MALNUTRITION AND GENDER BIAS: A CASE STUDY FROM BANGLADESH

By

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ABSTRACT

Bangladesh is one of the few countries in the world where female children experience higher mortality than their male counterpart, especially after the neonatal period. Various factors, including discrimination against female children in intra-family food distribution and healthcare, are thought to be possible mechanisms that result in inferior health and less chance of survival for females than males. This analysis provides an empirical study on child malnutrition using data collected from rural households in Bangladesh. It also investigates the impact of gender bias on child nutritional status. This study utilizes different measures of nutritional status to identify the existence of gender bias. Further, in the presence of gender bias, this study tries to identify the major factors giving rise to this discrimination. A sample group of the children between 0-59 months old is employed for the analysis. The study emphasizes three major aspects of child nutrition. The study explores the consequences of different socioeconomic determinants on both long-term (height-for-age) and short-term (weight-for-height) measures of child nutritional status and whether these consequences vary across different age groups. This thesis further extends itself to investigate the evidence of supposed discrimination against girls with respect to both long-term and short-term measures of child nutritional status. The study also concentrates on the influences of these socioeconomic factors on the existing gender discrimination. The major finding in this study is that there is a discrimination against girls for long-run nutritional status and that some socioeconomic factors and social beliefs and values are responsible for this discrimination.

CHAPTER ONE: INTRODUCTION

Bangladesh is one of the few countries in the world where female children experience higher mortality than male children, especially after the neonatal period. Various factors, including discrimination against female children in intra-family food distribution and healthcare, are thought to be possible mechanisms that result in inferior health and less chance of survival for females than males. Health and development professionals are striving to find ways to deal with the problems of gender inequality in health and survival. While health-intervention programs have shown positive impacts on overall nutritional status and survival of children, it is largely unknown how effective these factors are in reducing gender inequalities in health.

Since 1986, Bangladesh has reduced the proportion of underweight children in the country by 20 percent, and stunting in children under five has dropped by 25 percent. During this period, infant mortality dramatically decreased from 94 to an estimated 77 deaths per 1,000 live births while that rate in 1974 was 140 (The Bangladesh Bureau of Statistics, 2004).

Yet despite this progress, levels of malnutrition in Bangladesh remain the highest in the world, with 600 to 700 children dying of malnutrition-related causes in Bangladesh every day. Nearly 60 percent of under five children are underweight and more than half are stunted; low birth weight incidence is an estimated 45 percent—perhaps the highest in the world. Almost half of women suffer from chronic energy deficiency, while more than

70 percent of pregnant women are anemic, resulting in unhealthy children (The Bangladesh Bureau of Statistics, 2004).

The theory of the household represents the household not as an undifferentiated unit, but as a unit of cooperation as well as of inequality and internal discrimination (Sen, 2001). Bangladesh is no exception to this theory. Discrimination against girls is deeply rooted in the customs and traditions of Bangladesh. Girls in Bangladesh, especially in the rural areas and in conservative families, are often subject to gender discrimination. Many parents desire a male child because the male child carries the family name.

Biologically, girl babies are healthier than boy babies, but as they often face discrimination from the earliest stages of life through childhood and into adulthood in many developed and developing countries, the health status of girls is often significantly worse than that of boys (United Nations Development Project, 2000).

The sequence of gender discrimination typically is as follows:

- Girl children are breastfed for a shorter time period than their brothers. One explanation suggests that this enables mothers to try to become pregnant more quickly with a son.

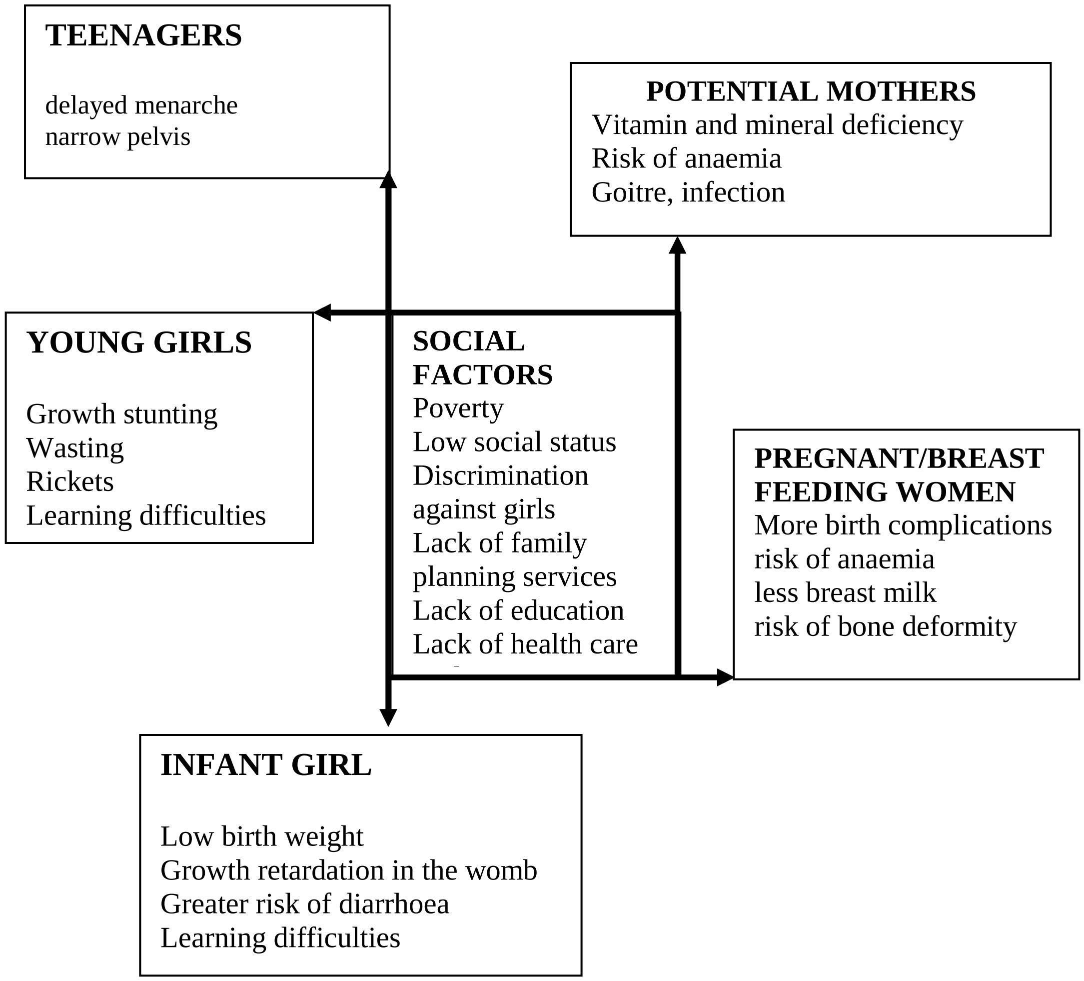
- Older girls are discriminated with respect to access to food.

- Typically, adult men and male children are fed first in the family. Women eat only when the men have finished, and their mother-in-law has eaten. Whatever is left is divided between the mother and female children. Females receive less, and poorer quality food (UNDP, 2000).

Because of this unequal treatment, girls are more severely malnourished than boys. The discrimination against girl children is closely linked to malnutrition and at the most basic level, when girls' health suffers, future generations are at risk. Girls who are malnourished and unhealthy grow into women who are malnourished and unhealthy. These women give birth to malnourished and unhealthy children, and the cycle continues.

Figure 1.1 shows that a vicious cycle of undernourishment and ill-health is set in motion: poorly nourished mothers giving birth to low birth-weight babies. Low birth-weight babies have a 3-4 times greater risk of dying from diarrhoeal diseases, acute respiratory infections, and if not immunized, measles. They are more likely to be malnourished at 1 year, and by around 5 years of age, low-birth-weight babies may have had more cyclic episodes of infection and malnutrition and may be severely stunted. This will be carried into adult life. Baby girls born with a low birth weight are, in addition, likely to go through childhood and adolescence with a disadvantage in terms of feeding and care, and grow up to be severely undernourished adult women in poor health (World Health Organization, 1996).

Figure 1.1: The Vicious Circle of Malnutrition



Source: (World Health Organization, 1996).

This thesis provides an empirical study on child malnutrition using data collected for three years (1996, 1997 and 1998) from rural households in Bangladesh. It also investigates the impact of gender bias on child nutritional status. Further, in the presence of gender bias, this study tries to identify the major factors giving rise to this discrimination. A sample group of the children between 0-59 months old is employed for the analysis. There are three research questions:

1. What are the affects of socio-economic determinants on both long-term and short-term measures of child nutritional status? What are their affects on different age groups?
2. In there any evidence of discrimination against girls as measured by both long-term and short-term measure of child nutritional status?
3. What are influences of these socio-economic factors on the existing gender discrimination?

In the next chapter, studies on malnutrition and gender bias are discussed. After that a brief background of Bangladesh is given. Chapter 4 discusses the reduced form function of child nutrition. Chapter 5 talks about the data used in this study and the methodology used for econometric analysis. Chapter 6 gives the results found for the three research questions. And, finally Chapter 7 talks about the summary of the results, conclusion and policy implications for this study.

CHAPTER TWO: LITERATURE REVIEW

This chapter first provides the definition of nutritional status and discusses its determinants. Secondly, it focuses on past studies concentrating on nutritional status and on gender discrimination.

2.1. Definition of Nutritional Status

"Nutrition" may be defined as a process whereby living organisms utilize food to produce enough energy and obtain adequate nutrients for growth, development and normal functioning of organs and tissues of the body to enjoy a healthy life. Adequate nutrition is a precondition of good health. For children to grow into healthy and productive adults, they need to be well nourished and healthy. Nutritional status of children is a manifestation of a host of factors, including household access to food and the distribution of this food within the household, availability and utilization of health services, and the care provided to the child (Christiaensen and Alderman, World Bank, October 2001).

"Malnutrition" refers to a number of diseases, each with a specific cause related to inadequate intake of one or more nutrients (for example, protein, iodine or calcium) and how each is characterized by cellular imbalance between the supply of nutrients and energy on the one hand, and the body's demand for them to ensure growth, maintenance, and specific functions, on the other (World Health Organization, WHO, November, 1996).

The most common form of malnutrition, and the focus of this study, is Protein Calorie Malnutrition (PCM) caused by insufficient intake of calories or protein to meet basic body's energy growth requirement. PCM is a very common phenomenon in Bangladesh, where approximately 45% of the children suffer from chronic malnutrition (UNICEF, 1998).

2.2 Determinants of Child Nutritional Status and Causes of Malnutrition

2.2.1 Conceptual Framework

The analysis presented in this study is based on the conceptual framework (Figure 2.1) of The United Nations Children's Fund (UNICEF 1998) and the subsequent extended model of care presented in Engle, Menon, and Haddad (1999) to explain the factors that can have an influence on child nutritional status and the causes of malnutrition are discussed in figure 2.2. This framework divides these determinants into three major levels, which are inter-related to each other. It recognizes three levels of causality corresponding to immediate, underlying, and basic determinants of child nutritional status (Smith and Haddad, 2001).

The Immediate Determinants

The immediate determinants of child's nutritional status are the child's dietary intake, including energy, protein, fat and micronutrients, and health status. These immediate determinants are themselves interrelated making it complex to actually determine which one occurred first in some cases. It is often easy to identify a malnourished child or a high incidence of malnutrition in a community because deficient dietary intake and poor health directly manifest themselves at the individual level. Although malnutrition can be reduced based on an obvious recognition of its immediate causes, long term improvements can only be assured if the analysis is extended to another level, that is if the underlying determinants are also investigated.

The Underlying Determinants

The immediate causes of malnutrition are affected by household level underlying determinants. The underlying determinants are various and also interrelated. They are also mostly associated with the under-fulfillment of children's specific basic needs. They are grouped into three main sectors: household food security, health environment and services, and maternal and child care. Although the first two precondition adequate dietary intake and the control of common diseases among children, they do not satisfactorily ensure them. There must be in addition a system that guarantees that food and health services are appropriately used for the benefit of the children. These essential services are included in the maternal and childcare sector. In that effect, all three underlying determinants are equally important.

The 1996 World Food Summit defined food security as "a situation in which all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life"

(FAO 1996). As opposed to simple availability of food, household food security is determined by financial, physical and social access to food and by its effective utilization. Thus, it is essential to acknowledge that an increase in national food production does not guarantee household food security. Likewise, food availability at the household level does not ensure access for an individual on account of factors that include intra-household allocation and culture. Food security is the main solution of malnutrition has been a central paradigm for years, but while food is crucial, it is not the only factor to consider.

The health environment and services are also important underlying determinants of child nutritional status. Water unavailability indirectly affects nutrition because it increases the workload of women thus reduces time availability for childcare. Also, lack of safe water sanitation directly affects health, food preparation, and general hygiene. Curative and preventive health services are needed to guarantee good health for all community members. It is often the case that countries incorporate their nutrition service in the Ministry of Health not conscious that malnutrition is not only the responsibility of the health department.

Care is defined as “the provision in the household and the community of time, attention, and support to meet the physical, mental, and social needs of the growing child and other household members” (Engle 1992). The caregiver must have sufficient education, time, and support to be able to offer care to a child. The factors for good care include education, physical and mental health, autonomy, workload and social support (Engle, Menon and Haddad 1999). The concept of care was emphasized at the 1992

International Conference of Nutrition in Rome where efforts were made to explain the reason why malnutrition persists even with enough food and presence of an adequate health environment.

Inequality in society is one of the most underlying causes of malnutrition. Poverty leads to many economic and social problems along with malnutrition. According to the World Bank's most recent definition poverty includes not only material deprivation (measured by income and consumption) but also low achievements in education and health (World Bank WDR 2002). The notion of poverty is also extended to include vulnerability, exposure to risk and powerlessness. Poverty has severe consequences for child malnutritional status. Poor people do not have access to key assets and they also cannot meet basic needs of life. The poor are unable to attain food security and do not have the resources for care. While caused by poverty, malnutrition goes through a vicious circle passed from generation to generation. Malnourished girls tend to later give birth to malnourished children, who in turn will most likely be intellectually deficient, thus have diminished productive and creative capacities (UNICEF 1998).

The Basic Determinants

The underlying determinants of child malnutrition described in the previous section are in turn affected by basic determinants, a group of factors that relate to resources, their control and use. The three major types of resources taken into account are human, economical and organizational. Human resources consist of people and their skills, motivation, knowledge and time. Economic resources include among others land, assets, and income. Organizational resources can be made up, for example, of formal and non-formal institutions. The availability and control of these resources are connected to both the historical processes of a country or community and to other outside processes such as economic dependency or imposed structural adjustment programs. These processes can be classified into four groups of basic determinants of malnutrition:

- Ecological and technical conditions of production (e.g., environment, levels of technology and people skills);
- Social conditions of production (e.g., power structure, division of labor)
- Political factors (e.g., structure, function, policies, legal system of the state);
- Ideological factors (e.g., cultural preferences, beliefs).

The level and interaction of these various factors explain the existing availability and control of resources in a country or community. In turn, the availability and control of these resources explain the extent of realization of the three necessary conditions (food, health and care) for good child nutrition.

The UNICEF conceptual chart shows that malnutrition is not simply an isolated case of poor diet, but is also affected by social, economic, cultural and political behavior. Immediate and direct causes are attributed to a lack of appropriate dietary intake and infection. Although poverty reduces the variety and quantity of foods available, behavioral practices also have an impact. Other underlying causes usually associated with the environmental issues include poor hygiene, lack of access to safe water, lack of or utilization of medical care, access to education and the role of the caregiver.

The major causes of child malnutrition can be classified into food insecurity, unhygienic environment, and poor caring practices (UNICEF, 1998). In Bangladesh, lack of food is not the only cause of malnutrition; lack of proper caring practices for children, improper nutrition in neonatal stage are also important contributing factors (UNICEF 1998).

2.3 Studies on the Determinants of Child Nutritional Status

Smith and Haddad (2001) undertook a cross-country evaluation of child malnutrition in developing countries around the world over the period 1970-96. According to the author socio-economic factors like the quality of countries' health services, women's education and women's status relative to men, and national food availability have a great influence on child nutrition throughout the developing countries. Christiaensen and Alderman (World Bank, October 2001), conducted a similar study evaluating child malnutrition in Ethiopia. This paper used the conditional or quasi-reduced nutrition demand approach to household and particular attention was devoted to the role of nutritional knowledge, sanitary conditions etc., as key determinants of chronic child malnutrition in the study area. The estimated results identified household resources, parental education, food prices and maternal nutritional knowledge as significant determinants of chronic child malnutrition in Ethiopia.

Evidence of the relationship between income and child nutrition is mixed. Sahn (1994) used consumption expenditures as a proxy of permanent income and found that it is an important determinant of chronic malnutrition (height-for-age) in Cote d' Ivoire, but conversely Barrera (1990) did not find any indication of correlation between income and child malnutrition in a study undertaken in Phillipines. Thomas and Strauss (1992) and Sahn and Alderman (1997) found significant income effects in Brazil and Mozambique, respectively, only for older children. In a study by Pal (1999), ordered probit estimates of nutritional status suggested that higher per capita income improves the nutritional status of preschool children in rural India. However, the effect of income disappears when instruments of longer-run income (per capita landholding and expenditure) are employed instead.

Some authors have found a strong negative impact of family size on child outcomes (Knodel et al, 1990); others have found it to be less important (Mock and Leslie, 1986) or even positive (Chernochovsky, 1984). In articulating the relationship between family size and children's nutritional status, the author emphasized the issue of competition for parental resources.

The study (Desai, Population Studies, 1995) focused on the relationship between family and the welfare of individual members of the family, particularly children showed the result that mother's education, urban residence, and the index of household wealth have a strong positive impact on child's height-for-age. It also explained that the change in the standardize score of height-for-age associated with the addition of a sibling aged less than five years has a statistically negative impact on the child's height-for-age standardized score. The literature also suggested another explanation of negative consequences for health due to crowding and greater exposure to diseases, such as measles, chickenpox, or diarrhea.

Caldwell (1979) contended that the schooling process creates a less fatalistic attitude towards life, and that it ultimately causes parents to be more conscious and more effective in combating their children's illness. Cleland (1990) explained that maternal education improves the bargaining strengths of the adult female in her household. In a study from Brazil, Thomas, Strauss and Henriques (1991) reported that the impact of maternal education on child height is almost entirely explained by indicators of access to information such as watching television, reading papers, an listening to the radio. Amar-Klemesu (2000) shows that maternal education is the principal predictor of good care practices. Strauss (2001) pointed out the income effect of parental education: it increases resources available for rearing children. As for paternal education, it is believed that it affects child anthropometry through the distribution of resources and the ability to use different types of health services more effectively (Schultz 1984).

Smith et. al. (2002) focused on the importance of women's status for child nutrition in four developing regions: South Asia, Sub-Saharan Africa, and Latin America and the Caribbean. They found higher women's status has a significant, positive effect on children's nutritional status in all four regions. Their findings also include that in South Asia and in Sub-Saharan Africa increases in women's status have a strong influence on both the long and short-term nutritional status of children. But in Latin America and the Caribbean, women's status has a positive effect only on children's short-term nutritional status and only in those households in which women's relative decision making power is very low.

Children from households that lack proper health environment such as water supply and inadequate sanitation facilities are at greater risk of diarrheal diseases, malaria and cholera (World Bank 2000). Every one of these conditions seriously contributes to malnutrition. Gwatkin, Guillot and Heuveline (1999) discovered that the two biggest causes of death among the poorest 20% of the world's developing countries (as classified by national GDP per capita) are respiratory infections and diarrheal diseases. The importance of household health environment variables is stressed in Strauss and Thomas (1995) and UNICEF (1998).

2.4 Studies on Gender Discrimination

There has been a resurgence of interest in recent years in the issue of male-female differences in mortality and in the evidence provided by population age structures for female survival disadvantages (Hill et. al., 1995). Hill et. al., (1995) in their study tried to measure the extent of gender differences in infant and child mortality and to explore the reasons for these differences in terms of gender differences in health status, disease incidence, preventive and curative treatment, and social status. This study found that the girl disadvantage is largest for the young child (1-4 years). This may be explained by the fact that in this age range, child care is more important than genetic factors in determining mortality risks, suggesting the importance of "gender" (referred when discussing the effects of sociocultural behaviors that vary between boys and girls and contribute to their mortality differentials) as opposed to "sex" (referred when describing male-female mortality differences or discussing largely biological effects) factors in the girl disadvantage. This study also found girl disadvantages in infancy.

Arnold (1992) uses data from a series of comparable national surveys to examine parental preferences for sons in the context of sex differences in mortality and other indicators of child health. He finds little link between son preference and gender differences in the indicators of child health care available in the DHS data sets.

In cases from North India and Bangladesh, a marked gender imbalance in health expenditure on children has been recorded (Dasgupta, 1987). Females also appear to be less often referred for allopathic treatment than are males (Harriss,1995). Chen et al, and Koenig and D'Sousa in Bangladesh and McNeill in Tamil Nadu, all conclude that while there is no gender difference in the incidence of disease, there may be gender differences in the duration and intensity of illness. Gender differences in sanitation have also been hypothesized as having an impact on morbidity in rural (north) India where the quantity, source, and degree of (fecal) contamination of bathing and clothes-washing water may be gender specific. Gender differences in the quality of and expenditure upon clothing may also influence health status. So, clearly scenarios of gender bias in basic demographic indicators (such as life expectancy, mortality, and the sex ratio) in South Asia exists.

Barbara Harriss (1995) claimed that food shares within the household are unequal throughout the entire world because of social and cultural factors, like religion. Wheeler (1984) noted that the allocation of food and nutrients within the South Asian household is determined by cultural and social factors. He explained that in this part of the world, men usually take a disproportionate share of household food resources and that women and children get less than adult men and compared to what they need physiologically. Women permit this distribution and therefore acquiesce to the continuation of female malnutrition in the younger generation.

The food cycle is shaped by culturally defined needs associated with equally culturally defined stages of life (Greenough, 1982). From birth, the gender of an infant establishes its cultural needs. While a child is breast-fed he or she gets a nutritionally balanced diet and a boosted immune system. Evidence from villages as dispersed as Morinda in Punjab, Matlab thatna in Bangladesh, Karnataka and DR Kupam in Tamil Nadu suggests that male babies are breast-fed longer than females (Barbara Harris).

2.5 Studies in Bangladesh

2.5.1 Studies on the Determinants of Child Nutritional Status

Shahidur Rashid (1999) focused on the influence of natural calamities like floods, and on food prices and on child nutrition in rural households in Bangladesh. He tested the argument of Dasgupta (1994) and Foster (1995) that the fluctuation in child growth in rural areas of the developing countries reflect the fact that rural households are unable to smooth consumption due to their inability to obtain credit as well as other socio-economic constraints. This study further finds that nutritional status of girls is more adversely affected than the nutritional status of boys by natural calamities.

Natural disasters such as prolonged droughts, floods, and cyclones threaten food security in many developing countries, directly reducing agricultural production and food supply and, hence, child nutrition (Del Ninno et. al, IFPRI 2001). They claim that

Bangladesh has some of the highest child malnutrition rates in the world and during the flood the situation is worsened. During the floods, meeting the basic needs of children becomes quite difficult, due to damage to homes and the increased efforts needed to obtain food and cook it, obtain safe water, and maintain a clean living environment. Some mothers had difficulty obtaining or preparing supplementary food for their children, and others were producing insufficient breast milk owing to their own reduced food consumption.

2.5.2 Studies on Gender Discrimination

There is some evidence of gender discrimination in access to health care and cumulative effects of discrimination against women that probably underlie their lower life expectancy relative to men (Kabeer, 1989). Chen et al. (1981) finds that boys are more likely to be brought to clinics and hospitalized than girls, despite equal incidence of infection and the availability of free clinical care in Bangladesh. This study also found that girls mortality risks as much as 60 percent higher than those for boys after the neonatal period and girls are fed less and suffered more malnutrition.

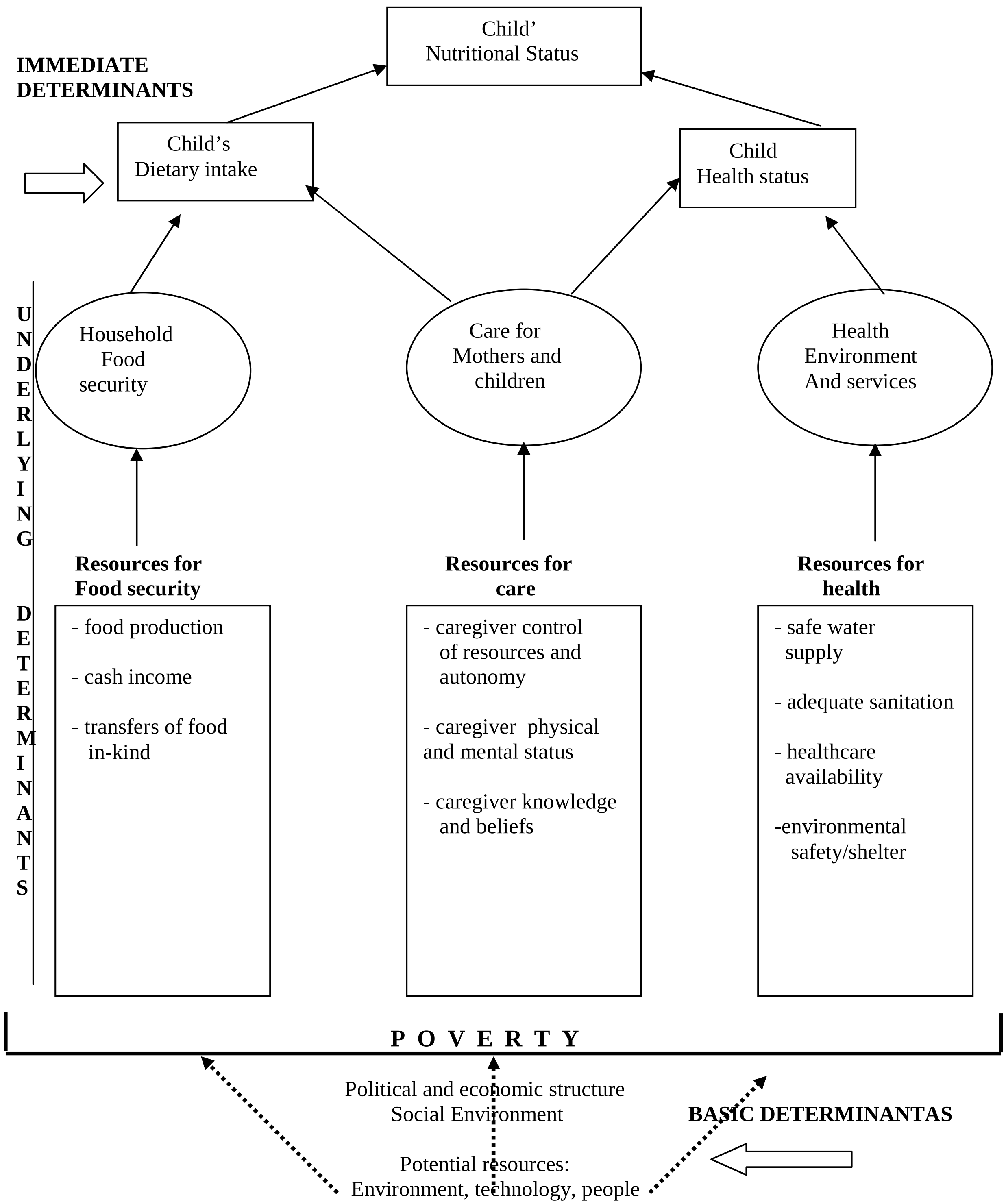
D'Souza and Chen (1980) in their study demonstrate that female biological advantage is only evident in the first month after birth, when it may be assumed that social discrimination has not yet had effect. By the end of the first year, the biological pattern is reversed. In the first four years of life, half as many more girls are likely to dies as boys. In fact, apart from death by drowning, UNICEF notes that girls in this age group accounted for a greater number of deaths from all other causes.

Choudhury et al. (2000) in their study also found that gender discrimination against girls in rural Bangladesh and they mentioned that the socioeconomic and health service factors, which had positive impact on nutritional status could not improve the condition of female children which indicate the deep-rooted nature of the inferior position of women. In their study it is observed that the beneficial effect of mother’s education was much greater for boys than girls. All these indicate the deep-rooted nature of the inferior position of women in this society in general. They suggested that an improvement of girls’ health to a level of boys may need broad-based interventions beyond health, aimed at changing value systems and behavior of the population. According to this study, female children were more likely to be severely malnourished that male children and this is consistent with higher female childhood mortality than males in Bangladesh.

Another study done by Hallman describes the gender bias of intrahousehold food allocation. A large number of studies have addressed this. Many focus on the inrahousehold distribution of nutrients. Of the 43 studies reiewed by Smith et al (2000), pro-male bias in nutrient allocations appears to be most prevalent in South Asia. According to this study boys are more favored in the distribution of nonfood health inputs, such as health care. Furthermore, this is the only area of the world in which girls have higher child mortality rates than boys. This study used 47 villages in three rural areas in Bangladesh and showed that individual resources controlled by husbands and wives have differential impacts on preschoolers by child gender.

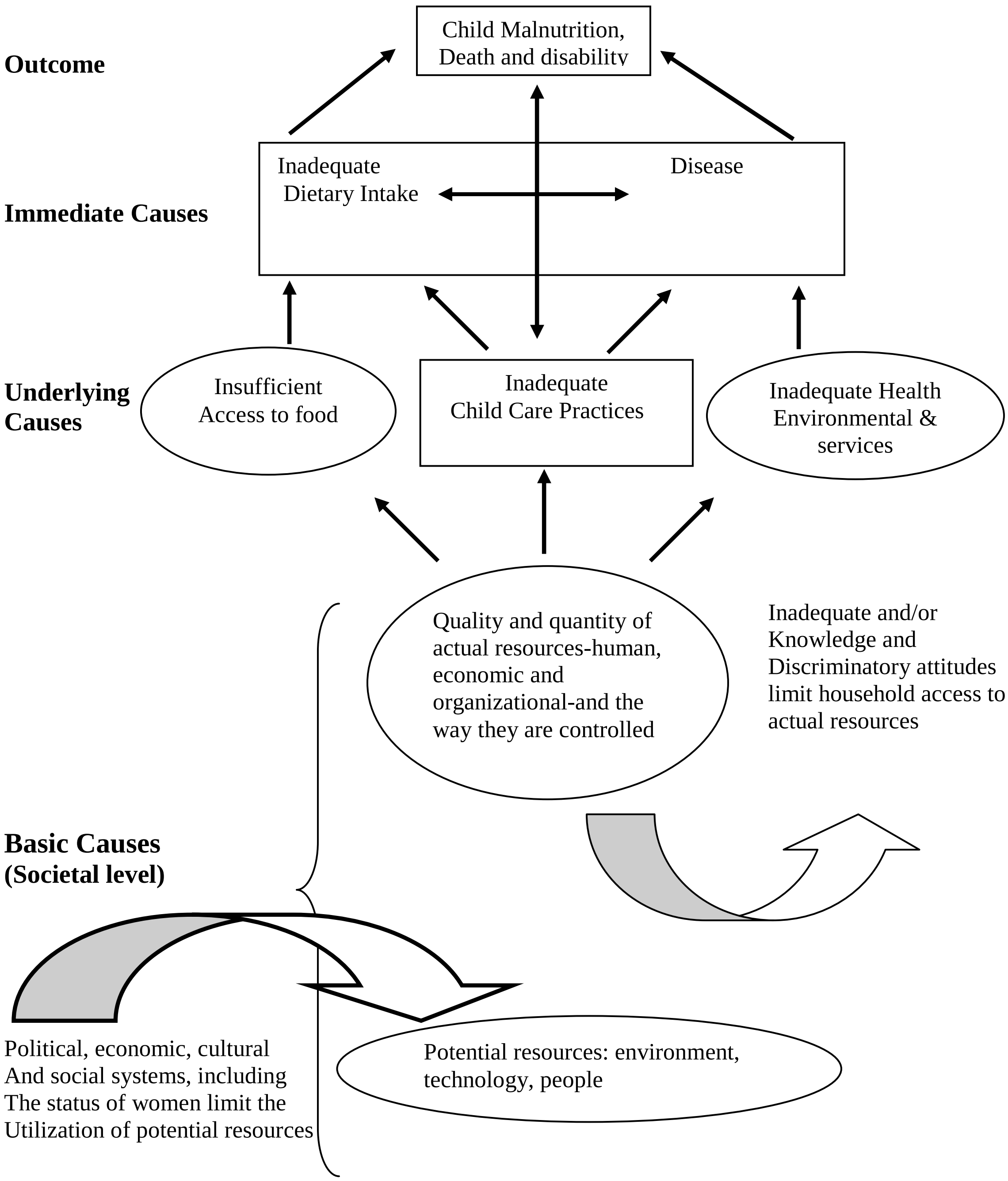
In summary, the above studies show that some socio-economic determinants like income, household size play a role on child nutritional status. Natural calamities and environmental factors of the household also affect child nutritional status. Gender bias is a result of a combination of cultural and social factors, e.g. food allocation, health care system, health environment (sanitation system used) in the household.

Figure 2.1: Determinants of Nutritional Status



Sources: Smith and Haddad (2000).

Figure 2.2: Causes of Malnutrition



Source: UNICEF (1998).

CHAPTER THREE: BANGLADESH: BACKGROUND CHARACTERISTICS

Bangladesh typifies many South Asian countries whose economy depends heavily on agriculture, and figures among the least developed countries in the world. This chapter provides some relevant background information about a nation that has gone through major changes since its independence in 1971. After the overview presented in the first section, the two following sections briefly review Bangladesh's agricultural policy and its current nutrition conditions. The last section will focus on food consumption patterns across Bangladesh.

3.1 Bangladesh Overview

3.1.1. Geography and Climate

Bangladesh has an area of 144,000 square kilometers and extends 820 kilometers north to south and 600 kilometers east to west. It is bordered on the west, north, and east by a 2,500-kilometer land frontier with India and, in the southeast, by a short land and water frontier (193 kilometers) with Burma. On the south is a highly irregular deltaic coastline of about 600 kilometers, broken by many rivers and streams flowing into the Bay of Bengal. The territorial waters of Bangladesh extend 12 nautical miles, and the exclusive economic zone of the country is 200 nautical miles (World Facts Index, 2000).

Bangladesh has a subtropical monsoon climate characterized by wide seasonal variations in rainfall, moderately warm temperatures, and high humidity. Heavy rainfall is characteristic of Bangladesh. About 80 percent of Bangladesh's rain falls during the monsoon season months. Natural calamities, such as floods, tropical cyclones, tornadoes, and tidal bores—destructive waves or floods caused by flood tides rushing up estuaries—ravage the country, particularly the coastal belt, almost every year. Between 1947 and 1988, thirteen severe cyclones hit Bangladesh, causing enormous loss of life and property.

Harsh natural disasters and mass population cause many environmental and social problems like limited access to clean water, prevalence of water-born diseases, water pollution especially of fishing areas resulting from pesticides, a decrease in underground table tables, soil degradation and deforestation (Central Intelligence Agency, 2000).

3.1.2 People

Bangladesh is the eighth most populous country in the world (USAID), with a population estimated at more than 138 million (July 2003), and a density of 965 people per square kilometer and a growth rate of 2.06%, one of the most densely populated countries in the world (Central Intelligence Agency 2000). 36% of the population is below the poverty line. The majority of the population lives in rural areas, placing severe demographic pressure on an agro-pastoral environment. The age structure of Bangladesh' population is 34%: 0-15 years, 59%:15-64 years and 3%: 65 years and over. (World Statistics and Atlases 2002).

3.1.3 Socioeconomic Conditions

Bangladesh has an agrarian economy with 32% of GDP coming from the Agriculture Sector. Major agricultural products are rice, jute, wheat, potato, pulses, tobacco, tea and sugarcane. The country is the largest exporter of jute and jute goods in the world. Readymade garments are among the most exported items. Tea, frozen shrimp, fish, leather goods and handicrafts are also major exportable commodities.

The country has undergone a major shift in its economic policies in recent years. At Bangladesh's birth, the country embraced socialism as the economic ideology with a dominant role for the public sector. But, since the mid-seventies, it undertook a major restructuring towards establishing a market economy with emphasis on private sector-led economic growth.

During the nineties, the country completed a major stabilization program which has reduced inflation as well as fiscal and current account deficits and established a healthy foreign exchange reserve position with low and sustainable debt-service liabilities. With modest economic growth, the basic indicators related to health, education and poverty have all shown sustained improvement. According to the World Bank estimate, Bangladesh has the 36th largest economy in the world in terms of GNP based on the purchasing power parity method of valuation, and the 54th largest in terms of nominal GNP in U.S. Dollars (Global Policy Network, 2003).

In the past decade, Bangladesh enjoyed a positive growth rate in GDP and other macroeconomic indicators have been favorable. However, Bangladesh continues facing the problems of illiteracy, malnutrition, unavailability of medical facilities. Sustainable economic development is one of the major goals of Bangladesh. Political turmoil has hampered the expected growth pattern in Bangladesh.

Although the GDP has grown rapidly, the high rate of population growth has minimized per-capita growth. In addition, major impediments to growth include frequent cyclones and floods, inefficient state-owned enterprises, inadequate port facilities, a rapidly growing labor force that cannot be absorbed by agriculture, delays in exploiting energy resources (natural gas), insufficient power supplies, and slow implementation of economic reforms.

About 45% of Bangladeshis are estimated to live below the poverty line. Urban poverty is increasing alarmingly although poverty has decreased nationally and in rural areas. Inequality is also increasing in all three areas i.e., national, urban and rural areas. But, urban inequality is much higher than national and rural because of the social structure.

Roughly 24% of Bangladeshis live in urban areas, in huge slums and conditions of massive social deprivation. The rest of the population depends directly or indirectly on agriculture for its livelihood. Garment manufacture, a major export, has created new opportunities for a growing female workforce. This has increased women’s economic independence though the working conditions are notoriously poor.

The literacy rate (age 15 and over can read and write) of Bangladesh is only 43.1% of the total population. Males have a higher literacy rate (53.9%) compared with females (31.8%).

Nutritional deficiencies, overcrowding, poor water and sanitation cause major health problems. Bangladesh's health indicators are especially disconcerting. In 2003, life expectancy at birth was estimated to be 61.33 while the country's fertility rate was quite high, at 3.17 children on average. Infant mortality rates are high, reaching 66.08 deaths per 1,000 births, well over that of other southeastern countries.

3.1.4 Agriculture

The economy of Bangladesh is primarily dependent on agriculture. About 84 percent of the total population live in rural area and are directly or indirectly engaged in a wide range of agricultural activities. About 63 percent of the labor force is employed in the agricultural sector.

The two main areas of agricultural production are food crops and food grains and they occupy 92 percent and 82 percent of the total cropped area respectively (Bangladesh Bureau of Statistics, 2000). Rice is predominant among the food crops and there are three major varieties of rice: Aman, Boro, and Aus.

Vegetables and fruit occupy a small portion of the total cropped area. Cash crops contribute very little in the total cropped area. Jute called "Golden Fiber in Bangladesh" is the only dominant cash crop among others such as cotton, sugar cane, and tobacco (Dayal, 1997).

3.1.5 Food Security and Nutritional Conditions

In Bangladesh, food insecurity is related to overpopulation that causes disappearance of croplands at a rate of 221 hectares a day. Apart from this, overpopulation, poverty, food access problems, climate variability and climate change, recurrent natural disasters and environmental degradation contribute to food insecurity in Bangladesh (Bangladesh Bureau of Statistics, 2000).

The human body requires about 40 nutrients that are supplied through food intake. Energy substrate, essential amino acids, polyunsaturated fat, vitamins, minerals and indigestible fiber are required to be a part of a balanced diet. But it is difficult for Bangladesh to follow the recommended daily allowance (RDA) since most people have access to a high carbohydrate based diet. (The Daily Star, 2000). The low figures of dietary intake represent mostly low-income population both in urban or rural show and their poor health. Which means that food availability is not the sufficient condition for food security; people also need sufficient food access.

Over the years the per capita consumption of food increased in Bangladesh. The overall change in nutritional status from 1993-84 to 1995-6 can be seen in daily food energy intake from 2100 to 2250 kilocalories and protein intake from 61 to 65 grams. But still, the malnutrition rate in Bangladesh is among the highest in the world (Nutrition Country Profiles, FAO). More than 54% of preschool-age children, equivalent to more than 9.5 million children, are stunted, 56% are underweight and more than 17% are wasted. Malnutrition among women is also extremely prevalent in Bangladesh. More than 50 percent of women suffer from chronic energy deficiency (Nutrition Country Profiles, FAO).

3.1.6 Food Consumption Patterns

Bangladeshis' daily food includes mostly rice and some wheat which contain high levels of carbohydrates. This makes up at least 60 percent of the daily diet (Nutrition Survey, 1996) and the remaining 40 percent of the diet consists of the following items in descending order—leafy and non-leafy vegetables, roots and tubers, fish, meat, milk and eggs, fruits, pulses, edible fat and oil, sugar and molasses, and salt.

Food supply depends on the monsoon and harvesting seasons. Rice is consumed mainly during the months following the harvest, from July and February, supplemented with wheat and potatoes from March and June. There are two lean seasons per year, from June to July, before the *aus* harvest and from October to November, before the *aman* harvest. During these periods, food prices increase and those who purchase entire or part of the consumption, such as landless laborers and small holders, need to reduce food intake. Their income also declines due to the decrease in the demand for fieldwork. In the lean season, therefore, the purchasing power of the poor tends to be severely eroded (Dayal 1997, Ahmed, Haggblade, and Chowdhury 2000).

CHAPTER FOUR: CONCEPTUAL FRAMEWORK

This chapter discusses the nutrition production function as defined for male and female children in order to derive a reduced-form nutrition function for male and female children. The function supplies a consistent statistical framework within which socioeconomic determinants of children's nutrition can be identified and factored into policy interventions accordingly.

4.1 The Model

The UNICEF conceptual framework discussed in chapter two can be effectively described in terms of a mathematical model. This mathematical model of household nutrient intake is an essential tool in understanding how the children are discriminated within a household and what are the internal and external forces to the household that affects discrimination. Thus, this facilitates the identification of the appropriate variables to be included in empirical analysis.

4.2 Economic and Econometric Model

4.2.1 Economic Model of Child Nutritional Status

According to Becker (1965,1974), Becker and Lewis (1973) and Becker and Tomes (1976), a major assumption is that the household as a decision-making unit is characterized by a single utility function that is maximized subject to a single budget constraint.

The basic concept for this analysis is a household decision model in which household members maximize utility, most often through some bargaining process, subject to nutrition provisioning functions, budget constraints and full-income constraints (Smith and Aduayom, 2003).[1] Let the family's preferences be defined over child nutritional status, N, goods directly consumed, and their leisure time as follows:
Utility functions can be specified as:

$$U_i(N_1,...,N_I,F_1,...,F_k,X_0,T_L), \quad i=1,...I, \qquad (1)$$

Where the N_i, i=1, …,I are members' nutrition provisioning functions, the F_k, k=1,…….K, are individual foods consumed by each member, X_0 is all non-food commodities and services consumed, and T_L is leisure time. Nutrition provisioning is the process through which goods, especially food, are combined with care time to provide for a person's nutritional health, or status. The nutrition provisioning function can be specified as:

$$N_i(Z_1,...,Z_J,X_{NO},T_N,\Omega_N), \quad i=1,...,I \qquad (2)$$

Here the Z_j, $j=1,...,J$ are nutrients such as calories, proteins and fats (the macronutrients) or vitamin A, Zinc, and Iron (micronutrients), all of which are derived from foods. The variable X_{NO} is non-food inputs into nutrition provisioning (e.g., medicines), T_N is time spent in nutrition provisioning (e.g., feeding a child) and where

$$\Omega = (\Omega_{ch},\Omega_{hh},\Omega_{co}) \qquad (3)$$

[1] The utility and nutrition provisioning functions are assumed to be continuously differentiable, increasing in all arguments, and strictly quasi-concave.

Here equation (3) can be defined as child characteristics like child sex, household characteristics like parent's educational level, etc.

The household will maximize the utility subject to the nutrition provisioning function (2) and the following:

$$T^h = T_w + T_c + T_l \qquad (4)$$

$$P_0 X_0 + P_N X_N = W_h T_w + E_h \qquad (5)$$

Equation (4) establishes that the household's time endowment (24 hours a day) is allocated among work (T_w), care (T_c) and leisure (T_l). Equation (5) is the household budget constraint. It equates the household's expenditures to the sum of employment incomes and exogenous incomes of the household.

When substituted into equation (2), the reduced-form equations for the inputs into the nutrition provisioning function give the following reduced-form equation for child nutritional status:

$$N^*(P_o, P_N, W_{h,} E_h, \Omega) \qquad (6)$$

This is a function of prices, the household's generating potential as embodied in their wages, their exogenous incomes, and child, household and community characteristics. It is important to note that the estimation of the reduced-form function N in equation (5) does not provide the information on the biological mechanisms responsible for children's growth deficiencies. Nevertheless, the function provides a consistent statistical framework within which the impact of household and community exogenous variables on children's health and nutrition can be estimated and consequently, factored into policy intervention.

4.2.2 Econometric Model:

Based on above reduced-form child nutrition, the dependent variable child nutritional status (denoted Y) is hypothesized to be determined by K explanatory variables, denoted by X and indexed k=1….K. The basic cross-community model takes the form

$$Y_{ic} = \alpha + \sum \beta_k X_{k,ic} + \mu_c + \nu_{ic}, \quad \nu_{ic} \sim N(0,\sigma^2) \qquad i = 1, \ldots\ldots n \qquad c = 1, \ldots.C$$

Where i denotes children and c denotes community. The μ_c are unobservable community-specific effects and ν_{ic} are stochastic. If the error term is exclusive of correlation with any explanatory variable, then the Ordinary Least Square (OLS) method will produce unbiased and consistent β_k estimates. A community fixed-effects specification is chose to eliminate any parameter bias caused by community-specific factors that may be correlated with one or more of the explanatory variables.

To analyze gender discrimination, a community fixed effect model is run. The model takes the form

$$Y_{ic} = \alpha + \sum \beta_k X_{k,ic} + \sum \delta_k \mathrm{X}_{k,ic} D_i + \mu_c + \nu_{ic}$$

$$\text{where } \nu_{ih} \sim N(0,\sigma^2),\ i = 1, \ldots\ldots n,\ \text{and, c} = 1, \ldots.C$$

$$D_i = 1 \text{ if girls}$$

$$\quad 0 \text{ otherwise}$$

This model includes one more term than the first model, the interaction of the gender dummy with all the other independent variables. In this model μ_c are unobservable community-specific effects and ν_{ic} are stochastic.

CHAPTER FIVE: DATA, MEASURES AND METHODOLOGY

Section 1 of chapter 5 describes the data used in the study. Sections 2 and 3 introduce, respectively, the dependent variables and the measures of selected determinants of child nutritional status. Finally, section 4 presents the estimation strategy utilized in the study.

5.1 Data

The data used for analysis were collected by CARE, Bangladesh. CARE, an international relief and development agency, initiated the Integrated Food for Development Project (IFFD) in Bangladesh in 1995. The main purpose of the project was to improve the livelihood security of rural destitute households by improving rural roadways. The survey design embodied two steps to collect the data. First, communities or villages were selected from one end of a road which is close to a market center and another community from opposite end of the road, far from a market center. There are a total 16 communities, two from each of the eight selected study areas. Next, the households were randomly selected households from each community. Not only did the road construction itself create temporary employment and provide food for the project participants, but the project also enhanced the overall increase of income among the households along the targeted roads, and the profile of activities in and around the areas.

The eight study areas are scattered over the country. The study areas are in the thanas of Debidwar, Mohanganj, Gopalpur I, Gopalpur II, Ghior, Dacope, Kachua and

Ulipur. Surveyed households lay along a route connecting regional headquarters, important growth centers or a paved (feeder) road to another growth center.

The data were collected over a three-year period: a pre-intervention baseline year (1996) and 2 post-intervention annual cycles (1997 and 1998) after road improvement had been completed. Of 1,437 households interviewed over the three years, a sample of 1,100 was obtained for which household information was collected at every round of the survey. Sample households were interviewed by local agents, researchers from CARE and Helen Keller International (HKI). The data were then compiled into databases for analysis. The survey contains questions regarding household economic activities and income, market access (time and cost), demographic and educational information, health and nutritional status of mother and her children less than 5 years old. This is a panel data.

For the purpose of this study, the data utilized are the average values of each year. Table 5.1 gives the sample broken down by age and sex of children. The sample analyzed in the study includes 3,877 observations and of them, 1,909 are for girls and 1,968 are for boys.

Several steps were taken in choosing the sample of children. First, only children aged 0-59 months are included in the analysis. Second, all children with missing or implausible data on weight, height, or age according to Demographic Health Surveys (DHS) standards were not included.[2] Third, all children with missing data for the independent variables controlled for in the regression analysis were excluded. Finally, for

[2] Weight-for-age and height-for-age scores less than –6 or greater than +6 are considered implausible.

each dependent variable of the study, an additional data cleaning process was performed, which led to the exclusion of few more cases.

5.2 Nutritional Status Measures

5.2.1 Child Nutritional Status

"Anthropometry" of children is widely accepted as an economical and non-invasive measure of the general nutritional status of an individual or a population group. Anthropometric measures can be used for various objectives depending on the indicators selected. The three measurements used to undertake anthropometric assessment of children are age, height, and weight. Three indices are commonly used to assess the nutritional status of children: height-for-age, weight-for-height, and weight-for-age. The reference standards come from North American Multi-ethnic data from the US National Center for Health Statistics (NCHS). The World Health Organization recommends the reference standards for international use (WHO 1995). The z score or standard deviation unit is defined as the difference between the anthropometric value for an individual and the median value for the reference population divided by the standard deviation for the reference population. The formula is:

$$Z_i = (A_i - \overline{A}_{rp}) \div \sigma_{\overline{A_{rp}}}$$

Where A is a given anthropometric measure for child i, and $\overline{A}_{rp}$ is the median value of the anthropometric measure for the reference population. Z scores are regularly used in child nutritional status studies because they (1) allow the use of a fixed point in the distributions of different indices and across different ages; (2) enable the computation of useful summary statistics (i. e. mean and standard deviation) for a group of children (Cogill 2001).

Height-for-age z score (*haz*) is commonly interpreted as indicative of chronic malnutrition and/or frequent sickness and disease. Indeed, *haz* reflects linear growth achieved before birth and during childhood. It therefore cannot be used to measure short-term changes in malnutrition. Stunting, which is defined as standardized height-for-age of less than –2 z scores is an indicator of past growth failure and reflects long-term malnutrition. Given the cumulative effects and that complete catch-up linear growth may not occur, the prevalence of stunting tends to increase with child age. Weight-for-height z score (*whz*) is indicative of current or acute malnutrition and is more sensitive to current periods of sickness and short-term food shortages. It is independent of the age variable since a child's weight should be about the same for a given height regardless of how old she is, making it useful indicator in conditions where reported age is either unknown or unreliable. Wasting occurs if a child's *whz* falls below –2 standard deviations from the international reference. Weight-for-age z score (*waz*) is the most commonly used indicator to measure malnutrition because weight measurement is the least error prone with non-professionals as measurers. *Waz* is a summary measure reflecting aspects of both acute and chronic influences on nutritional status and is recommended as an indicator to assess changes in the magnitude of malnutrition over time. A child with low *waz*, -2 standard deviations below the international reference, reflects the condition of being underweight for a specific age (Cogill 2001).

This study employed both long-term (height-for-age) and short-term (weight-for-height) measures of child nutritional status.

5.3 Operational Measures of the Determinants of Child Nutritional Status

This section presents the operational measures of the relevant determinants of child nutritional status explored in this study. The section concentrates on the explanatory variables included in the reduced-form regression analysis. Tables 5.1 gives the description of the data set employed and 5.2 and 5.3 provide a list and a description of dependent and independent variables respectively.

5.3.1 Explanatory Variables for Regression Analysis

Individual child characteristics included in the model are age and sex of the child. The variables that measure child age are a three-step sequence of dummy variables. The group of children aged 0-1 year is the reference category and the two other categories are children that are older than 1 year and but less than 3 years, and children older than 3 years but less than 5 years. Age is included to capture the typical deterioration of linear growth in children that is believed to occur between the age of one and five.

The sex of the child is indicated by a dummy variable that takes the value of 1 if girls and 0 if boys. Sex may indicate the importance a household gives to different children when allocating resources (Sahn and Stifel 2002), or may show a genetic difference in linear growth between boys and girls.

The parental characteristics included in the model consist of mother's education. Mothers usually play a vital role in household activities concerning childcare. Mother's education serves as proxy for their access to information and knowledge about caring for a child. Maternal education has been considered one of the principal determinants of child health in poor countries. The variables that measure mother's education are a three-step sequence of dummy variables. No education is the reference category and the two additional categories are, up to 5 years (primary education) and greater than 5 years (secondary education).

The household characteristics include household size, household age-sex composition, source of drinking water and type of sanitation utilization, and income as an proxy of economic status. Household size is a numerical measure of the number of people who typically live and eat together. It reflects the number of people among which household resources need to be allocated. Sahn (1988) found that economies of scale in nutrient intake have a propensity to favor the nutritional status of children from larger families. Household composition variables affect nutrient requirements of the household and demand for food. The selected variables include the percentage of males and females in the age groups of 0-15, 16-55 and greater than 56 that constitute the household.

The type and quality of drinking water and sanitation available to household members capture important dimensions of the health environment of a household. In this particular study, the type of sanitation plays a vital role, whereas access to drinking water is less important as an explanatory variable, since 95% households in the sample use handpump water. Therefore the source of water is not included as an explanatory variable in the analysis. For sanitation, no use of latrine is the reference category for sanitation, and two additional categories are the existence of increasingly sanitary facilities, open latrine and closed latrine. Children from households that do not have access to adequate sanitation facilities are at greater risk of diarrheal diseases, malaria and cholera (World Bank 2000). Empirical studies found that every one of these illnesses seriously contributes to malnutrition. Gwatkin, Guillot and Heuveline (1999) discovered that the two biggest causes of death among the poorest 20% of the world's developing countries (as classified by national GDP per capita) are respiratory infections and diarrheal diseases. The importance of household health environment variables is stressed in Strauss and Thomas (1995) and UNICEF (1998).

Higher income is expected to affect household resources as well as child health directly. For example, higher earnings increase household's access to food as well as medical care during illness, thus improving the health situation. This study used annual income owned by the household as a proxy of economic status and the income is measured in Taka per year, local currency ($1= 58 Taka).

5.4 Estimation Strategy

In order to assess the socioeconomic determinants of child nutritional status, a community fixed effect model is estimated including a dummy variable for the sex of the child. The regression analysis is conducted first for the entire sample of children and then for the 3 age groups individually.

$$Y_{ic} = \alpha + \sum \beta_k X_{k,ic} + \mu_c + \nu_{ic},\ \nu_{ic} \sim N(0,\sigma^2) \qquad i = 1,......n \qquad c = 1,....C$$

Where i denotes children and c denotes community. The μ_c are unobservable community-specific effects and ν_{ic} are stochastic affects. If the error term is uncorrelated with any explanatory variable, then the Ordinary Least Square (OLS) method will produce unbiased and consistent β_k estimates. A community fixed-effects specification is chosen to eliminate any parameter bias caused by community-specific factors that may be correlated with one or more of the explanatory variables. [3] As mentioned in section 5.1, there are total 16 communities in, two from each of the eight selected study areas.

In this model, the coefficient of the gender dummy will provide the evidence of gender discrimination. Inferring gender bias using anthropometric data requires the comparison of gender differences with some norm and the differences in norms across age groups (Smith and Byron, 2004). The measures employed in this study, the height-for-age and weight-for-height z scores, already incorporates a comparison to a reference norm mentioned in section 5.2.1 and that will take into account biologically-based gender differences in growth. When these z scores are compared based on gender, they should identify gender bias. If girls' nutritional status is lower than or equal to boys' nutritional status, then there is an evidence of gender bias.

[3] As the survey conducted by two-stage sample design, more than one household is sampled for each cluster or community. Thus the possibility that the error term will not be independently and identically distributed occurs. Unobserved cluster or community-specific factors will influence the outcome variables similarly for households living in the same cluster, leading to biased estimates of the parameter covariance matrix. Additionally, a Breusch-pagan test (STATA 2001) indicates strong heteroskedasticity. Thus a robust covariance matrix is used to complete standard errors and thus t-statistics.

Tests of significant differences in level of the anthropometric variables across different age groups are employed and this will show the evidence of gender bias more precisely. For the anthropmetric z scores (haz, whz), two sample t tests of the hypothesis that haz and whz have the same mean across boys' and girls' are performed. The formula used to test if the mean of group x is equal to mean of group y ($\mu_x = \mu_y$) when the variance for groups x and y (σ_x, σ_y) are unknown but assumed to be identical ($\sigma_x = \sigma_y$) is explained in the Appendix.

The socio-economic factors related to gender discrimination are identified by using multivariate regression analysis with a boys and girls pooled sample. The regression is a community fixed-effects model. The dependent variable, child nutritional status(y_{ic}), is hypothesized to be determined by K explanatory variables, denoted by X and indexed k=1….K. The basic model takes the form

$$Y_{ic} = \alpha + \sum \beta_k X_{k,ic} + \sum \delta_k \mathrm{X}_{k,ic} D_i + \mu_c + \nu_{ic}$$

where $\nu_{ic} \sim N(0,\sigma^2),\ i = 1,......n,$ and, $\mathrm{c} = 1,....C$

$D_i = 1$ if girls

0 otherwise

This model includes one more term than the first model, that is, the interaction of gender dummy (0 for boys, 1 for girls) with all the independent variables. Where i denotes children and c denotes community. The μ_c are unobservable community-specific effects and ν_{ic} are stochastic disturbance terms. If the sex-interaction term for a variable is statistically significant (at least at the 10% level), a significant difference in effect between girls and boys is detected and this concludes that this particular variable is responsible for gender bias. The estimation of this is model handled in two steps. A regression model containing all the independent variables and their interactions with sex dummy (0 for boys and 1 for girls) is run, and the significance of each interaction term is tested. In step 2, a separate regression run for both boys and girls. The main goal of this is to detect whether the computed girls parameters from step 1 are significant.

Since the surveys interviewed more than one household in the same community or cluster, there is a likelihood that the error term will not be independently and identically distributed within a household. If so, the nutritional status variables for children within the same household will be influenced by unobserved cluster–specific characteristics in the same way. Therefore a robust covariance matrix is used to compute standard errors in place of the traditional calculation and also to calculate t-statistics. Also, a Breusch-Pagan test shows strong Heteroskedasticity warranting the use of the Huber/White/sandwich estimator of variance for robust standard errors (Statacorp 2002).

A test for parameter stability is taken to determine whether there are indeed significant differences in the parameter estimates across boys and girls. A general Chow-F test establishes whether the null hypothesis that the parameter estimates are the same over boys and girls is rejected. The formula used is described in the Appendix in Chapter Eight.

5.4.1 Test of Specification and of Mis-Specification

Breusch-Pagan derived in 1979 a Langrage Multiplier (LM) test for heteroskedasticity. The steps in the Breusch-Pagan test are summarized in the Appendix in Chapter Eight. To detect multicollinearity, the inverse correlation matrix of the independent variables is used. Variance inflation factors (VIF), the diagonal elements of the correlation matrix, are given by $(1-R_i^2)^{-1}$ where R_i^2 is the R^2 from regressing the ith independent variable on all the other independent variables. IF the mean VIF is considerably greater than 1 or the largest VIF is greater that 30 (Statacrorp 2002) or 10 (Kennedy 1998), there is then the evidence of multicollinearity. The test of mis-specification employed in this study is the Ramsey-Reset Test for omitted variables, which looks for omitted variables by including in the original model powers of the fitted values of the dependent variable. The procedure is described in Appendix in Chapter Eight.

5.4.2 Endogeneity Issues

Since the study employs a reduced-form estimation framework, caution is necessary in treating household demographic variables as exogenous. Parents may in fact decide to have fewer and healthier children, consequently making household size and household composition endogenous. In the short run, however, the endogeneity of these variables should not be considered a problem.

Another potential endogeneity problem emerges with the economic status variable (income). If consumption, leisure and time allocation decisions are jointly determined with child health, household resource availability can conceivably be endogenous. For example, a woman with undernourished, and hence vulnerable, children might allocate more time for their care and less time for work that brings in additional income. In other words, the line of causation between household resources and nutritional status may go in both directions. So, the results should be interpreted with this caution in mind.

Table 5.1 The data sets and sample sizes

Number of children (0-12 months)		Number of children (12-36 months)		Number of children (36-59 months)	
Boys	Girls	Boys	Girls	Boys	Girls
187	200	740	728	1041	981

Table 5.2: Description of the variables of the study

Variables	Type
Child nutritional status	
Child's Height-for-age	Continuous
Child's Weight-for-height	Continuous
Whether child is stunted	Dichotomous
Whether child is wasted	Dichotmous

Table 5.3: Independent variable of the study: child, household characteristics

Variables	Type
Child Characteristics	
Child aged 0-12 months (reference category)	Dichotomous
Child aged 12-36 months	Dichotomous
Child aged 36-59 months	Dichotomous
Male child (reference category)	Dichotomous
Female child	Dichotomous
Households characteristics	
Mothers' education in years	
No education (less than 5 years) (reference category)	Dichotomous
Primary education (1-5 years)	Dichotomous
Secondary education > 5 years	Dichotomous
Household size	Dichotomous
Household age-sex composition	
Females member 0-15	Continuous
Female member 15-55	Continuous
Female member 55+	Continuous
Male member 0-15	Continuous
Male member 15-55	Continuous
Male member 55+	Continuous
Economic Status	
Household yearly income	Continuous
Environmental Factors	
Open latrine used (reference category)	Dichotomous
Close latrine used	Dichotomous
No latrine	Dichotomous
Time period	
Year 1996 (reference category)	Dichotomous
Year 1997	Dichotomous
Year 1998	Dichotomous

CHAPTER SIX: RESULTS: DETERMINANTS OF CHILD NUTRITION AND INFLUENCES OF SOCIO-ECONOMIC FACTORS ON GENDER DISCRIMINATION

This chapter provides results that address the research questions outlined in chapter 1:

1. What are the affects of socio-economic determinants on both short-term and long-term child nutritional status? What are their affects in different age groups?
2. Is there any evidence of discrimination against girls as measured by child nutritional status?
3. What are the influences of socio-economic determinants on gender discrimination?

Section 6.1, 6.2 and 6.3 will focus on these research questions respectively. The first section will discuss about the causes of malnutrition, or the factors that affect long-term (haz) and short-term (whz) measure of child nutritional status. The second section focuses on the gender discrimination against girls with respect to nutritional status. The third section will address the socio-economic factors that influence gender discrimination. The analysis in this chapter will focus on long- term nutritional status as this study detected anti-female gender bias only in this measurement. As mentioned above, gender bias in child nutritional status come from two sources, behavioral and biological. This study is focused only on sources of the behavioral factors that are causing gender bias.

6.1 Determinants of Child Nutritional Status

Table 6.1 displays the mean and standard deviation of each of the variables that enters into the models of the regression analysis. Fig 6.4 and 6.6 shows that 62% children in this sample are long-term malnourished and of them 53% are girls and 47% are boys. In the case of short-term malnutrition, 9% malnourished, and the malnutrition rate was equal for both boys and girls.

A community fixed-effects specification is chosen to analyze the first research question. This is to eliminate any parameter bias caused by community-specific factors that may be correlated with one or more of the explanatory variables. Table 6.4 and 6.5 present the community fixed effects regression results for long term and short term child nutritional status (haz and whz) respectively, exploring the determinants of child nutritional status using the pooled sample of children in the survey period while controlling for the survey period and age groups of children. The independent variables are arranged into three groups: child, parent, and household characteristics. Both boys' and girls' nutritional measures are influenced by the major socio-economic determinants in the expected direction. The second column in each table reports the coefficients of the explanatory variables employed. The number of stars placed on the coefficients reveals their level of significance (see notes at the bottom of the tables). Since the Brush-Pagan tests indicate the presence of Heteroskedasticity, robust standard errors were used to calculate the t-statistics, which are reported in the third column of the tables. The R^2 (listed at the bottom of table) is relatively low and similar to those found in other child nutritional studies. Also, Ramsey-Reset tests (Statacorp 2002) reveal possible omitted variable bias in the regressions of both measures of child nutritional status. The test statistics are reported in the end tables 6.4 to 6.6.6. The variance inflation factor (VIF) test indicated the presence of weak multicollinearity. The largest VIF for table 6.4 and 6.5 is equal to 5.67 and 8.55 respectively, which is below 10. The mean VIF is 2.53 for both tables, which is not far above the cut-off of 1.

The regression results for the age dummies (12-36 months and 36-59 months) are consistent with the findings of past studies that both short-term and long-term nutritional status declines significantly with age, reflecting the typical deterioration of linear growth in children aged 12-59 months, the most vulnerable age category for both boys and girls.

There is strong evidence from other empirical studies that children of better-educated mothers are healthier, and our results are consistent with this evidence. Mother's education (primary and secondary) has a significant positive effect both on long-term and short-term measures of nutritional status in Bangladesh. More educated mothers have children with better nutritional status than less educated mothers. One additional year of maternal primary education adds 0.14 to a child haz score, while secondary education adds a further 0.55 haz score. With respect to acute malnutrition, whz increases by 0.069 z scores for one additional year of maternal secondary education. Since the model controlled for income as economic status, the effect of maternal education most likely reflects better caring practices such as timely prenatal care, appropriate complementary feeding and enhanced health seeking behaviors.

Household size has a negative impact on long-term child nutritional status (-0.051). This may be because more children in the household make it harder for the parents to take care of each of the children. Also Fan increase number of household members lead to more pressure on limited household resources like food. But household size does not have any significant impact on short-term nutritional status. A greater number of adult women (15-55 or older) in the household positively affect both haz and whz (0.139, 0.064). This may be explained by the fact that older females are good substitute care providers for pre-school aged children. Additionally, a relatively higher rate of male adults (older than 55) in a household negatively affect whz (-0.102). This may imply that in case of food shortage, adult male high energy and protein requirements affect resource allocation patterns within households, which ultimately do not favor younger children. In case of long-term nutritional status, a greater number of young males (0-15 years old) in the household have a negative affect on long term nutritional status, which may imply that parents will give less time and food to each child.

The results show that household health environments, measured as type of sanitation used has no significant impact on long term nutritional status (haz), but a significant impact on short term nutritional status (whz), which can be seen by the coefficient of opened latrine (-0.079) in table 6.5. The effect of latrine on health is most likely to be through some illnesses which are reflected in short term rather than long term health status.

Economic status, as measured by annual income, has a strong influence on child nutritional status both in short-term and long-term. One unit of income significantly adds 0.080 z scores to a child haz and 0.024 z scores to a child whz. The elasticity of income shows that for 1% increase in income, haz increases by 0.06% and whz increases by

0.04%. This means that increasing income has more influence on long-term nutritional status than on short term.

These results indicate that as children grow older household characteristics influence their nutritional status even more than at younger age levels. Table 6.6.1 to Table 6.6.6 show the results of different household characteristics and other socio-economic factors on both long-term and short-term nutritional status. These tables show that income is more significant as children grow older and have greater daily requirements of nutrients and other basic needs. This result is also consistent with past studies. In the long-term nutritional status, both maternal primary and secondary education has a significant positive effect as the children are growing up. Mother's education has no significant impact on short-term nutritional status.

6.2 Discrimination Against Girls

As mentioned in Chapter 5 that we need a reference norm or level to measure the variation in any variable and this is also true for discrimination. The measures used in this study (haz, whz) already incorporate the comparison with the reference population recommended by World Health Organization (WHO), when they are compared based on gender they should be able to detect discrimination. According to the literature, the presence of anti-female gender bias in care for children would be detected when girls exhibit lower measurements than boys, especially in the 0-5 age groups.

The gender dummy variable in the regression results in table 6.4 and 6.5 help to detect gender discrimination. Table 6.4 shows that holding all other factors constant, the long-term nutritional status (haz) for girls (-0.273) is significantly lower than that for boys. This shows a strong evidence of discrimination against girls in Bangladesh. In contrast, for short-term nutritional status (whz), there is no definite evidence of anti-female gender bias as the coefficient of gender dummy is not significant in table 6.5.

The gender differences are more starkly revealed when examined by age group (Smith and Byron, 2004). Table 6.2 and 6.3 show the significant difference for both long term and short term z-scores mean between boys and girls by different age groups in the study period. Table 6.2 shows that in case of long term nutritional status, in age group 1 (0-12 month old), in 1997 and in 1998 there is no significant difference of z-score but in 1999 we find a fairly strong differences in favor of boys (the difference is 0.44 z-score). This suggests the presence of gender discrimination even among infants. For age group 2 (12-36 months old), the study period exhibits continued differences in favor of boys (the difference is 0.22, 0.35 and 0.20 for 1997, 98 and 99 respectively). In age group 3 (36-59 month old), the average haz for girls is significantly lower than that for boys, except the year 1997.

Figure 6.1 and 6.2 show the relationship between age (in months) and the girl-boy difference graphically over the survey period for long term and short term nutritional status respectively. These figures show that boys' advantage relative to girls' drops after the first year of age, except 1998.

Table 6.2.1 shows the percentage of malnutrition across boys and girls over the study period. It is clear that girls are more malnourished than boys over the study period. In older age categories, the percentage of malnutrition is also higher for girls' than for boys' evidence that discrimination continues, as children grow older. Regardless of year and age, the percentage of malnourished is always higher than that for boys. This may happen due to a lack of proper child care towards girls.

In contrast, as shown in table 6.3 and figure 6.2, there is no significant difference in mean z-scores among girls and boys in case of short-tem nutritional status (whz). Therefore, there is no definite evidence of discrimination against girls in short-term nutritional status.

This study performed three individual regressions by age group to see if there were any changes in behavior of underlying determinants of discrimination across age. Tables 6.6.1 through 6.6.6 show the results of these models. Here the results exhibit a strong evidence of gender discrimination in all three age groups in the case of long-run nutritional status. In contrast, there was no evidence of gender bias groups for short-term nutritional status in any age group. Consequently, the next section will only focus on the long-term chronic nutritional status.

6.3 Influences of Socio-Economic Factors on Gender Discrimination

A community fixed effects model was employed to analyze the third research question. This model includes the interaction of the sex dummy with each explanatory variable along with the original explanatory variables. Table 6.7 shows the results for this model. The second column of this table was taken from table 6.4, which reports the coefficients of the explanatory variables where both boys and girls were included in the sample and under each coefficient their corresponding t-statistics was reported. The third and forth columns show the separately calculated coefficients for boys and girls respectively. The last column in the table reports the t statistics (i.e. the level of significance) of the interaction term with the gender dummy, which represents the contribution of the socio-economic factors to anti-female discrimination. The regression results suggest several socio-economic behavioral factors in the model that have a significant affect on gender bias in rural Bangladesh.

In table 6.7, for the age group 3 (36-59 months), the t statistics for difference is significant (-1.76), but for the other age groups it is not significant. This may be explained by the fact that as children get older their nutritional status depends not only on care but also on other household characteristics; e. g. household income, household size. In a patriarchal society like Bangladesh, households give higher priority to male children than female children in terms of food and care. Because the society values boys more than girls, a typical mother has a predilection to take more care for a male child than a female child and this helps to increase gender discrimination.

More education may enable a mother to have a greater awareness of social discrimination and, accordingly, they tend to treat female and male children with equal importance. This is supported by the model results which show that mother's secondary education plays a significant positive role in reducing anti-female gender bias (the t statistics difference is 2.85). Educated mothers understand better that both boys' and girls' need equal nutrition and care to have a healthy future.

As households increase in size, gender discrimination against girls also increases (t statistics for difference is –2.20). In larger households, boys get priority in access to food. As the number of female adults (15-55 years old) in a household increases, discrimination against girls reduces significantly (t statistic for difference is 1.77). Probably one explanation for this may be that females in this age group are either elder sisters or grandmothers who would take good care of all the children in general and this would eventually lead to lower discrimination against girls.

The analysis shows that some behavioral social factors are contributing towards reducing gender discrimination like mother's education and numbers of adult females in the household, but they are dominated by the discrimination enhancing factors like household size. For this reason, one can observe an overall gender discrimination against girls in long-term nutritional status in rural Bangladesh.

Another important finding from this analysis shows that income does not have a significant influence on gender discrimination against girls. This is consistent with the idea that discrimination against girls is a result of prevalent social practices not the economic status of the individual household. This fact is further underlined by the discovery that higher household income contributes to better nutritional status but does not do anything to reduce the discrimination against girls.

Table 6.1 Independent variables: weighted means and standard deviation (SD) by sex and by household

Variable	Male		Female	
	Mean	SD	Mean	SD
Child characteristics				
Height-for age	-2.24	1.04	-2.48	1.17
Weight-for-height	-1.09	0.72	-1.09	0.73
Age 0-12 months	0.09	0.29	0.10	0.31
Age 12-36 months	0.38	0.48	0.38	0.49
Age 36-59 months	0.53	0.50	0.51	0.50
Number of Observation	**1968**		**1909**	

Households Characteristics

Variable	Mean	SD
Mother's characteristics		
Mothers' education		
No education (less than 5 years)	0.68	0.01
Primary education (1-5 years)	0.22	0.01
Secondary education (> 5 years)	0.09	0.00
Household age-sex composition		
Females member 0-15	1.57	0.02
Female member 15-55	1.35	0.01
Female member 55+	0.21	0.01
Male member 0-15	1.45	0.02
Male member 15-55	1.37	0.01
Male member 55+	0.20	0.01
Household size	6.36	0.04
Economic Status		
Yearly income	18607.50	237.69
Environmental Factors		
Open latrine used	0.53	0.01
Close latrine used	0.39	0.01
No latrine	0.08	0.00
Year 1996	0.36	0.01
Year 1997	0.34	0.01
Year 1998	0.30	0.01
HAZ	-2.36	0.02
WHZ	-1.09	0.01
Number of Observation	3877	

Table 6.2: Nutritional Status of Girls and Boys by Age and Sex (mean Height-for-Age)

	Boys				Girls			
	Age (in months)	Mean	Standard Deviation	Valid Cases	Mean	Standard deviation	Valid cases	Mean difference between boys and girls
	0-1	-1.93	1.12	68	-2.17	1.120	78	0.241
	1—3	**-2.18*** **	0.96	355	**-2.39*** **	1.106	314	0.217***
1997	3—5	-2.45	1.22	285	-2.57	1.348	322	0.124
	0—1	-1.96	1.01	60	-1.91	0.988	71	-0.059
	1—3	**-2.21*** **	1.05	236	**-2.56*** **	1.112	238	0.353***
1998	3—5	**-2.24*** **	1.02	382	**-2.48*** **	1.216	337	0.233***
	0—1	**-1.74*** **	0.95	58	**-2.18*** **	1.179	52	0.436***
	1—3	**-2.46** **	1.09	149	**-2.66** **	1.140	176	0.201***
1999	3—5	**-2.23*** **	0.89	374	**-2.54*** **	1.063	322	0.307***

Note: ** and *** indicate that a two-sided t-test of the girl-boy difference at 5% and 10% levels, respectively.

Table 6.2.1: Percentage of Malnutrition by Age and Sex

(% of Stunted child)

	0-12 months old		12-36 months old		36-59 months old	
	Boys	Girls	Boys	Girls	Boys	Girls
1997	56.52	74.68	75.56	76.73	71.52	74.46
1998	58.33	63.38	68.22	78.99	64.65	71.76
1999	53.44	73.07	76.51	81.81	67.64	74.07

Table 6.3: Nutritional Status of Girls and Boys by Age and Sex
(mean Weight-for-Height)

		Boys			Girls			Mean Difference
	Age (in months)	Mean	Std	Valid Cases	Mean	std	Valid cases	
1997	0-1	-0.68	0.87	68	-0.55	0.91	78	-0.13
	1—3	-1.17	0.69	354	-1.18	0.69	317	0.004
	3—5	-1.03	0.71	287	-1.10	0.68	324	0.07
1998	0—1	-0.72	0.77	60	-0.46	0.62	71	-0.25
	1—3	-1.22	0.72	236	-1.19	0.72	238	-0.02
	3—5	-1.10	0.64	382	-1.14	0.76	340	0.04
1999	0—1	-0.53	0.93	58	-0.70	0.84	52	0.16
	1—3	-1.07	0.71	580	-1.16	0.64	175	0.08
	3—5	-1.09	0.65	374	-1.11	0.67	324	0.02

Note: ** and *** indicate that a two-sided t-test of the girl-boy difference at 5% and 10% levels, respectively.

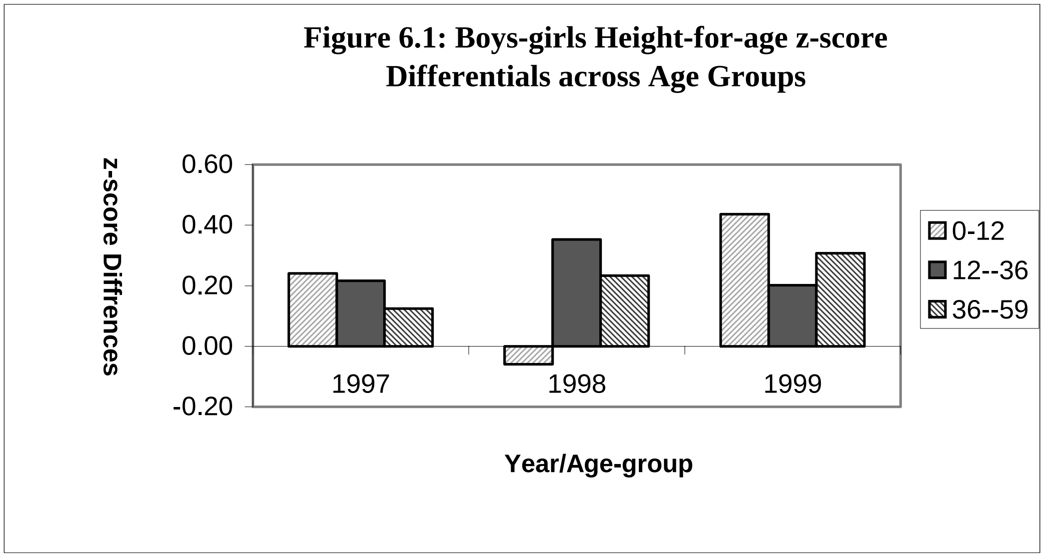


Figure 6.1: Boys-girls Height-for-age z-score Differentials across Age Groups
z-score Diffrences
0.60
0.40
0.20
0.00
-0.20
1997
1998
1999
Year/Age-group
0-12
12--36
36--59

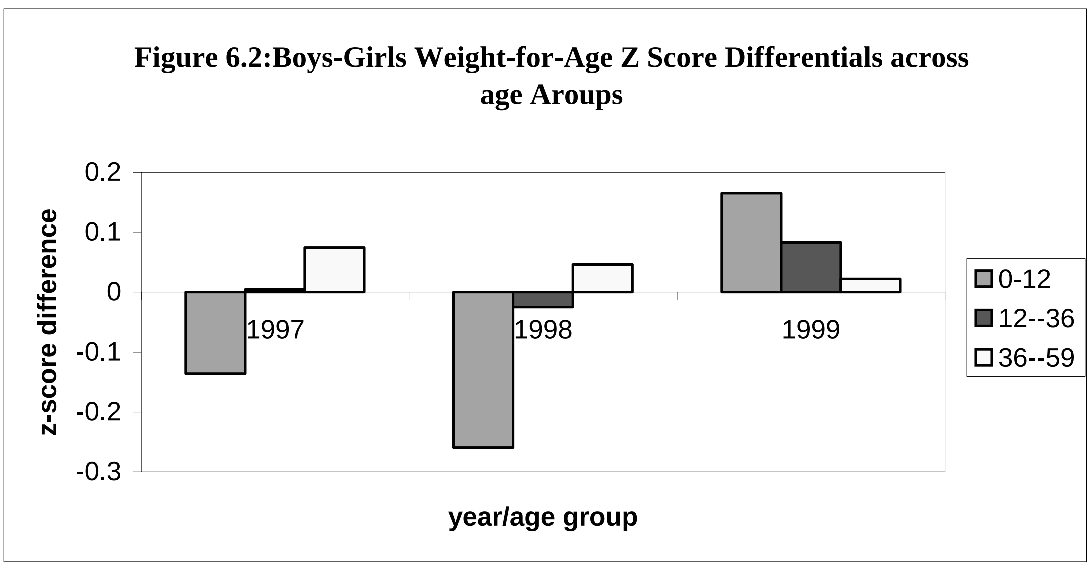


Figure 6.2:Boys-Girls Weight-for-Age Z Score Differentials across age Aroups
z-score difference
0.2
0.1
0
-0.1
-0.2
-0.3
1997
1998
1999
year/age group
0-12
12--36
36--59

Figure 6.3: Distribution of HAZ.

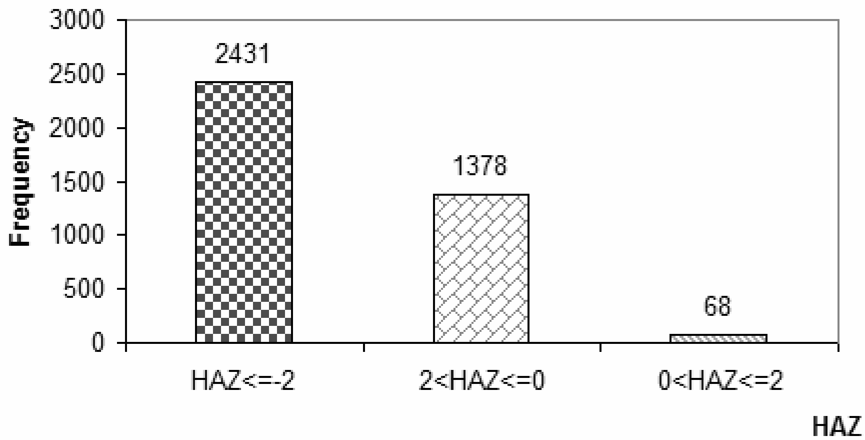


Figure 6.4: Percent Distribution of HAZ.

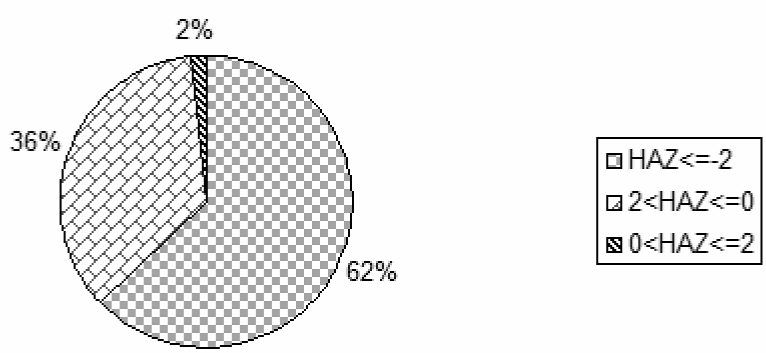


Figure 6.5: Distribution of WHZ.

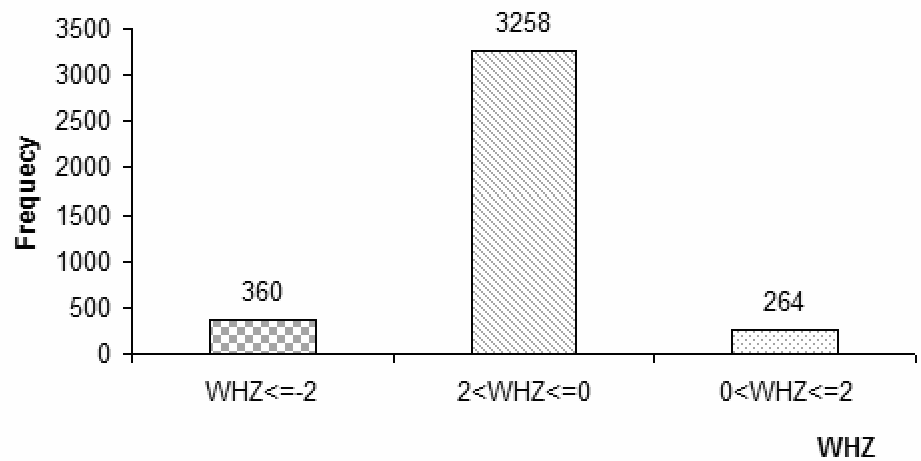


Figure 6.6: Percent Distribution of WHZ.

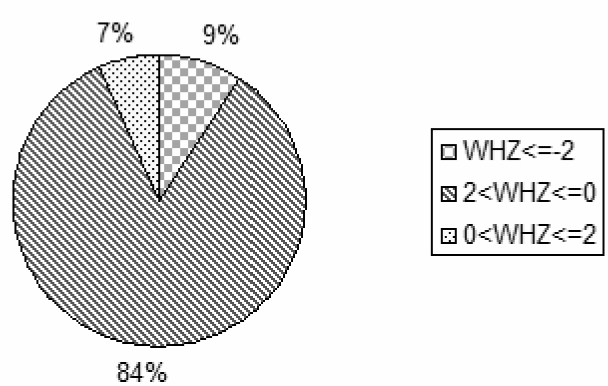


Table 6.4: Determinants of Child Nutrition (Haz): Regression Result for Pooled Data

Variable	Coefficient	t statistic	P>|t|	Elasticity
Sex of the child	-0.272	**-6.87*** **	0.00	-0.115
Child aged 12-36 months	-0.417	**-6.85*** **	0.00	-0.177
Child aged 36-59 months	-0.470	**-7.85*** **	0.00	-0.199
Mother's education:primary	0.140	**3.17*** **	0.00	0.059
Mother's education: secondary	0.559	**9.36*** **	0.00	0.233
Household Income	0.081	**6.15*** **	0.00	0.064
Household Size	-0.051	**-3.03*** **	0.00	
Numbers of females 15-55	0.139	**4.07*** **	0.00	0.056
Numbers of females 55+	0.118	**2.48*** **	0.01	0.007
Numbers of males 0-15	-0.050	**-2.34*** **	0.01	-0.057
Numbers of males 15-55	0.019	0.060	0.54	
Numbers of males 55+	0.063	1.35	0.18	
Opend Latrine Used	-0.108	-1.54	0.13	
Closed Latrine Used	0.030	0.4	0.69	
Year 1997	0.026	0.62	0.54	
Year 1998	-0.047	-1.07	0.28	

Number of observation 3877

Rsquared 0.09

Reset variable test Fstat 0.89 P-value 0.44
*1% level of significance
** 5% level of significance

**10% level of significance
Notes:

- All p values are based on White-corrected standard errors and robust to

Intra-cluster correlation.

- Elasticity is computed at the absolute mean value of haz. The elasticities for dummy variables are calculated by the corresponding coefficient over the mean of the dependent variables.

Table 6.5: Determinants of Child Nutrition (Whz): Regression Results for Pooled Data

Variable	Coefficient	t statistic	P>|t|	Elasticity
Sex of the child	0.017	0.64	0.52	
Child aged 12-36 months	-0.593	**-12.82*** **	0.00	-0.544
Child aged 36-59 months	-0.496	**-10.98*** **	0.00	-0.455
Mother's education:primary	0.018	0.65	0.54	
Mother's education: secondary	0.069	**1.75***	0.08	0.062
Household Income	0.024	**2.97****	0.00	0.041
Household Size	0.002	0.16	0.87	
Numbers of females 15-55	0.064	**2.68*** **	0.00	0.019
Numbers of females 55+	-0.048	1.57	0.11	
Numbers of males 0-15	0.021	1.45	0.15	
Numbers of males 15-55	-0.025	1.23	0.22	
Numbers of males 55+	-0.102	**-2.90*** **	0.00	-0.009
Opend Latrine Used	-0.079	**-1.78***	0.07	-0.072
Closed Latrine Used	-0.043	-0.92	0.35	
Year 1997	-0.040	-1.46	0.14	
Year 1998	-0.033	-1.16	0.24	

Number of observation 3886

Rsquared 0.06

Reset variable test Fstat .38 P-value 0.77
* 1% level of significance
** 5% level of significance
*** 10% level of significance
Notes:

- All p values are based on White-corrected standard errors and robust to Intra-cluster correlation.
- Elasticity is computed at the absolute mean value of whz. The elasticities for dummy variables are calculated by the corresponding coefficient over the mean of the dependent variables.

Table 6.6.1: Determinants of Child Nutrition (Haz): Regression Results for Age Group 1(0-12 months)

Variable	Coefficient	t statistic	P>|t|	Elasticity
Sex of the child	-0.234	**-2.04****	0.04	-0.117
Mother's education:primary	0.173	1.28	0.210	
Mother's education: secondary	0.414	**1.97***	0.05	0.201
Household Income	0.040	0.83	0.40	
Household Size	-0.005	-0.14	0.88	
Numbers of females 15-55	-0.122	-1.09	0.27	
Numbers of females 55+	-0.060	-0.34	0.73	
Numbers of males 0-15	-0.015	-0.27	0.79	
Numbers of males 15-55	-0.026	-0.32	0.75	
Numbers of males 55+	0.004	0.03	0.98	
Opend Latrine Used	0.394	**1.65***	0.09	
Closed Latrine Used	0.630	**2.55*****	0.01	0.302
Year 1997	0.144	1.13	0.26	
Year 1998	0.071	0.51	0.61	

Number of observation 387

Rsquared 0.06

Reset variable test Fstat 1.33 P-value 0.26
* 1% level of significance
** 5% level of significance
*** 10% level of significance
Notes:

- All p values are based on White-corrected standard errors and robust to

Intra-cluster correlation.

- Elasticity is computed at the absolute mean value of haz. The elasticities for dummy variables are calculated by the corresponding coefficient over the mean of the dependent variables.

Table 6.6.2 Determinants of Child Nutrition (Haz): Regression Results for Age Group 2(12-36 months)

Variable	Coefficient	T statistic	P>|t|	Elasticity
Sex of the child	-0.279	**-4.31*** **	0.00	-0.116
Mother's education:primary	0.165	**2.29*** **	0.02	0.071
Mother's education: secondary	0.510	**5.77*** **	0.00	0.221
Household Income	0.070	**3.53*** **	0.00	0.056
Household Size	-0.014	-0.57	0.57	
Numbers of females 15-55	0.098	1.61	0.11	
Numbers of females 55+	0.130	1.68	0.09	
Numbers of males 0-15	-0.039	-1.13	0.25	
Numbers of males 15-55	-0.015	-0.27	0.79	
Numbers of males 55+	0.180	**2.52** **	0.01	0.015
Opend Latrine Used	-0.107	-0.88	0.37	
Closed Latrine Used	-0.047	-0.37	0.80	
Year 1997	-0.077	-1.23	0.22	
Year 1998	-0.241	**-3.26*** **	0.00	

Number of observation 1468

Rsquared 0.08

Reset variable test Fstat 1.49 P-value 0.21
* 1% level of significance
** 5% level of significance
*** 10% level of significance
Notes:

- All p values are based on White-corrected standard errors and robust to Intra-cluster correlation.
- Elasticity is computed at the absolute mean value of haz. The elasticities for dummy variables are calculated by the corresponding coefficient over the mean of the dependent variables.

Table 6.6.3: Determinants of Child Nutrition (Haz): Regression Results for Age Group 3(36-59 months)

Variable	Coefficient	t statistic	P>|t|	Elasticity
Sex of the child	-0.277	**-4.89*** **	0.00	-0.115
Mother's education:primary	0.126	**2.12** **	0.03	0.054
Mother's education: secondary	0.575	**7.11*** **	0.00	0.241
Household Income	0.090	**5.13*** **	0.00	0.072
Household Size	-0.073	**-3.06*** **	0.00	-0.075
Numbers of females 15-55	0.191	**4.27*** **	0.00	0.067
Numbers of females 55+	0.123	**1.92** **	0.05	0.081
Numbers of males 0-15	-0.67	**-2.14*** **	0.03	-0.20
Numbers of males 15-55	-0.053	1.17	0.24	
Numbers of males 55+	-0.284	-0.43	0.66	
Opend Latrine Used	-0.182	**-1.96** **	0.05	-0.13
Closed Latrine Used	-0.016	-0.17	0.87	
Year 1997	0.093	1.42	0.15	
Year 1998	0.054	0.86	0.39	

Number of observation 2022

Rsquared 0.09

Reset variable test Fstat 0.40 P-value 0.75
* 1% level of significance
** 5% level of significance

*** 10% level of significance
Notes:

- All p values are based on White-corrected standard errors and robust to
Intra-cluster correlation.
- Elasticity is computed at the absolute mean value of haz. The elasticities for dummy variables are calculated by the corresponding coefficient over the mean of the dependent variables.
-

Table 6.6.4: Determinants of Child Nutrition (Whz): Regression Results for Age Group 1 (0-12 months)

Variable	Coefficient	t statistic	P>|t|	Elasticity
Sex of the child	0.121	1.28	0.20	
Mother’s education:primary	0.106	0.93	0.35	
Mother’s education: secondary	0.224	1.50	0.13	
Household Income	-0.019	-0.48	0.63	
Household Size	-0.061	**-1.79***	0.07	-0.243
Numbers of females 15-55	0.112	1.09	0.28	
Numbers of females 55+	-0.047	-0.34	0.73	
Numbers of males 0-15	0.123	0.26	0.79	
Numbers of males 15-55	0.109	1.49	0.14	
Numbers of males 55+	0.231	1.77	0.08	
Opend Latrine Used	0.022	0.12	0.91	
Closed Latrine Used	0.107	0.54	0.59	
Year 1997	0.024	0.25	0.80	
Year 1998	-0.068	-0.59	0.56	

Number of observation 387

Rsquared 0.04

Reset variable test Fstat .56 P-value 0.64
* 1% level of significance
** 5% level of significance

*** 10% level of significance
Notes:

- All p values are based on White-corrected standard errors and robust to Intra-cluster correlation.
- Elasticity is computed at the absolute mean value of whz. The elasticities for dummy variables are calculated by the corresponding coefficient over the mean of the dependent variables.

Table 6.6.5: Determinants of Child Nutrition (Whz): Regression Results for Age Group 2 (12-36 months)

Variable	Coefficient	T statistic	P>|t|	Elasticity
Sex of the child	0.008	0.20	0.84	
Mother's education:primary	0.043	0.92	0.35	
Mother's education: secondary	0.143	**2.24****	0.03	0.124
Household Income	0.047	**3.75*****	0.00	0.073
Household Size	-0.008	-0.05	0.96	
Numbers of females 15-55	-0.040	-1.06	0.29	
Numbers of females 55+	-0.052	-1.07	0.29	
Numbers of males 0-15	-0.019	-0.88	0.38	
Numbers of males 15-55	0.035	1.03	0.30	0.065
Numbers of males 55+	0.067	1.19	0.23	0.016
Opend Latrine Used	-0.058	-0.78	0.44	
Closed Latrine Used	-0.055	-0.74	0.46	
Year 1997	-0.033	-0.78	0.44	
Year 1998	-0.028	-0.60	0.55	

Number of observation 1468

Rsquared 0.05

Reset variable test Fstat .93 P-value 0.42
* 1% level of significance
** 5% level of significance

*** 10% level of significance
Notes:

- All p values are based on White-corrected standard errors and robust to
Intra-cluster correlation.
- Elasticity is computed at the absolute mean value of whz. The elasticities for dummy variables are calculated by the corresponding coefficient over the mean of the dependent variables.

Table 6.6.6: Determinants of Child Nutrition (Whz): Regression Results for Age Group 3 (36-59 months)

Variable	Coefficient	t statistic	P>|t|	Elasticity
Sex of the child	0.007	0.120	0.84	
Mother's education:primary	-0.022	-0.62	0.53	
Mother's education: secondary	0.000	0.02	0.98	
Household Income	0.013	1.22	0.22	
Household Size	0.009	0.68	0.49	
Numbers of females 15-55	-0.110	**-3.42*** **	0.00	
Numbers of females 55+	-0.049	-1.25	0.21	
Numbers of males 0-15	-0.051	**-2.48*** **	0.01	
Numbers of males 15-55	-0.001	-0.06	0.95	
Numbers of males 55+	0.107	**2.21** **	0.03	0.019
Opend Latrine Used	-0.099	**-1.74***	0.08	-0.091
Closed Latrine Used	-0.041	-0.68	0.49	
Year 1997	-0.051	-1.34	0.18	
Year 1998	-0.029	-0.79	0.43	

Number of observation 2031

Rsquared 0.05

Reset variable test Fstat 1.16 P-value 0.32

*** 1% level of significance

** 5% level of significance

**10% level of significance

Notes:

- All p values are based on White-corrected standard errors and robust to Intra-cluster correlation.
- Elasticity is computed at the absolute mean value of whz. The elasticities for dummy variables are calculated by the corresponding coefficient over the mean of the dependent variables.

Table 6.7: Influences of Socioeconomic Determinants on Gender Discrimination for Haz

Variable Name	Cofficients			Difference	
	All	Boys	Girls	Cofficient	T-statistics
Sex of the child	-0.272				
	(-6.87)				
Child Aged 12-36	-0.417	-0.359	-0.464	-0.105	-1.42
	(-6.85)	**-4.25**	**-5.28**		
Child Aged 36-59	-0.47	-0.435	-0.504	-0.070	**-1.76*** **
	(-7.85)	**-5.29**	**-5.79**		
Mother's Education: Primary	0.14	0.136	0.118	-0.018	-0.25
	(3.17)	**2.31**	1.79		
Mother's Education: Secondary	0.559	0.368	0.707	0.339	**2.85*** **
	(9.36)	**5.05**	**7.81**		
Household Size	-0.051	-0.059	-0.10	-0.159	**-2.20*** **
	(-3.03)	**-2.71**	**-2.85**		
Income	0.081	0.095	0.068	-0.026	-0.91
	(6.15)	**5.11**	**3.68**		
Number of females 15-55	0.139	0.099	0.191	0.091	**1.77** **
	(4.07)	**2.19**	**3.70**		
Number of females 55+	0.118	0.084	0.159	0.075	1.23
	(2.48)	1.43	**2.08**		
Number of males 0-15	-0.05	-0.063	-0.038	-0.101	1.36
	(-2.34)	**-2.18**	-1.19		
Number of males 15-55	0.019	0.021	0.017	-0.004	1.37
	(0.60)	0.49	0.35		
Number of males 55+	0.063	0.108	0.001	-0.107	0.06
	(1.35)	**1.72**	0.01		

Table 6.7 continued

Open Latrine Used	-0.108	-0.065	-0.169	-0.105	-0.69
	(-1.53)	-0.69	-1.56		
Close Latrine Used	0.029	0.106	-0.086	-0.192	-1.05
	(0.4)	1.11	-0.76		
Year 1997	0.026	0.053	-0.002	-0.054	-0.57
	(0.62)	0.92	-0.02		
Year 1998	-0.047	0.003	-0.095	-0.097	-0.97
	(-1.07)	0.04	-1.45		
Number of Observations	3877	1968	1909		
R-Square	0.0842	0.083	0.0803		

*** 1% level of significance

** 5% level of significance

**10% level of significance

Notes: All p values are based on White-corrected standard errors and robust to intre-cluster correlation.

CHAPTER SEVEN
SUMMARY AND CONCLUSION

This study has primarily focused on two issues: (i) child nutritional status and (ii) gender discrimination against girls. It is important to identify factors leading to higher nutritional status as it can lead to lower child mortality rate and a more productive workforce for the future. Gender discrimination in child nutritional status can lead to malnourished young girls, who become malnourished mothers and then compromise the health of their offspring. In the last eight years, the government of Bangladesh and other non-governmental organizations have intensified efforts to fight malnutrition, but still the level of chronic malnutrition in Bangladesh is 56%, which is higher than that of other developing countries in South-Asia. In India, Nepal and Pakistan the malnutrition rate is 53%, 2% and 38% respectively. (Website:Nation by Nation, 1997).

From the literature review, gender differential analysis shows that girls are more severely malnourished than the boys of same age groups in Bangladesh. It is estimated by Food and Agriculture Organization (FAO) that about 58% of Bangladesh's girls under five years old are underweight for their age suggesting chronic malnutrition and the rate is 54% for boys in this age group. In case of India 38% of girls under five years old are malnourished and the rate is 37% for boys (FAO, 1997).

The primary purpose of this thesis is to identify the effect of underlying determinants on child nutritional status and their influence on existing gender discrimination against girls. This analysis is conducted for children in 0-59 months age in eight different villages in Bangladesh using annual data from 1996-1998. Estimation was done using a household fixed effect model.

7.1 Conclusions

This study confirms the dependence of nutritional status on several key socio-economic factors. There is significant anti-female gender discrimination in long-term child nutritional status in rural Bangladesh. The study emphasizes the role of mother's education in influencing both long-term and short-term nutritional status of children. Further, secondary education of mothers' positively affects the long-term nutritional status of the children in all age groups. The total number of children in the family negatively affects nutritional status i.e. if the household comprises of many young girls and boys, it leads to sharing of food and care and hence worsening of nutritional status of all the children. A Larger proportion of female members plays a positive role on both long-term and a short-term child nutritional status for all age groups. Higher household income also plays a significant role in improving short-term and long-term nutritional status for all children aged 0-5 years. However, this finding does not hold for each age group separately. Individual regressions for different age groups showed that income does not influence short-term or long-term nutritional status for infants but it plays a significant for older children.

The study shows that long-term nutritional status of girls suffer from discrimination. However, there is no definite evidence of worsening of short-term nutritional status of girls due to discrimination against them. The same factors that affected the nutritional status of both the girl and boy child are found to affect the gender bias. Mother’s education plays a significant role in curbing discrimination against girls. A bigger household size is conducive to anti-female gender discrimination. The larger number of adult females that participate in providing child care play an important role in reducing discrimination. It is also observed that as the children grow older, girls suffer even more discrimination. This may happen because as children become older their food needs or nutritional requirements for growth increase and, thus, even less portions of food go to the girls. High prevalence of discrimination against the girl child is a result of the strong influence of some socioeconomic factors working to increase discrimination.

The fact that, even though the socioeconomic and health service factors which had positive impact on nutritional status could not alter the condition of female children which indicate the deep-rooted nature of the inferior status of women in this society in general. Thus, an improvement of girls’ health to the level of boys’ may need broad-based interventions beyond health, aimed at changing value systems and behavior of the population.

7.2 Policy Implications

Public policy can go a long way toward improving child nutritional status and decreasing anti-female discrimination. The results of this study demonstrate that policies that aim to improve household economic status and health environments, and educational status of mothers, could help to improve child nutritional status.

Emphasis on girls' education*:* Overall the education system with particular focus on girls' education would work toward increasing the nutritional status of children and reducing discrimination against girls in the long term, but for immediate effect we need to promote adult education emphasizing educating the mothers.

Create opportunities for income*:* Poverty is endemic in Bangladesh, effecting over 86% of the population. Most of the poor live in the rural areas. Action to eradicate poverty and increase income must be taken because it is one of the most influential determinants of malnutrition for both short-term and long-term. In short-term, targeted income transfers to the poorest section of the population will provide some immediate relief and create a safety net. Off-farm income generating activities must be promoted, especially in rural areas, in order to reduce the pressure of agricultural activity on the already nutrient depleted soils. Employment opportunities and earnings can be increased, for example, through investment in education and skills training.

From the finding of this study, it can be said that even though income has no influence on anti-female gender discrimination, we can say that if household economic status improves, child malnutrition will decrease and that will lead to a decrease in discrimination.

Access to adequate water and sanitation facilities*:* The government of Bangladesh should also invest in social amenities, like increasing the proportion of people with access to potable water and sanitary latrines. With government support, sanitary latrines can be built for households, neighborhoods and markets. Education about hygiene needs to be given at the village level. This can be done by having workers spread information about the importance of safe hygiene practices through artistic mediums such as plays, storytelling and posters.

Special programs for Child Health care*:* Special attention must be directed to infant feeding. In the short run, targeted supplementary feeding needs to be offered to all infants born with growth deficiency so that they can catch up sooner with their healthier counterparts that will also help in reducing gender discrimination. Bangladesh needs supplementary feeding programs particularly focusing on children 6-24 months in conjunction with free programs with health care centers. The benefits of breast-feeding, complementary feeding and supplemental feeding can also be communicated to mothers through peer counseling. In the long run, major policies need to be formulated in the proportion of educated women and women's status as they have significant influence in improving child nutritional status and also in reducing anti-female gender discrimination. For example, the value of girls' education can be stressed to families and communities by consistently organizing social mobilization and gender awareness activities. The introduction of non-formal education centers could fulfill the basic educational needs, such as literacy, to some out-of-school girls and older women. Financial assistance in the form of credit should be directed to poor women in order to encourage income-generating activities.

Care for mothers*:* Programs to improve the nutritional status of children in developing countries need to give priority to women's health care because improving women's nutritional status enhances child nutritional status and also decreases discrimination. In the short run, a nutrient intake (Iodine, Vitamin D, …etc.) program targeting pregnant women countrywide can help reduce low birth weight. To be successful in the long run, prenatal intervention programs need to be focused on both nutrient deficiency prevention and treatment.

Even though, this study has shown that some behavioral factors can reduce anti-female gender discrimination but an improvement of girls' health to a level of boys may need broader interventions beyond health; aimed at changing value systems and behavior of the overall population.

CHAPTER EIGHT: APPENDIX

1. $$t = \frac{\bar{x} - \bar{y}}{\sqrt{\frac{(n_x - 1)s_x^{\,2} + (n_y - 1)s_y^{\,2}}{n_x + n_y - 2}} \times \sqrt{\frac{1}{n_x} + \frac{1}{n_y}}}$$

where n_x and n_y are the number of observations in group x and y respectively. The result is distributed as Student's t with ($n_x + n_y - 2$) degrees of freedom.

2. The test statistic for a two-sample z-test for proportion is :

$$z = \frac{\hat{p}_x - \hat{p}_y}{\sqrt{\frac{(x+y)}{n_x + n_y}\left(1 - \frac{(x+y)}{(n_x + n_y)}\right)} \times \sqrt{\frac{1}{n_x} + \frac{1}{n_y}}},$$

where $\hat{p}_x = {x}/{n_x}$ and $\hat{p}_y = {y}/{n_y}$ (Statacorp 2002)

3. The formula for the F test is

$$F = \frac{SSR_F - (SSR_B + SSR_G)}{k} / \frac{SSR_B + SSR_G}{N_B + N_G - 2 * k}$$

Where SSR_F is the sum of square residual of a regression that includes the pooled data for both male and female, SSR_B and SSR_G the sum of square residual of regressions for boys and girls respectively. The Chow-F test rejected the null hypothesis and concluded that there were significant differences in the parameter estimates across the sex of the child in the study period. Which will help us to show the robustness of our results.

4. Specification and Mis-specification Test

4.1. Breusch-Pagan Langrange Multiplier (LM) test for Heteroskedasticity.

Consider the linear model:

$$Y_t = B_1 + B_2 X_t + B_3 X_t + u_t \qquad (t = 1, ..., N) \qquad (1)$$

First, estimate model (1) by OLS and obtain the residuals, e_t .

Second, run the following auxiliary regression:

$$e_t^{\ 2} = A_1 + A_2 X_t + A_3 X_t + v_t \qquad (2)$$

which is a regression on the squared residuals on all the original variables. To test T test if the variables have an explanatory power in regression (2), compute the LM static

$$LM = N * R^2 \qquad (3)$$

The LM statistic for Heteroskedasticity is the sample size N time s the R-squared from (2). Under the null hypothesis, LM is asymptotically distributed as chi-squared (χ^2) with degrees of freedom equal to the number of independent variables excluding the intercept term (Greene 2000). If the χ^2 value exceeds the critical value of the chosen level of significance (p-value>=0.10), then the null hypothesis of homoskedasticity is rejected.

4.2. Ramsey-Reset Test for omitted variables

Suppose the model first estimated is:

$$\hat{Y}_i = \hat{B}_1 + \hat{B}_2 X_{2t} + \hat{B}_3 X_{3t} \qquad (t = 1, \dots, N) \qquad (1)$$

The Reset test proceeds by estimating,

$$\hat{Y}_t = \hat{G}_1 + \hat{G}_2 X_{2t} + \hat{G}_3 X_{3t} + \gamma_1 \hat{Y}_t^2 + \gamma_2 \hat{Y}_t^3 + \gamma_3 \hat{Y}_t^4 \qquad (t = 1, \dots, N) \qquad (2)$$

Therefore, two regressions are estimated where (2) is (1) with the additional of powered fitted values obtained from (1). The null hypothesis is that no variable was omitted from the first regression ($\gamma_1 = \gamma_2 = \gamma_3 = 0$), and the alternative hypothesis is that there are omitted variables. To test for specification error, the F test statistic is formed as:

$$F = \frac{SSR_M - SSR / M}{SSR / (N - K - 1)}$$

where SSR_M is the sum of squared residuals in the restricted equation (without the powered fitted values), SSR is the sum of squared residuals in the unrestricted equation, M is th number of restrictions, N is the number of observations, and K is the number of parameters estimated in the unrestricted equation. If the F test statistic is greater that n the F critical value (P-value>=0.10), we reject the null hypothesis that no variable is omitted in the regression model (Johnston and Dinardo 1997).

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