(3):331-347.

Hauck, W.W, and Donner, A. (1977). Wald's Test as applied to hypoteses in light analysis. *Jornal of the American Statistical Association,* 72, 851-853.

Han-Am and Sleigh-a(1995). Persistent diarrhea in children admitted to Port Moresby General Hospital. *P-N-G-Med-Journal.* 38(4):272-277.

Horton, S. (1986). Child Nutrition and Family size in the Philippines. *Journal of Development Economics, 23,* 166-176.

Horton, S. (1988). Birth Order and Child Nutritional Status: Evidence from the Philippines. *Economic Development and Cultural Change,* 36: No.2, 203-231.

Hosmer, W. and Lemeshow, S. (1989). *Applied Logistic Regression.* New York Wiley.

Jemal, H. and Wolde Mariam, G.(1995). Baseline Nutrition Survey of Region 13, Harari.*Ethiopian Nutritional Institute*, Report 38/ENI.

John, H.A. and Forrest D.N. (1984). *Linear Probability, Logit and Probit Models.* SAGE Publications, Inc. U.S.A.

Kamalamma, G. (1996). *Health and nutritional Status in India.* New Delhi, India, APH Publishing Corporation, x, p. 214-221.

Katz, J., West.K.P, Tarwotjo,I. and Sommer, A. (1989). The importance of age in Evaluating. Anthropometric Indices for predicting mortality. *American Journal of Epidemology.*130(6):1219-1226.

Lamontagne, J.F., Engle P.L. and Zeitlin, M.F.(1998). Maternal employment, child care,

and nutritional status of 12-18 months old children in Manayua, Nicaragua. *Social Science and Medicine Journal.* 46(3):403-414.

Lindtjorn, B. and Alemu, T. (1997). Intra-household correlations of nutritional status in rural Ethiopia. *International Journal of Epidemology.* 26(1):160-165.

Lulu, M. (1996). Health and Behavioural Determinants of Morbidity. *Journal of public health* 110:4 215-219.

Martorell, R., Revera. J., Kaplowitz, T. and pollitt, E. (1991). Long –term

Walterlow, J.C., Buzina, R., Keller, W., Lane, J., Nichaman, M. and Tanner, J. (1977). The Presentation and use of Height and weight data for Comparing the Nutritional Status of Groups Of Children under the age of Ten years. *Bulletin of World health Organization.*

Measuring WHO (1947). Changes in Nutritional Status. Geneva.

Wolfe, B. L. and Behrman, J.R. (1982). Determinants of child mortality and nutrition in developing country. *Journal of Development Economy.* 11:163 –193.

Wolfe, B.L. and Behrman, J.R. (1987). Women's schooling and children's health: Are the effects robust with adult sibling control for the women's childhood background?:, *Journal of Health Economics.*V. 8. 3:83-98.

Zlotkin, S.H. (1991). Neonatal Nutrition. In: Linder Maria C. (ed.), *Nutritional Biochemistry and Metabolism with Clinical Applications.* Second edition. Prentice Hall International Inc.

Table 7: Pearson's Chi-square Test Statistics (NUT- STAT)

VARIABLES	CHI-SQUARE	DF	P-VALUE	VAR – LABELS
ADDIS-AB	88.85197	1	0.00000	ADDIS ABABA
AFFAR	0.00247	1	0.96033	AFFAR
AMHARA	270.23132	1	0.00000	AMHARA
BENSHAG	7.98199	1	0.00472	BENSHANGULI/GUMUZ
BOIL-WAT	39.25650	1	0.00000	BOIL WATER
CHILS-05	79.39703	5	0.00000	CHILDREN BELOW 5 YEARS
DIRE-DAW	109.75097	1	0.00000	DIRE DAWA
DISPOS	387.48082	1	0.00000	DISPOSAL PLACE
GAMBLA	1.86470	1	0.17208	GAMBELLA
H13-SEX	347.67113	1	0.00000	CHILD SEX
H15-RLG	35.33003	1	0.00000	RELIGION OF PARENTS
HARARI	29.27197	1	0.00000	HARARI
HD-AGE	50.76132	4	0.00000	AGE OF HOUSEHOLD HEAD
HD-EDUC	823.70260	1	0.00000	LITRACY OF HHLD HEAD
HD-EMPL	414.05946	1	0.00000	EMPLOYMENT STATUS/HEAD
HD-HLT	19.08601	1	0.00001	HEALTH STATUS/HEAD
HDOCCU	423.36801	1	0.00000	OCCUPATION/HEAD
HEAL-DIS	331.28373	1	0.00000	DISTANCE TO HEALTH FACILT
HHLDS-S	48.39241	1	0.00000	HOUSEHOLD SIZE
INCOME	163.86581	1	0.00000	INCOME OF HOUSEHOLD
LATRINE	759.18160	1	0.00000	TOILET CONDITION
N50-AGE	3615.26009	4	0.00000	AGE OF CHILD
N59-GIV	28.07279	1	0.00000	FOOD GIVEN AFTER BRITH
N60-BRS	28.58794	1	0.00000	AGE BREASTHEEDING START
N61- BEG	264.55596	1	0.00000	BREASTFEEDING NOW
N63-FOD	753.27927	1	0.00000	FOOD GENEN LAST 2 WEEKS
OROMIYA	110.94996	1	0.00000	OROMIYA
OWN-DWL	215.76082	1	0.00000	HOUSING UNIT OCCUPIED
SNNP	2.78469	1	0.09517	SNNP
SOMALIE	0.03308	1	0.85568	SOMALIE
SOUR-WAT	1011.53327	1	0.00000	SOURCE OF WATER
SPAGE	65.00073	4	0.00000	MOTHER/SPOUSE AGE
SPEDUC	1297.11669	1	0.00000	MOTHER/SPOUSE L/STATUS
SPEMP	132.33529	1	0.00000	MOTHER/SP. EMPLOYMENT
TIGRAY	85.42244	1	0.00000	TIGRAY
URB-RUR	622.87017	1	0.00000	URBAN/RURA RESDIENCE
N51-ORD	311.55070	8	0.00000	BIRTH ORDER
SPHLT	10.13717	1	0.00145	MOTHER/SPOUSE HEALTH

Table 8: Pearson's Chi-square Test Statistics (IMM-ST)

VARIABLES	CHI-SQUARE	DF	P-VALUE	VAR – LABELS
ADDIS-AB	214.57200	1	0.00000	ADDISABABA
AFFAR	294.55422	1	0.00000	AFFAR
BENSHAG	86.60967	1	0.00000	BENSHANGULI/GUMUZ
AMHARA	7.91790	1	0.00000	AMHARA
BOIL-WAT	32.19210	1	0.00000	BOIL WATER
CHILS-05	18.00974	5	0.00293	CHILDREN BELOW 5 YEARS
DIRE-DAW	254.07654	1	0.00000	DIRE DAWA
DISPOS	1253.66761	1	0.00000	DISPOSAL PLACE
GAMBLA	14.88851	1	0.00011	GAMBELLA
H13-SEX	0.08059	1	0.77650	CHILD SEX
H15-RLG	73.48389	1	0.00000	RELIGION OF PARENTS
HARARI	244.53074	1	0.00000	HARARI
HD-AGE	35.46602	5	0.00000	AGE OF HOUSEHOLD HEAD
HD-EDUC	1407.35912	1	0.00000	LITRACY OF HHLD HEAD
HD-EMPL	1329.89217	1	0.00000	EMPLOYMENT STATUS/HEAD
HD-HLT	10.78118	1	0.00103	HEALTH STATUS/HEAD
HDOCCU	1958.45504	1	0.00000	OCCUPATION/HEAD
HEAL-DIS	3641.77136	1	0.00000	DISTANCE TO HEALTH FACILT
HHLDS-S	11.00284	1	0.00091	HOUSEHOLD SIZE
INCOME	137.04980	1	0.00000	INCOME OF HOUSEHOLD
LATRINE	1628.48825	1	0.00000	TOILET CONDITION
N50-AGE	186.71710	4	0.00000	AGE OF CHILD
N59-GIV	26.74607	2	0.00000	FOOD GIVEN AFTER BRITH
N60-BRS	6.11402	1	0.01341	AGE BREASTHEEDING START
N61- BEG	14275804	1	0.00000	BREASTFEEDING NOW
N63-FOD	91.96638	1	0.00000	FOOD GENEN LAST 2 WEEKS
OROMIYA	1.05283	1	0.30486	OROMIYA
OWN-DWL	1024.01195	1	0.00000	HOUSING UNIT OCCUPIED
SNNP	222.45116	1	0.00000	SNNP
SOMALIE	125.43258	1	0.00000	SOMALIE
SOUR-WAT	2368.42369	1	0.00000	SOURCE OF WATER
SPAGE	16.85182	4	0.00207	MOTHER/SPOUSE AGE
SPEDUC	1936.53949	1	0.00000	MOTHER/SPOUSE L/STATUS
SPEMP	139.36493	1	0.00000	MOTHER/SP. EMPLOYMENT
TIGRAY	811.93994	1	0.00000	TIGRAY
URB-RUR	2636.56554	1	0.00000	URBAN/RURA RESDIENCE
N51-ORD	130.64323	8	0.00000	BIRTH OF CHILD
SPHLT	0.16403	1	0.68547	MOTHER/SPOUSE HEALTH

Table 9: Pearson's Chi-square Test Statistics (DIARRHEA)

VARIABLES	CHI-SQUARE	DF	P-VALUE	VAR – LABELS
ADDIS-AB	27.04889	1	0.00000	ADDISABABA
AFFAR	17.33553	1	0.00003	AFFAR
AMHARA	3.36633	1	0.06654	AMHARA
BENSHAG	28.59301	1	0.00000	BENSHANGULI/GUMUZ
BOIL-WAT	6.515000	1	0.01070	BOIL WATER
CHILS-05	16.82349	5	0.00485	CHILDREN BELOW 5 YEARS
DIRE-DAW	333.26461	1	0.00000	DIRE DAWA
DISPOS	58.97094	1	0.00000	DISPOSAL PLACE
GAMBLA	9.49749	1	0.00206	GAMBELLA
H13-SEX	14.50115	1	0.00014	CHILD SEX
H15-RLG	101.91321	1	0.00000	RELIGION OF PARENTS
HARARI	0.71173	1	0.39887	HARARI
HD-AGE	93.0787	4	0.00000	AGE OF HOUSEHOLD HEAD
HD-EDUC	0.01575	1	0.90012	LITRACY OF HHLD HEAD
HD-EMPL	95.26322	1	0.00000	EMPLOYMENT STATUS/HEAD
HD-HLT	4017.31098	1	0.00000	HEALTH STATUS/HEAD
HDOCCU	96.47850	1	0.00000	OCCUPATION/HEAD
HEAL-DIS	43.01841	1	0.00000	DISTANCE TO HEALTH FACILT
HHLDS-S	17.32235	1	0.00000	HOUSEHOLD SIZE
INCOME	1.75490	1	0.18526	INCOME OF HOUSEHOLD
LATRINE	197.17517	1	0.00000	TOILET CONDITION
N50-AGE	17.43232	4	0.00159	AGE OF CHILD
OROMIYA	0.75051		0.13796	OROMIYA
OWN-DWL	2020059	1	0.00000	HOUSING UNIT OCCUPIED
SNNP	81.49141	1	0.00018	SNNP
SOMALIE	14.01744	1	0.00000	SOMALIE
SOUR-WAT	48.38057	1	0.00000	SOURCE OF WATER
SPAGE	193.80966	4	0.00000	MOTHER/SPOUSE AGE
SPEDUC	138.10928	1	0.00000	MOTHER/SPOUSE L/STATUS
SPEMP	127.89511	1	0.00000	MOTHER/SP. EMPLOYMENT
STUNC	104.63930	1	0.00000	STUNTED
TIGRAY	23.57589	1	0.00000	TIGRAY
UNDC	217.14484	1	0.00000	UNPERWEIGHT
URB-RUR	26.24385	1	0.00000	URBAN/RURA RESDIENCE
WASTC	828.33324	1	0.00000	WASTED
SPHLT	890.77961	1	0.00000	MOTHER/SPOUSE HEALTH

Table 10: Goodness of Fit Statistics for the Model Using Enter Method (NUT_STAT)

-2log likelihood (Constant Model)	32222.54	Percentage of correct classification	
-2log likelihood (Saturated Model)	25420.189	Normal	78.86%
Goodness-of-Fit	24758.028	Malnourished	85.93%
Model Chi-Square	6802.351	Overall	83.64%
Degrees of freedom	40		

---------------------- Variables in the Equation ----------------------

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
URB_RUR	0.3443	0.0788	19.0907	1	0.0000	0.0141	1.4110
HH_SIZE	-0.0168	0.0101	2.7516	1	0.0972	-0.0048	0.9834
H13_SEX	0.2204	0.0605	13.2789	1	0.0003	0.0187	1.2466
H15_RLG	-0.0826	0.0362	5.2173	1	0.0224	-0.0100	0.9207
N50_AGE	0.0584	0.0024	591.3536	1	0.0000	0.1352	1.0602
N51_ORD	0.0183	0.0146	1.5710	1	0.2101	0.0000	1.0185
N59_GIV	0.2086	0.0516	16.3504	1	0.0001	0.0211	1.2319
N60_BRS	0.0944	0.0376	6.3139	1	0.0120	0.0116	1.0990
N61_BEG	-0.8897	0.0450	391.3306	1	0.0000	-0.1099	0.4108
N63_FOD	0.5151	0.0800	41.4514	1	0.0000	0.0350	1.6738
HDAGE	0.0139	0.0026	29.1697	1	0.0000	0.0290	1.0140
HDEMPL	-0.0666	0.0527	1.6001	1	0.2059	0.0000	0.9356
HD_HLT	0.0663	0.0338	3.8606	1	0.0494	0.0076	1.0686
HD_EDUC	0.8969	0.0709	159.9797	1	0.0000	0.0700	2.4519
SPAGE	-0.0457	0.0032	204.0555	1	0.0000	-0.0792	0.9554
SPEMP	-0.0976	0.0381	6.5605	1	0.0104	-0.0119	0.9070
SPEDUC	0.3391	0.1180	8.2563	1	0.0041	0.0139	1.4037
SPHLT	-0.0384	0.0338	1.2930	1	0.2555	0.0000	0.9623
SOUR_WAT	0.6265	0.0387	261.7465	1	0.0000	0.0898	1.8710
HEAL_DIS	-0.0188	0.0361	0.2712	1	0.6025	0.0000	0.9814
LNINC_12	-0.2754	0.0159	299.3752	1	0.0000	-0.0961	0.7592
CHILD_05	-0.1177	0.0257	21.0106	1	0.0000	-0.0243	0.8890
TIGRAY	0.6980	0.0723	93.2901	1	0.0000	0.0532	2.0097
AFFAR	0.0130	0.1045	0.0155	1	0.9008	0.0000	1.0131
AMHARA	0.5069	0.0522	94.2612	1	0.0000	0.0535	1.6601
OROMIYA	-0.1713	0.0430	15.8285	1	0.0001	-0.0207	0.8426
SOMALIE	0.0555	0.0823	0.4545	1	0.5002	0.0000	1.0571
BENSHANG	-0.1410	0.1297	1.1817	1	0.2770	0.0000	0.8685
GAMBELA	-0.0630	0.0728	0.7475	1	0.3873	0.0000	0.9390
HARARI	-0.1739	0.1011	2.9574	1	0.0855	-0.0055	0.8404
ADDIS_AB	-0.0434	0.0871	0.2485	1	0.6181	0.0000	0.9575
DIRE_DAW	-1.0631	0.0985	116.5710	1	0.0000	-0.0596	0.3454
INT_1	-0.0072	0.0020	12.8407	1	0.0003	-0.0183	0.9928
INT_2	0.0014	0.0004	10.5889	1	0.0011	0.0163	1.0014
INT_3	0.2528	0.0913	7.6611	1	0.0056	0.0133	1.2877
INT_4	0.5686	0.0819	48.1819	1	0.0000	0.0379	1.7657
INT_5	-0.0669	0.0736	0.8276	1	0.3630	0.0000	0.9353
INT_6	-0.0214	0.0883	0.0588	1	0.8084	0.0000	0.9788
INT_7	-0.1223	0.0136	80.9292	1	0.0000	-0.0495	0.8849
INT_8	0.4326	0.0667	42.0363	1	0.0000	0.0352	1.5413
Constant	1.1715	0.1789	42.8957	1	0.0000		

Table 11: Goodness of Fit Statistics for the Model Using Forward (NUT_STAT)

-2log likelihood (Constant Model)	32222.54
-2log likelihood (Saturated Model)	25435.835
Goodness-of-Fit	247771.617
Model Chi-Square	6786.705
Degrees of freedom	26
Percentage of correct classification	
Normal	78.43%
Malnourished	85.96%
Overall	83.52%

---------------------- Variables in the Equation ----------------------

Variable	B	S.E.	Wald	Df	Sig	R	Exp(B)
URB_RUR	0.4108	0.0623	43.4795	1	0.0000	0.0589	1.5080
H13_SEX	0.2070	0.0599	11.9256	1	0.0006	0.0176	1.2300
H15_RLG	-0.0807	0.0351	5.2730	1	0.0217	-0.0101	0.9225
N50_AGE	0.0577	0.0022	711.4098	1	0.0000	0.1484	1.0594
N59_GIV	0.2129	0.0513	17.2313	1	0.0000	0.0217	1.2372
N60_BRS	0.0947	0.0372	6.4806	1	0.0109	0.0118	1.0994
N61_BEG	-0.8987	0.0447	404.9289	1	0.0000	-0.1118	0.4071
N63_FOD	0.4950	0.0425	135.5993	1	0.0000	0.0644	1.6405
HDAGE	0.0139	0.0025	29.8106	1	0.0000	0.0294	1.0140
HD_EDUC	0.8452	0.0575	216.4215	1	0.0000	0.0816	2.3284
SPAGE	-0.0464	0.0031	224.3651	1	0.0000	-0.0831	0.9546
SPEMP	-0.1008	0.0376	7.1825	1	0.0074	-0.0127	0.9041
SPEDUC	0.3178	0.0771	16.9731	1	0.0000	0.0216	1.3741
SOUR_WAT	0.6240	0.0359	302.1391	1	0.0000	0.0965	1.8664
LNINC_12	-0.2794	0.0151	343.2777	1	0.0000	-0.1029	0.7562
CHILD_05	-0.1289	0.0232	30.9417	1	0.0000	-0.0300	0.8790
TIGRAY	0.7188	0.0683	110.8988	1	0.0000	0.0581	2.0520
AMHARA	0.5305	0.0464	130.7449	1	0.0000	0.0632	1.6998
OROMIYA	-0.1501	0.0362	17.2167	1	0.0000	-0.0217	0.8606
DIRE_DAW	-1.0382	0.0952	118.8164	1	0.0000	-0.0602	0.3541
INT_1	-0.0073	0.0020	13.5002	1	0.0002	-0.0189	0.9927
INT_2	0.0016	0.0003	24.1641	1	0.0000	0.0262	1.0016
INT_3	0.2643	0.0691	14.6531	1	0.0001	0.0198	1.3026
INT_4	0.5381	0.0707	57.9068	1	0.0000	0.0417	1.7127
INT_7	-0.1151	0.0105	120.5680	1	0.0000	-0.0607	0.8913
INT_8	0.4804	0.0574	69.9355	1	0.0000	0.0459	1.6167
Constant	1.1913	0.1454	67.1066	1	0.0000		

Table 12: ****MULTIPLE REGRESSION ****

Equation Number 1 Dependent Variable. NUT_STAT nutritional status

Multiple R	.47586
R Square	.22645
Adjusted R Square	.22566
Standard Error	.41179

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	26	1268.61112	48.79274
Residual	25556	4333.66157	.16958

F = 287.73524 Signif F = .0000

------------------------- Variables in the Equation -------------------------

Variable	B	SE B	Beta	Tolerance	VIF	T	Sig T
URB_RUR	0.0529	0.0101	0.0398	0.5276	1.8950	5.2550	0.0000
H13_SEX	0.0943	0.0052	0.1002	0.9940	1.0060	18.1560	0.0000
H15_RLG	-0.0262	0.0060	-0.0272	0.7804	1.2810	-4.3720	0.0000
N50_AGE	0.0095	0.0002	0.3482	0.4914	2.0350	44.3620	0.0000
N51_ORD	-0.0053	0.0012	-0.0270	0.7811	1.2800	-4.3450	0.0000
N60_BRS	0.0127	0.0060	0.0121	0.9257	1.0800	2.1230	0.0338
N61_BEG	-0.1436	0.0073	-0.1534	0.4920	2.0330	-19.5570	0.0000
N63_FOD	0.1048	0.0076	0.0893	0.7231	1.3830	13.7990	0.0000
HDAGE	0.0019	0.0004	0.0490	0.2689	3.7200	4.6190	0.0000
HDEMPL	-0.0351	0.0083	-0.0285	0.6748	1.4820	-4.2490	0.0000
HD_HLT	0.0089	0.0054	0.0092	0.9732	1.0280	1.6510	0.0987
HD_EDUC	0.0631	0.0063	0.0670	0.6755	1.4800	10.0040	0.0000
SPAGE	-0.0073	0.0005	-0.1485	0.2693	3.7130	-14.0070	0.0000
SPEMP	-0.0181	0.0061	-0.0177	0.8530	1.1720	-2.9760	0.0029
SPEDUC	0.1518	0.0080	0.1326	0.6249	1.6000	19.0500	0.0000
SOUR_WAT	0.1068	0.0066	0.1053	0.7114	1.4060	16.1380	0.0000
LNINC_12	-0.0428	0.0025	-0.1098	0.7119	1.4050	-16.8450	0.0000
CHILD_05	-0.0236	0.0040	-0.0336	0.9448	1.0580	-5.9310	0.0000
TIGRAY	0.1422	0.0109	0.0782	0.8401	1.1900	13.0290	0.0000
AFFAR	-0.0286	0.0170	0.0096	0.9368	1.0680	1.6830	0.0923
AMHARA	0.1085	0.0077	0.0906	0.7244	1.3800	14.0210	0.0000
SOMALIE	0.0444	0.0133	0.0194	0.8945	1.1180	3.3320	0.0009
GAMBELA	0.0201	0.0120	0.0098	0.8862	1.1280	1.6790	0.0932
ADDIS_AB	0.0255	0.0154	0.0097	0.8792	1.1370	1.6510	0.0988
DIRE_DAW	-0.1623	0.0172	-0.0543	0.9106	1.0980	-9.4140	0.0000
SNNP	0.0316	0.0072	0.0283	0.7351	1.3600	4.4160	0.0000
(Constant)	0.6371	0.0265				24.0020	0.0000

Table 13: Goodness of Fit Statistics for the Model Using Enter (DIARRHEA)

-2log likelihood (Constant Model)	31943.197	Percentage of correct classification	
-2log likelihood (Saturated Model)	24904.340	Diarrhea	70.49%
Goodness-of-Fit	24485.755	No Diarrhea	84.65%
Model Chi-Square	7038.857	Overall	79.86%
Degrees of freedom	40		

Variable	B	S.E.	Wald	Df	Sig	R	Exp(B)
URB_RUR	-0.1535	0.1436	1.1423	1	0.2852	0.0000	0.8577
HH_SIZE	-0.0023	0.0183	0.0155	1	0.9009	0.0000	0.9977
H13_SEX	0.1082	0.0922	1.3765	1	0.2407	0.0000	1.1142
H15_RLG	-0.2999	0.0364	67.9471	1	0.0000	-0.0454	0.7409
N50_AGE	0.0002	0.0010	0.0497	1	0.8236	0.0000	1.0002
HDAGE	0.0023	0.0018	1.5239	1	0.2170	0.0000	1.0023
HDOCCU	-0.0769	0.0603	1.6277	1	0.2020	0.0000	0.9259
HDEMPL	0.1082	0.0610	3.1480	1	0.0760	0.0060	1.1143
HD_HLT	1.4817	0.0489	917.1591	1	0.0000	0.1693	4.4006
HD_EDUC	-0.2450	0.0490	25.0156	1	0.0000	-0.0268	0.7827
SPAGE	-0.0292	0.0025	138.4061	1	0.0000	-0.0653	0.9712
SOUR_WAT	0.0125	0.0447	0.0776	1	0.7805	0.0000	1.0125
SPEMP	0.2888	0.0339	72.7107	1	0.0000	0.0470	1.3349
SPEDUC	0.3677	0.0587	39.2236	1	0.0000	0.0341	1.4443
SPHL	-1.4013	0.0607	532.9780	1	0.0000	-0.1289	0.2463
HEAL_DIS	0.0555	0.0355	2.4396	1	0.1183	0.0037	1.0571
OWN_DWL	0.5710	0.0652	76.7225	1	0.0000	0.0484	1.7700
LNINC_12	-0.0681	0.0152	19.9559	1	0.0000	-0.0237	0.9342
CHILD_05	-0.0194	0.0240	0.6521	1	0.4194	0.0000	0.9808
TIGRAY	0.1817	0.0661	7.5617	1	0.0060	0.0132	1.1993
AFFAR	-0.1726	0.1093	2.4955	1	0.1142	-0.0039	0.8414
AMHARA	0.2409	0.0494	23.8143	1	0.0000	0.0261	1.2724
OROMIYA	0.2287	0.0450	25.8520	1	0.0000	0.0273	1.2570
SOMALIE	0.3104	0.0823	14.2340	1	0.0002	0.0196	1.3639
BENSHANG	-0.1361	0.1426	0.9119	1	0.3396	0.0000	0.8727
GAMBELA	0.3436	0.0727	22.3435	1	0.0000	0.0252	1.4099
HARARI	0.2998	0.1112	7.2636	1	0.0070	0.0128	1.3496
ADDIS_AB	0.1643	0.1107	2.2027	1	0.1378	0.0025	1.1785
DIRE_DAW	2.3412	0.1091	460.4411	1	0.0000	0.1198	10.3935
DISPOS	0.0553	0.0632	0.7649	1	0.3818	0.0000	1.0568
LATRINE	-0.2803	0.0546	26.3766	1	0.0000	-0.0276	0.7555
BIOL_WAT	0.1513	0.0836	3.2758	1	0.0703	0.0063	1.1633
STANC	0.1658	0.0356	21.6873	1	0.0000	0.0248	1.1803
WASTC	0.8489	0.0470	325.6053	1	0.0000	0.1007	2.3371
UNDC	0.3371	0.0329	104.6735	1	0.0000	0.0567	1.4009
INT_1	0.0405	0.0955	0.1797	1	0.6716	0.0000	1.0413
INT_2	-0.0311	0.0650	0.2294	1	0.6320	0.0000	0.9694
INT_3	1.0108	0.0705	205.2755	1	0.0000	0.0798	2.7478
INT_4	-0.0189	0.0197	0.9209	1	0.3372	0.0000	0.9813
INT_5	0.1600	0.0658	5.9138	1	0.0150	0.0111	1.1736
Constant	-0.9111	0.2304	15.6343	1	0.0001		

Table 14: Goodness of Fit Statistics for the Model Using Forward (DIARRHEA)

-2log likelihood (Constant Model)	31943.197
-2log likelihood (Saturated Model)	24923.528
Goodness-of-Fit	24473.775
Model chi-square	7019.669
Degrees of freedom	22
Percentage of correct classification	
Diarrhea	70.16%
No Diarrhea	84.57%
Overall	79.70%

---------------------- Variables in the Equation ----------------------

Variable	B	SE	Wald	Df	Sig	R	Exp(B)
H13_SEX	0.1253	0.0310	16.3144	1	0.0001	0.0212	1.1335
H15_RLG	-0.3102	0.0327	89.7310	1	0.0000	-0.0524	0.7333
HDEMPL	0.1460	0.0543	7.2337	1	0.0072	0.0128	1.1572
HD_HLT	1.4782	0.0489	915.6296	1	0.0000	0.1691	4.3851
HD_EDUC	-0.2511	0.0353	50.5544	1	0.0000	-0.0390	0.7779
SPAGE	-0.0271	0.0020	184.9570	1	0.0000	-0.0757	0.9733
SPEMP	0.2971	0.0334	79.0621	1	0.0000	0.0491	1.3460
SPEDUC	0.3814	0.0581	43.0973	1	0.0000	0.0359	1.4643
SPHL	-1.4017	0.0606	534.7585	1	0.0000	-0.1291	0.2462
OWN_DWL	0.5412	0.0624	75.2234	1	0.0000	0.0479	1.7181
LNINC_12	-0.0724	0.0149	23.7378	1	0.0000	-0.0261	0.9302
AFFAR	-0.4188	0.1044	16.0966	1	0.0001	-0.0210	0.6578
BENSHANG	-0.3725	0.1391	7.1741	1	0.0074	-0.0127	0.6890
DIRE_DAW	2.0709	0.1031	403.4026	1	0.0000	0.1121	7.9318
SNNP	-0.2528	0.0384	43.3903	1	0.0000	-0.0360	0.7766
LATRINE	-0.3018	0.0513	34.5683	1	0.0000	-0.0319	0.7395
STANC	0.1688	0.0355	22.6177	1	0.0000	0.0254	1.1839
WASTC	0.8504	0.0469	328.3397	1	0.0000	0.1011	2.3406
UNDC	0.3346	0.0326	105.1107	1	0.0000	0.0568	1.3973
INT_3	1.0137	0.0705	206.7033	1	0.0000	0.0801	2.7558
INT_4	-0.0277	0.0061	20.4992	1	0.0000	-0.0241	0.9727
INT_5	0.1573	0.0657	5.7302	1	0.0167	0.0108	1.1703
Constant	-0.5471	0.1483	13.6153	1	0.0002		

Table 15: **** MULTIPLE REGRESSION ****

Equation Number 1 Dependent variable.. DIARRHEA
Multiple R .58542
R Square .34272
Adjusted R Square .34214
Standard Error .38371

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	22	1914.74476	87.03385
Residual	24941	3672.12606	.14723

F = 591.13203 Signif F = .0000

------------------------- Variables in the Equation -------------------------

Variable	B	SE B	Beta	Tolerance	VIF	T	Sig T
URB_RUR	-0.029000	0.008450	-0.021127	0.695442	1.438	-3.432	0.0006
H13_SEX	0.023639	0.004863	0.024981	0.997956	1.002	4.861	0.0000
H15_RLG	-0.049582	0.005199	-0.051169	0.915333	1.092	-9.536	0.0000
HDAGE	6.11E-04	2.91E-04	0.014586	0.544869	1.835	2.097	0.0360
HD_HLT	0.245428	0.005258	0.258104	0.861731	1.160	46.673	0.0000
HD_EDUC	-0.038454	0.005639	-0.039490	0.785829	1.273	-6.819	0.0000
SPAGE	-0.006054	3.90E-04	-0.108477	0.540052	1.852	-15.529	0.0000
SPEMP	0.047256	0.005338	0.047531	0.914321	1.094	8.853	0.0000
SPEDUC	0.049216	0.008734	0.034423	0.706211	1.416	5.635	0.0000
SPHLT	0.349809	0.005292	0.365255	0.863061	1.159	66.100	0.0000
OWN_DWL	0.080703	0.009618	0.048380	0.792695	1.262	8.391	0.0000
LNINC_12	-0.011527	0.002336	-0.028444	0.793246	1.261	-4.935	0.0000
CHILD_05	-0.010356	0.003659	-0.014644	0.984361	1.016	-2.830	0.0047
AFFAR	-0.070702	0.015937	-0.023240	0.960262	1.041	-4.436	0.0000
BENSHANG	-0.067019	0.021318	-0.016252	0.986093	1.014	-3.144	0.0017
DIRE_DAW	0.370151	0.015786	0.123853	0.944582	1.059	23.448	0.0000
SNNP	-0.034020	0.005971	-0.030106	0.943886	1.059	-5.698	0.0000
LATRINE	-0.033674	0.007852	-0.026511	0.689550	1.450	-4.288	0.0000
BIOL_WAT	0.032006	0.013047	0.012680	0.986444	1.014	2.453	0.0142
STANC	0.025693	0.005225	0.026780	0.888446	1.126	4.917	0.0000
WASTC	0.154243	0.005819	0.138099	0.970898	1.030	26.507	0.0000
UNDC	0.057624	0.005234	0.060623	0.869242	1.150	11.010	0.0000
(Constant)	0.153078	0.026876				5.696	0.0000

Table 16: Goodness of Fit Statistics for the Model Using Enter (IMM_STAT)

-2log likelihood (Constant Model)	31345.094	Percentage of correct classification	
-2log likelihood (Saturated Model)	19452.513	2-4 types Immunized	85.04%
Goodness-of-Fit	24733.292	Not Immunized	78.35%
Model Chi-Square	11892.581	Overall	82.04%
Degrees of freedom	38		

-------------------- Variables in the Equation --------------------

Variable	B	S.E.	Wald	Df	Sig	R	Exp(B)
URB_RUR	-6.6827	2.0089	11.0657	1	0.0009	-0.0170	0.0013
HH_SIZE	0.0458	0.0110	17.2134	1	0.0000	0.0220	1.0469
H13_SEX	-0.1191	0.1631	0.5328	1	0.4654	0.0000	0.8877
H15_RLG	-0.2484	0.0429	33.4993	1	0.0000	-0.0317	0.7801
N50_AGE	0.0215	0.0026	67.2002	1	0.0000	0.0456	1.0217
N51_ORD	-0.0393	0.0108	13.1986	1	0.0003	-0.0189	0.9615
HDAGE	-0.0070	0.0029	5.9387	1	0.0148	-0.0112	0.9930
HDOCCU	0.2012	0.0739	7.4040	1	0.0065	0.0131	1.2229
HDEMPL	-0.2853	0.0730	15.2756	1	0.0001	-0.0206	0.7518
HD_HLT	-0.2503	0.0385	42.2645	1	0.0000	-0.0358	0.7786
HD_EDUC	0.4717	0.1872	6.3503	1	0.0117	0.0118	1.6028
SPAGE	0.0086	0.0040	4.6822	1	0.0305	0.0093	1.0087
SPEMP	0.2795	0.0401	48.6708	1	0.0000	0.0386	1.3225
SPEDUC	1.9586	0.2511	60.8374	1	0.0000	0.0433	7.0895
SPHLT	-0.0232	0.0384	0.3653	1	0.5456	0.0000	0.9771
HEAL_DIS	-3.3858	2.0083	2.8422	1	0.0918	-0.0052	0.0339
OWN_DWL	-0.1787	0.0982	3.3159	1	0.0686	-0.0065	0.8363
LNINC_12	0.2010	0.0182	121.5531	1	0.0000	0.0618	1.2226
AGE_SQR	-0.0002	4.26E-05	18.3188	1	0.0000	-0.0228	0.9998
CHILD_05	-0.0888	0.0297	8.9526	1	0.0028	-0.0149	0.9150
TIGRAY	2.3500	0.0883	708.2952	1	0.0000	0.2420	10.4856
AFFAR	-1.3520	0.1434	88.8377	1	0.0000	-0.0526	0.2587
AMHARA	0.5901	0.0559	111.3938	1	0.0000	0.0591	1.8042
OROMIYA	0.5062	0.0502	101.7647	1	0.0000	0.0564	1.6590
SOMALIE	-0.7517	0.1014	54.9988	1	0.0000	-0.0411	0.4716
BENSHANG	1.4655	0.1760	69.2958	1	0.0000	0.0463	4.3296
GAMBELA	-0.0832	0.0867	0.9216	1	0.3371	0.0000	0.9201
HARARI	2.1827	0.1538	201.5109	1	0.0000	0.0798	8.8700
ADDIS_AB	0.3168	0.1376	5.2994	1	0.0213	0.0103	1.3728
DIRE_DAW	2.2759	0.1457	244.1513	1	0.0000	0.0879	9.7363
INT_1	0.1395	0.1621	0.7407	1	0.3895	0.0000	1.1497
INT_2	0.1104	0.1751	0.3976	1	0.5283	0.0000	1.1168
INT_3	0.2726	0.2146	1.6124	1	0.2042	0.0000	1.3133
INT_4	0.1315	0.1361	0.9344	1	0.3337	0.0000	1.1406
INT_5	-0.0063	0.0788	0.0063	1	0.9366	0.0000	0.9938
INT_6	0.0061	0.0171	0.1253	1	0.7234	0.0000	1.0061
INT_7	-0.2194	0.0354	38.3196	1	0.0000	-0.034	0.8030
INT_8	0.6974	0.0532	171.8032	1	0.0000	0.0736	2.0086
Constant	3.5368	2.0186	3.0699	1	0.0798		

Table 17: Goodness of Fit Statistics for the Model Using Forward (IMM_STAT)

-2log likelihood (Constant Model)	31345.094
-2log likelihood (Saturated Model)	19468.202
Goodness-of-Fit	24977.735
Model Chi-Square	11876.891
Degrees of freedom	26
Percentage of correct classification	
2-4 types Immunized	85.04%
Not Immunized	78.29%
Overall	82.02%

---------------------- Variables in the Equation ----------------------

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
URB_RUR	-6.6038	2.0413	10.4659	1	0.0012	-0.0164	0.0014
HH_SIZE	0.0455	0.0106	18.4880	1	0.0000	0.0229	1.0465
H15_RLG	-0.2392	0.0426	31.5035	1	0.0000	-0.0307	0.7872
N50_AGE	0.0214	0.0026	67.2208	1	0.0000	0.0456	1.0216
N51_ORD	-0.0364	0.0093	15.2370	1	0.0001	-0.0205	0.9643
HDOCCU	0.2148	0.0731	8.6440	1	0.0033	0.0146	1.2396
HDEMPL	-0.2833	0.0727	15.1837	1	0.0001	-0.0205	0.7533
HD_HLT	-0.2531	0.0368	47.3728	1	0.0000	-0.0380	0.7764
HD_EDUC	0.6063	0.0406	223.406	1	0.0000	0.0840	1.8336
SPEMP	0.2737	0.0395	47.9438	1	0.0000	0.0383	1.3149
SPEDUC	2.2860	0.1289	314.3359	1	0.0000	0.0998	9.8356
HEAL_DIS	-3.4537	2.0428	2.8584	1	0.0909	-0.0052	0.0316
LNINC_12	0.1993	0.0182	119.9725	1	0.0000	0.0613	1.2205
AGE_SQR	-0.0002	4.24E-05	18.1759	1	0.0000	-0.0227	0.9998
CHILD_05	-0.0890	0.0293	9.2304	1	0.0024	-0.0152	0.9149
TIGRAY	2.3523	0.0870	731.0497	1	0.0000	0.2458	10.5097
AFFAR	-1.3389	0.1425	88.2842	1	0.0000	-0.0525	0.2621
AMHARA	0.5966	0.0533	125.2101	1	0.0000	0.0627	1.8158
OROMIYA	0.5243	0.0472	123.3161	1	0.0000	0.0622	1.6893
SOMALIE	-0.7374	0.0993	55.1277	1	0.0000	-0.0412	0.4783
BENSHANG	1.4817	0.1754	71.3788	1	0.0000	0.0470	4.4003
HARARI	2.2095	0.1525	209.8598	1	0.0000	0.0814	9.1113
ADDIS_AB	0.3254	0.1363	5.6988	1	0.0170	0.0109	1.3846
DIRE_DAW	2.3012	0.1443	254.3562	1	0.0000	0.0897	9.9864
INT_7	-0.2240	0.0343	42.725	1	0.0000	-0.0360	0.7993
INT_8	0.7024	0.0530	175.5387	1	0.0000	0.0744	2.0185
Constant	3.2576	2.0477	2.5308	1	0.1116		

Table 18: * * * * **MULTIPLE REGRESSION** * * * *

Listwise Deletion of Missing Data

Equation Number 1 Dependent Variable.. IMM_STAT immunization status

Block Number 1. Method: Enter

Multiple R	.64483
R Square	.41581
Adjusted R Square	.41507
Standard Error	.38027

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	29	2343.09837	80.79650
Residual	22765	3291.89948	.14460

F = 558.74495 Signif F = .0000

------------------------- Variables in the Equation -------------------------

Variable	B	SE B	Beta	Tolerance	VIF	T	Sig T
URB_RUR	-0.018542	0.010830	-0.013652	0.403598	2.478	-1.712	0.0869
HH_SIZE	0.003629	0.001349	0.015887	0.736423	1.358	2.691	0.0071
H15_RLG	-0.038567	0.005943	-0.037665	0.761745	1.313	-6.489	0.0000
HDAGE	-7.19E-04	2.64E-04	-0.016046	0.739716	1.352	-2.724	0.0064
HDOCCU	0.019918	0.010184	0.016774	0.348902	2.866	1.956	0.0505
HDEMPL	-0.028523	0.009191	-0.021275	0.546061	1.831	-3.103	0.0019
HD_HLT	-0.039869	0.005236	-0.038991	0.978770	1.022	-7.615	0.0000
HD_EDUC	0.099473	0.006152	0.098314	0.694047	1.441	16.168	0.0000
SOUR_WAT	0.097290	0.007306	0.087091	0.599935	1.667	13.316	0.0000
SPEMP	0.036743	0.005969	0.033511	0.865757	1.155	6.155	0.0000
SPEDUC	0.172581	0.008574	0.130651	0.609117	1.642	20.129	0.0000
HEAL_DIS	0.393333	0.005885	0.395385	0.733260	1.364	66.835	0.0000
OWN_DWL	0.019470	0.010368	0.011673	0.664145	1.506	1.878	0.0604
LNINC_12	0.026209	0.002544	0.064436	0.656036	1.524	10.303	0.0000
AGE_SQR	1.88E-05	2.69E-06	0.036200	0.955792	1.046	6.986	0.0000
CHILD_05	-0.009601	0.004134	-0.012530	0.881597	1.134	-2.322	0.0202
TIGRAY	0.591740	0.010310	0.319165	0.829887	1.205	57.396	0.0000
AFFAR	-0.242594	0.016289	-0.078805	0.916508	1.091	-14.893	0.0000
SOMALIE	-0.177288	0.013169	-0.073237	0.867169	1.153	-13.463	0.0000
BENSHANG	0.113065	0.021606	0.027000	0.964021	1.037	5.233	0.0000
GAMBELA	-0.093315	0.011552	-0.042567	0.924061	1.082	-8.078	0.0000
HARARI	0.199667	0.016893	0.062543	0.916447	1.091	11.819	0.0000
ADDIS_AB	-0.030799	0.014618	-0.011440	0.870360	1.149	-2.107	0.0351
DIRE_DAW	0.216698	0.016522	0.070505	0.888078	1.126	13.116	0.0000
SNNP	-0.087897	0.006663	-0.073514	0.826296	1.210	-13.192	0.0000
DISPOS	0.016783	0.009157	0.011251	0.680967	1.468	1.833	0.0668
LATRINE	0.030292	0.008127	0.025408	0.552220	1.811	3.727	0.0002
STANC	0.008853	0.005178	0.008852	0.957425	1.044	1.710	0.0873
WASTC	-0.019530	0.006886	-0.014581	0.970936	1.030	-2.836	0.0046
(Constant)	0.110534	0.027002				4.094	0.0000