Recovery of Children from Malnutrition in Adolescence: The Case of Pakistan

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Contents

List of Tables

List of Figures

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Abstract

There is potential for recovery among children suffering from malnutrition. The extent to which there were improvements in the children's Body Mass Index (BMI) is explored in the study of 890 children from rural areas of Pakistan using Pakistan Rural Household Survey (PRHS) 2001 and Pakistan Panel Household Survey (PPHS) 2010. Using the Body Mass Index (BMI) the percentage of underweight children is 55.72% in 2001 while it falls to 43.48% in 2010. The likelihood that the recovery of children was influenced by certain factors is calculated using the probit regression. Education of mothers in 2001 was associated with improved nutritional status of children in 2010. Similarly, other variables like the number of rooms in a house and ownership of assets which indicate the living conditions of a household had a positive relation with the recovery of children from malnutrition. These results show that there is a large potential for recovery in malnourished children as they grow into the adolescent years.

Chapter 1

Introduction and Background

1.1 Introduction

Malnutrition occurs when a person is not getting enough food required for the body to function or not getting the right amount of micronutrients. A person may develop malnutrition due to the lack of a single vitamin in the diet. Micronutrients are required by the body in small amounts. These help the body to grow and function properly (Aga Khan University, Pakistan, 2011).

Even if people are getting enough to eat, they can become malnourished if the food they eat is not providing the right amount of micronutrients. Obesity is also a form of malnourishment. Malnutrition is the largest single contributor of diseases in the world according to United Nation's Standing Committee on Nutrition (SCN) (Fifth Report on the World Nutrition 2004).

Malnutrition impairs physical and mental growth of children. If stunting process occurred in early childhood, the height-for-age did not improve across the eight years of adolescence (United Nations Administrative Committee on Coordination, 2000). Child malnutrition can continue to be a problem in the adulthood. It increases the risk of infectious diseases leading to increasing number of deaths. It also increases the economic burden of the society. (Jesmin, Yamamoto, Malik, & Haque, 2011)

A number of studies have been targeted to check if the undernourished children have been able to catch up on growth during their adolescence.

Environmental changes in the lives of children with malnutrition and physical changes over time have been assessed. Stunted children have shown improvement if their environment during the first two years of life was improved. Studies have also been conducted to examine the reasons for stunting. These reasons may not help to reverse the effects of stunting in children. For example, family income forms the risk of stunting but was not associated with the incidence of recovery from stunting. This study is aimed to assess the reversal of child malnutrition in adolescence in rural Pakistan.

Malnutrition has been studied as a subject in Pakistan before. The different aspects of malnutrition like its prevalence, causes and magnitude have been covered. Arif et al. (2012) studied the situation of malnutrition in Pakistan in the context of poverty and health. Mansuri (2006) assessed the nutritional status of Pakistani children and the effect of migration on it.

The possibility of reversal of malnutrition has not been covered in Pakistan. This study aims to explore the reasons for the reversal of the process of becoming malnourished. This study uses panel data to assess changes over time in children who are malnourished at an early age. This analysis will help to understand the factors that influence the health status of children and help them overcome malnourishment over time.

1.2 Background of the Study

There are more than 150 million children in the world under the age of 5 who are malnourished, and 54% of the child deaths in developing countries are connected to malnutrition. Malnutrition is a major health issue in South Asian region. Three major contributors of the region are Bangladesh, India, and

Pakistan which make-up for half of the world's malnourished women and children. Malnutrition is a recognised health issue in Pakistan elevating the rates of child mobility and mortality rates. Malnutrition when combined with infectious disease can result in child and maternal mortality. (Aga Khan University, Pakistan, 2011)

Malnourished women are at a higher risk of giving birth to low weight babies. Infants born with a low birth weight are at a higher risk of morbidity and mortality. Those who survive are often stunted and malnourished. Stunting is an indicator of growth retardation. The stunted children grow into individuals who contribute less to the society. Stunting declined in Pakistan from 67% in 1977 to 40-50% and remained at such levels until the end of the 1990s. These rates are still very high when compared to the global average.

1.3 Objectives

The objectives developed for the study are:

- To examine the magnitude of child malnutrition in rural Pakistan,
- To assess the recovery of children from malnutrition in adolescence; and
- To analyse the determinants that help children overcome malnutrition

1.4 Hypotheses of the Study

The hypotheses of the study are as follows:

- Child malnutrition is highly prevalent in rural Pakistan
- Children can overcome malnutrition in adolescence
- Recovery of children from malnutrition is affected by different factors

1.5 Rationale of the Study

Malnutrition is highly prevalent in rural Pakistan. Studying the same children over time to see their progress and understanding the causes of their progress is the main objective of the study. Exploring the reasons leading to recovery from malnutrition can help shape interventions. Such interventions can help to bring children out of malnutrition. Interventions can be suggested which are cost effective and can be carried out earlier in life to avoid prolonged effects of malnutrition.

1.6 Organization of the Study

The study is divided into five chapters. The first chapter comprises of the introduction to the topic, its background with respect to the situation in Pakistan and the world, the objectives of the study, the hypotheses of the study and the rationale of the study. The second chapter focuses on the relevant literature from Pakistan and all over the world. It summarizes a number of works that have been done by people across the globe on similar topics. The third chapter contains the sources of data, the study framework, explains the methodology adopted in the study and gives a definition of all the variables included in the study. The next chapter focuses on the results of the study. The nutritional situation in 2001 is discussed in detail which is followed by the situation in 2010. Recovery of children from malnutrition and the variables associated with it come next. The final chapter focuses on the conclusion and policy implications.

Chapter 2

Literature Review

A report by Aga Khan University, Pakistan (2011) indicates that stunting, wasting and micronutrients malnutrition are widespread in Pakistan. These are caused by dietary deficiencies, poor maternal and child health and nutrition, a high burden of morbidity and low micronutrient content in the soil especially iodine and zinc. These micronutrients are essential for growth .immunity and mental development. The increase in malnutrition is due to poverty, high illiteracy rates among mothers, food insecurity, infant feeding practices and lack of access to age-appropriate foods.

Adair (1999) explored the ability of growth of stunted children. More than 2000 children were involved in a longitudinal survey from Cebu in The Philippines. Children who were stunted at age two were checked again at ages 8.5 and 12 using logistic regression analysis. 63% of the children were stunted at age 2 based on the WHO reference. The number of stunted children was 30% less at age 8.5 and 32.5% more improved at age 12. The determinants that had an effect on the catch-up growth were categorised into biological factors, socio-economic measures and dietary intake. Biological factors include mother's height, birth weight, gestational age etc. Socio-economic measures include total household income, ownership of certain assets, presence of electricity and piped water, cleanliness in the area around the house etc. the determinants linked with the improvement of stunted children were taller mothers, child being a first born, height at birth, fewer siblings,

and less severe stunting. However, low birth weight and more severe stunting were the factors which hindered children from recovering. The results prove there is a huge potential for catch-up growth in children in the preadolescent years.

Grantham-McGregor et al (2007) reinforce the need for attention to the children's development during the first five years. Sometimes small disturbances in the development process can have lasting effects on the brain's capacity. Recovery from these early effects on the cognitive functioning is possible with interventions. National statistics do not have the appropriate data to study the seriousness of the issue. Failure to complete primary education gives some idea of the extent of the issue. Only 78% of the children enrolled into school complete primary educations.. Most of the children who fail to do so are from sub Saharan Africa and south Asia. Growth potential of children is similar across countries. Some catch –up growth can occur but most stunted children remain stunted through to adulthood. Longitudinal studies conducted in Pakistan and Guatemala show stunting in infants predicted age of walking. Stunting at 24 months was linked to cognition at 9 years in Peru, intelligent quotient (IQ) at 8 and 11 years in Philippines's and Indonesia. Cross sectional studies in Tanzania, Nepal, China, Jamaica, India, Malaysia, Turkey and Brazil study the association between stunting and poor school progress. Some of them enrolled late to school, some of them did not enrol into a school, attained lower grades for their age or had poor cognitive ability.

The data on nutritional status of the adolescents is less to study stunting. International Centre for Research on Women (ICRW) conducted a study

comparing stunting rates across countries. The stunting which occurred early in the childhood continued to exist across the eight years of adolescence. There is hardly any evidence to prove that the stunting can be revered in adolescence. A number of studies have been shown that some catch-up growth may be possible .The environment they reside in plays an important role. There are only chances of improvement in the stunted children if their environment changes with the first two years of life (*The World Nutrition Situation 2010).*

30 million babies are born annually with impaired growth in the developing world. Two third of these children are from South and Central Asia. These babies have a long-term effect on the individuals, households, communities and nations. The children who are born malnourished are at a greater risk of disease such as diarrhoea and pneumonia. The risk of death is also higher for such infants. During adolescence, children grow at a higher pace that at any other time of the life. However well-nourished and under nourished individuals may grow up to gain the same height. This height can be same during adolescence but can be different during adulthood due to the stunting in childhood.

MH (1994) conducted a study on malnourished children. When children are stunted in their childhood they may exhibit catch-up growth in their adulthood. This catch-up growth is often to changes in environment or treatment of the disease children are suffering from. The maximum height of individuals may be limited because of genetic imprinting. Some data from the US show that change in environment can reverse the process of stunting in the Third World. Children can then reach their full potential heights. The reason

why catch-up is not possible in some cases is due to the unavailability of appropriate diet over a specific period of time. The amount of nutrients is unknown in such a diet, however, sulphur has been underutilized.

Glewwe et al (2001) study the relationship between nutritional status of children and their learning potential in a longitudinal data set using Filipino children from birth until the end of their primary education. Children with better nutrition perform considerably better in school. There are two reasons for their performance; entering school early and greater productivity in each year of schooling. The cost benefit analysis carried out revealed that for each dollar invested in nutrition in childhood are worth three dollars or more worth of gain in academic achievement. This study was carried out using an achievement production function. It relates nutrition in early childhood and academic output of children measured on a test. Instead of using the cumulative inputs in nutrition, height-for-age is used as a measure for the nutrition history up to that age. The results show that home environment and parental tastes cannot be linked with poor performance of malnourished children in school. There is still a positive relation between nutrition and academic achievements.

Sedgh et al (2000) studied the relation between vitamin A intake, non-dietary factors and growth in Sudanese children of age 6 month- 72 months. These children were stunted at the start of the study. Growth and Vitamin A intake were linked after controlling for the age, sex, socio-economic variables and breast-feeding status. A multivariate analysis was carried out to show that the children who were in the highest grew 13mm more than the children in the lowest quintile. Recovery from stunting may be possible by consuming diets

which in carotenoids. These effects may be the loudest in those children who are very young or those who have been malnourished. Other factors associated with recovery of stunting were age, sex, breast-feeding status, socio-economic status and the severity of stunting.

Mansuri (2006) has assessed the nutritional status of Pakistani children. The effect of migration on the health status was studied in addition to a lot of other factors like gender, household characteristics, access to market, availability of healthcare and quality of healthcare. The data used was from rural Pakistan. The results show that growth of young girls is positively affected by migration. Only the migrant households were analysed to obtain these results and health status of siblings was compared before and after migration.

Arif et al(2012) examined the situation of malnutrition in Pakistan in the last decade. This situation was understood using the estimates of poverty and health status of children and their mothers'. Variables on individual, household and community level were used to understand the changes in malnutrition. The focus was mainly on child illness, mother's health and poverty status of households. The results of the study did not show any significant association between poverty and malnutrition or food shortages and malnutrition. The main cause of malnutrition was found to be child illness in addition to child's and mother's nutritional status, environmental factors and poor healthcare facilities.

Makoka (2013) analysed the effect of maternal education on children's nutritional status. The effect was observed for children below the age of 5 years in three African countries; Malawi, Zimbabwe and Tanzania using the

Demographic and Health Surveys (DHS). Three measures of the nutritional status were used i.e. stunting, wasting and underweight. The association between maternal education and child's nutrition was analysed using bivariate analysis and the Pearson Chi-Square Test of independence. Further, a logistic regression was used to study the determinants affecting the relation. Results emphasized the importance of mothers' education for improved indicators of child's nutrition. The levels which significantly improved the two indicators stunting and underweight were 9 years of schooling in Malawi and 11 years of schooling in Tanzania and Zimbabwe.

Buror (2003) studied the relation between education of women and the survival of their children was explored using the Ghana Demographic and Health Surveys (GDHS). The rate of child mortality is very high in Africa. The mortality rate is as high as 151 children under 5 in every 1000 years. Mother's education is taken as the independent variable. Its relation to antenatal care, nutrition of mothers, nutrition of children and postnatal care were studied. The data was used from the 1998 GDHS. The prevalence of diseases and malnutrition was also analysed in reference to mothers' education. Malnutrition was found to be associated with mothers' education. Malnutrition is one of the reasons for childhood mortality. There was a clear distinction between illiterate mothers and mothers with secondary education and above in the prevalence of childhood malnutrition. Malnutrition was measured by calculating weight for age and height for age.

Susan H. Cochrane et al. (1982) evaluate the effect of parents' education in two ways. One way is to assess the effects of education on income, wages, knowledge and health. The other approach combines all the channels through

which education is beneficial to estimate the overall effect. The cross-national data had the limitation of variability in adult education and its link to the availability of health inputs. The study was further divided into two steps. The data of individual family units was used to control the exogenous variables and estimate the net effect of education on child health. Then the multivariate studies were reviewed. These two steps were merged to study the aggregate regions within countries. Later, the individual estimates and net effects were compared. The results indicated mothers' education to be closely linked with child's nutritional status and mortality. The bivariate analysis indicated a decrease in 9 deaths per 1000 children for each added year of mothers' schooling. The study also mentions 17 other studies conducted in different parts of the world finding an association between parental education and nutritional status of children. 12 of these studies used the variable of mothers' years of schooling and 7 of them found a strong and positive connection with the nutrition of children. 4 other studies using the measure of mothers' literacy also found a positive connection with child's nutritional status.

Gupta MC et al (1991) selected a number of malnourished children from an urban slum of low economic status of India. Same numbers of children were identified who were normally nourished and their growth matched for their age and sex. A 37 point questionnaire was administered to the mothers to test their knowledge, attitude and practices. The mothers of normal children scored considerably better on the questionnaire. Both education and knowledge were found to be positively associated with children's nutritional status.

Oyekale (2000) checked the impact of mothers' educational level on malnutrition in children was analysed using the Foster-Greer-Thorback approach in Gambia and Niger of Sub-Saharan Africa. The rate of malnutrition was measured using the three methods; stunting, wasting and underweight. The rates were higher for mothers who had no secondary education. Then a probit analysis was carried out to study the determinants which reduced the rate of malnutrition in children. The determinants were found to be education of mothers', living in urban rather than rural areas, availability of both the parents at home, administration of polio vaccine, presence of piped water and access to radio and television. The determinants which further increased the occurrence of malnutrition were diarrhoea, fever and age at first polio vaccine.

Fakir (2011) studied the anti-female nutritional bias in Bangladesh. This gender inequality exists in a lot of South Asian countries due to cultural or other reasons such as limited resources. The study was focused on malnourishment and anti-female sex bias from many perspectives in an urban slum area of Bangladesh. Malnourishment was calculated using the measure of weight-for-age for all children under the age of 5 and were compared using the WHO growth monitoring chart. The results indicated the difference of the female child from the median was greater than the difference of the male child. The Alkire-Foster method also proved to be a better estimate for malnourishment. Mothers' education significantly reduced malnourishment but it was not found to reduce the anti-female sex bias in nutrition. Public health measures and behavioural aspects were found to contribute more towards reducing malnourishment rather than economic variables.

Kaneta K. Choudhury (2000) studied the difference in the health status of young girls and boys in Bangladesh. This gender bias is explained using a number of socio-economic, demographic and health related factors in this study. A very commonly used method to measure malnutrition i.e. measurement of the mid-upper arm circumference (MUAC) was used. 2016 children less than 5 years were studied. The results indicated that 54.2% of the severely malnourished children were female while 45.8% were male. The logistic regression analysis revealed the variables affecting this gender gap significantly were the age of children, education of the head of the households and use of immunization services. Girls had 44% higher odds of being malnourished than boys. Mother's age and education was found to be associated with a decrease in malnourished children.

KO Ajao (2010) conducted a study in Nigeria to study the impact of family size on the nutritional status of under five children along with household food security and childcare practices. Data was collected using a semi-structured questionnaire from 423 mothers at different stages. The study was descriptive and used a cross-sectional approach. Children whose mothers were less educated were more likely to be stunted. Women who had more than two children who were less than 5 years old were at a higher risk of being underweight. This was the case due to the fact that mothers get to spend less time with each child. Large family size was also associated with adverse circumstances because the availability of food was less for large families.

B. S. Tomar M.D. (1980) conducted a survey consisting of 100 families was conducted in an industrial area of Gwalior. It included 314 children and its purpose was to see the influence of lacking vitamins in the children's diet. In

addition to this, the difference in the calorie intake was analysed for small and large families. The unit of comparison was the protein consumption per unit per day. Information was collected regarding type of family, number of family members, number of siblings in the family and other of birth. Dietary survey was also collected side by side. Environmental factors were analysed for each family. Height, weight, head circumference and mid-arm circumference were recorded. Malnutrition was classified using the Harvard growth charts as a reference. Results show that 68% children were below their expected weight. Changes in the skin and hair colour were observed in children in the 3rd and 4th degree of malnutrition. Decrease in protein consumption was associated with both increase in the number of adults in a family and increase in the number of children in a family. Decrease in protein intake was linked with increasing frequency of clinical signs of malnutrition.

JD & A (1969) conducted a study in Candelaria, Columbia examined the numerous factors leading to malnutrition in children under the age of 6. The factors included the conditions at birth, cultural, maternal, economic and family size. 506 families were included in the study and there were 1094 children in total. Gomez system from the Hospital Infantil in Mexico (1955) was used for the analysis. Gomez system compared the current body weight with the expected normal weight for age. Expected weight came from normal well-nourished children. The results expressed 40% of the children as malnourished. These malnourished children were mainly between the ages of 12 and 36 months. All the factors associated with malnutrition were effective through the mother. The results also indicated that the nutritional status of children would improve if family size was smaller.

Amartya Sen (1983) conducted a study in India at the Agro-Economic Research Centre at Santiniketan. It was conducted in two villages in West Bengal. Nutritional status of children under 5 years of age was checked for undernourishment as well as sex bias. Sex bias was further reflected in the results in two forms. Undernourishment was more common in girls as compared to boys and their growth statistics were lower too. The nutritional values of these villages were generally better due to land reforms. The sex bias was unbelievably higher somehow.

Raj A et al. (2015) studied malnutrition in children under the ages of five across three countries; India, Nepal and Bangladesh. Demograohic and Health Surveys were used across the three countries for data. The relationship between number and sex of siblings and malnutrition was examined using multinomial logistic regression. Girls were more severely stunted when the number of brothers increased while boys were not affected by it. Increase in the number of siblings resulted in an increase in stunting in both boys and girls. In case of being underweight having more than three sisters resulted in severe underweight for girls but not boys. Wasting was more common in girls who had brothers. Stunting and underweight was common in girls who had more than one sister. Malnutrition in boys was less affected by the presence of siblings.

Wamani H et al. (2007) studied the sex difference in 10 Sub-Saharan countries using data from 16 demographic and health surveys (DHS). Sex difference and stunting rates were examined in children under the age of 5. The difference was also associated with household socio-economic status. Stunting and sex differentials were assessed using t-test, chi-square test and

binary logistic regressions. The results showed that stunting was lower in females as compared to males. The poorest 40% households were more likely to have stunted males as compared to females in the same group. The sex differential was more in the lowest socio-economic groups.

Chapter 3

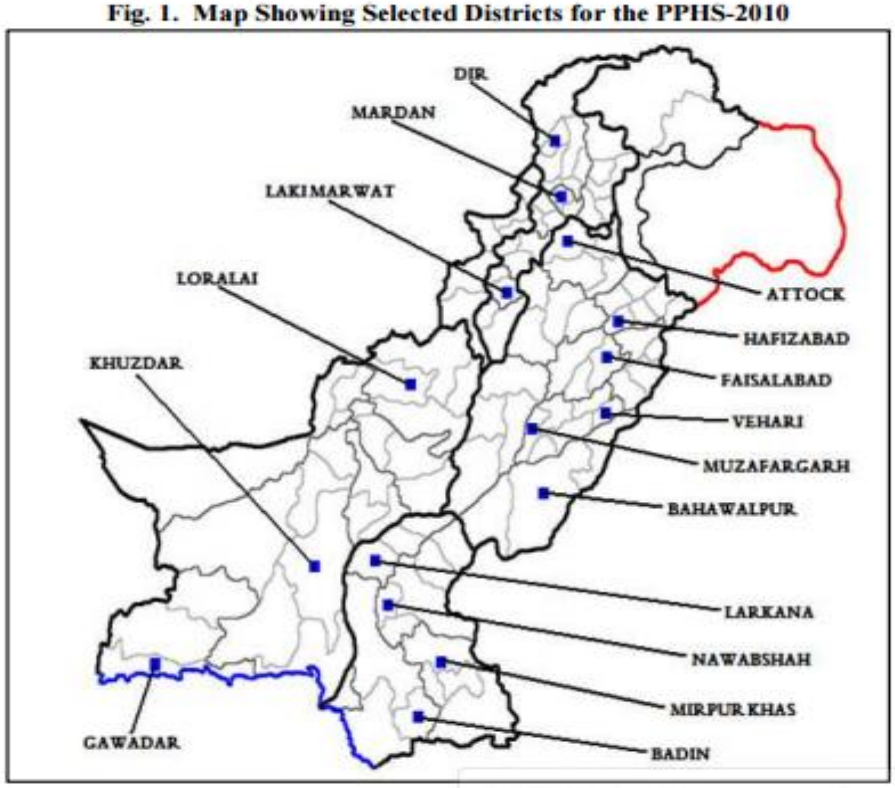
Data, Variables and Methodology

3.1 Sources of Data

Data on children's age, weight, height and sex is required to make all the necessary calculations. These measures are available in the surveys carried out by Pakistan Institute of Development Economics (PIDE) in 2001 and 2010. A rural survey was carried out in PIDE in 2001 called the Pakistan Rural Household Survey (PRHS). The panel survey consisted of rural areas from 16 districts in all the four provinces of Pakistan. The second round of PRHS was carried out in 2004 and the third round in 2010. The third survey in 2010 included the urban households too and was called the Pakistan Panel Household Survey (PPHS). Urban households were included for the first time in the sample. This study focuses on the development of malnourished children aged 0-2 in 2001. The same children will be evaluated again in 2010 for their nutritional status. The study covers only rural households because panel data for 2001 and 2010 rounds are available for rural areas only. The most relevant set of data will therefore be PRHS 2001 and PPHS 2010. The districts included in province Punjab are Attock, Hafizabad, Faisalabad, Vehari, Muzafargarh and Bahawalpur. From Sindh the districts are Larkana, Nawabshah, Mirpur Khas and Badin. Gwadar, Khuzdar and Badin are included in the data from province Balochistan. Lakimarwat, Dir and Mardan contribute to the data from province Khyber Pakhtunkhwa. Figure 1 identifies

the sampled districts in the map of Pakistan. The districts are widely spread across all regions of the country.

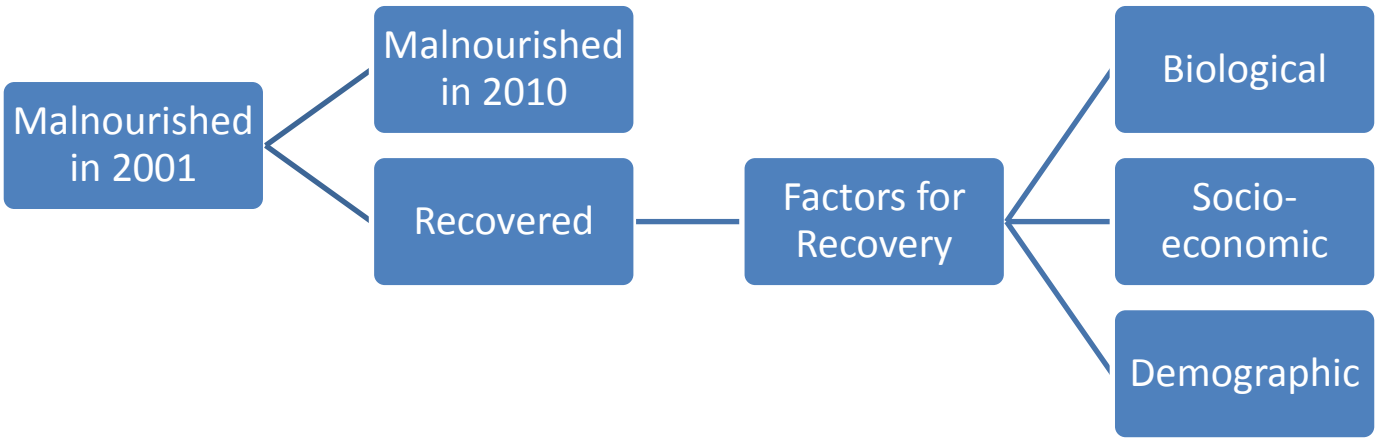
Fig. 1. Map Showing Selected Districts for the PPHS-2010



The sample includes children from Pakistan Rural Household Survey (PRHS) 2001 who are below the age of 2. There is a record of 1349 children who lie below the age of 2 in 2001. From 2010, Pakistan Panel Household Survey (PPHS) has a record of the urban population as well. We are only considering the children from the rural households since panel data is available for rural households only. In PPHS 2010, there is a record of 2081 children from rural areas who lie between the ages of 9 and 11. Children who have been included in PRHS 2001 and lie between the ages of 9 to 11 in PPHS 2010 are included in the study. The total number of children who are recorded in PRHS 2001

and again in PPHS 2010 is 892. To see the improvement in nutritional status of children data from both the surveys is required.

3.2 Analytical Framework



As shown in the figure 2, the prevalence of malnutrition is calculated in 2001 using the data from Pakistan Rural Household Survey (PRHS). After 9 years the third round of the Pakistan Panel Household Survey (PPHS) is used to calculate the prevalence of malnutrition of the same population. The results give us the number of children who have recovered from malnutrition as they have grown up. The children can overcome malnutrition due to a number of factors. These factors are biological, socio-economic and demographic and are all taken from the base year i.e. 2001.These factors are associated with the recovered children and the influence of these variables is studied. Those who have a significant effect on the recovery of children from malnutrition have been discussed in detail.

3.3 Methodology

3.3.1 Unit of Analysis

The unit of analysis will be children of ages 0-2 in 2001 and then 9-11 in 2010. The analysis includes 0-2 year old children because most of the linear growth retardation occurs at this age. New born children can have low birth weight due to other maternal or biological reasons. that this study has not excluded them rather it has included them to see changes overtime in the nutritional status of new born children. The 0-2 year old children are again assessed after 10 years when they turn 9-11 year old. They are not studied beyond this age because the growth pattern differs in every child. After the age of 11 a transition phase starts when growth in stature and height is accelerated due to hormonal changes.

3.3.2 Calculation of malnutrition

Malnutrition is calculated for children below 2 years of age using the data from Pakistan Rural Household Survey (PRHS) 2001. The measures of malnutrition used are:

3.3.3 Weight for Age (WAZ analysis) or Underweight

WAZ is the Weight for age z-score. Children with z-scores ranging from -6 to 5 will be used in this analysis. A child is considered malnourished if his or her z-score is more than two standard deviations below the WHO reference population. WHO (1994)

$$\mathbf{WAZ = (w_i - w_r) / SD}$$

This formula calculates the difference between the weight of a child and the median weight from the reference population, divided by the standard deviation of the weight of the same group of children.

3.3.4 Height for age (HAZ analysis) or Stunting

HAZ is the height for age z-score and it measures the stunting condition or chronic malnutrition. Stunting is a result of long-term insufficient nutrient intake. HAZ is calculated by a similar formula. Children with z-scores ranging from -6 to 6 will be included in this analysis.

$$\mathbf{HAZ = (h_i - h_r) / SD}$$

This formula calculates the difference between the height of a child and the median height from the reference population, divided by the standard deviation of the height of the same group of children.

3.3.5 Weight for Height (WHZ analysis) or Wasting

WHZ is the weight for height z-score. It calculates the current nutrition condition and indicates acute malnutrition. Wasting is an indicator of mortality in children. WHZ analysis includes children ranging from -5 to 5 z-scores. WHZ is a ratio of weight and height. It is calculated by dividing the weight in kilograms by the square of the height in metres.

$$\mathbf{WHZ= (kg /m^2)}$$

3.3.6 Calculation of Catch-Up Growth Using BMI

There is no definite definition of catch-up growth. It can be described as accelerated growth after a period of retardation. Catch-up growth is expected to restore growth to normal levels for that age. It may not bring individuals to normal levels for their age and sex. BMI is a simple ratio of weight and height. We can categorize individuals into being underweight, normal, overweight or obese on the basis of BMI. BMI can be used for all ages.

BMI = weight/ (height) ^{2}

BMI is a calculated by dividing the weight in kilograms of individuals by the square of their height in metres. The classification of WHO for BMI is given in the table 3.1. This classification of BMI is applied to all the children in 2001 and 2010 and it is used as base to check the recovery of malnourished children.

Table 3.1 Classification of BMI

Classification	BMI Range
Underweight	<18.5
Healthy weight	18.5-24.9
Overweight	>=25
Pre obese	25-29.9
Obese	>=30
Obesity Class I	30-34.9
Obesity Class II	35-39.9
Obesity Class III	>=40

Source:WHO

3.4 Probit Analysis

Probit analysis is a specialized version of a binomial response regression. It processes the dependent variable to assess any changes brought about by the independent variable. Probit analysis is conducted by the statistical package Stata 12. The objective is to find the determinants of child recovery where dependent variable is a discontinuous variable and is regressed on independent variable i.e. Sex of the child, child being a first born, ownership

of certain assets, presence of piped water, number of rooms in the house, mother's education and family size. Probit model is used because the dependent variable is recovery of children from malnutrition which is binary.

$$Z^*=X_i\beta+\mu$$

Z= recovery of a child

Where Z=1 for recovery and otherwise Z=0

X_i= vector of explanatory variables

β= vector of parameters

μ= error term

Recovery of a Child=β_1 Sex +β_2 First Born+β_3 Assets+β_4 Piped Water+β_5 Number of rooms+β_6 Mothers' Education+β_7 Family Size+β_8 Mothers' Age

3.5 Definition of Variables

Dependent Variable: Recovery of malnourished child

The dependent variable is the children who are malnourished in 2001 but have recovered from malnutrition in 2010.

Independent Variables: The variables used are all taken from the base year i.e. 2001. These base year characteristics are checked for influencing the recovery of children from malnutrition in 2001. These characteristics are divided into three categories:

i) Biological Factors:

Sex of the child and child being a first born

ii) Socio-economic measures

Ownership of certain assets, presence of piped water and number of rooms in the house

iii) Demographic measures

Mother's education and family size

Table 3.2 List of Variables

S.no	Variables	Units
1	Gender of the child	Dummy Variable
2	Family size	Continuous Variable
3	Mother's education	Continuous Variable
4	Mother's age	Continuous Variable
5	Child being a first born	Dummy Variable
6	Ownership of assets	Dummy Variable
7	Number of rooms	Continuous Variable
8	Facility of piped water	Dummy Variable

Sex of the child

Pakistan is one of the countries in South Asia which experiences a difference in the nutritional status of young boys and girls. This gender inequality is anti-female. The difference can be explained by cultural, demographic, socio - economic and health related factors. Some of the studies conducted in India and Bangladesh explain this difference and the reasons why it exists. Fakir (2011) explained the nature of the relationship between malnutrition and anti-

female sex bias in an urban slum in Bangladesh. The status of malnutrition was much worse in girls than it was in boys. Malnutrition was found to be less for children who had educated mothers. However, mothers' education had no effect on the anti-female sex bias. Sen & Sengupta (1983) conducted a study in India on malnutrition and the sex bias related to it. The results showed undernourishment was more common in girls while the growth statics were lower.

Child being a first born

In developing countries where the family size is large, birth order has an effect on the health of children. Nutrients available to the children are affected by the birth order. A study by Behrman (1988) in rural India indicated that parents favour older children. The nutritional allocation in the household is done on the basis that more vulnerable children are exposed to malnutrition. Another study by Arif (2004) in pakistan found out that birth order has an effect on the nutritional status of children. The results proved that younger siblings were much worse while their nutritional status was compared with their older siblings. The relation is also explored further in the study if this variable makes an impact on the recovery of malnutrition and if it's a significant one.

Ownership of certain assets

Ownership of assets shows the socio-economic conditions of a household. The more assets a household owns, the better the living conditions are expected to be. The assets included in the questionnaire are car, refrigerator, motorbike, washing machine, air cooler, air conditioner, heater, geyser, cooking stove,

cooking range, microwave oven, television, tractor, scooter, iron, telephone, computer etc. The presence of these assets does not directly improve malnutrition but their presence in the household shows an improvement in the socio-economic conditions of a household.

Number of rooms in the house

Number of rooms in the house is also an indicator of socio-economic conditions of the household. The condition and quality of housing has been observed to influence child morbidity and nutritional status. In a study by Bhuiya, Zimick, & D'Souza (1986) socio-economic indicators were found to affect child mortality and nutritional status. The number of rooms was found to be neagatively associated with the proportion of children who had malnutrition. This relation needs to be explored further to check if number of rooms are a cause of recovery from malnutrition.

Presence of piped water

Availibility of water and sanitaton are a sign of good hygiene practices of the household. Clean drinking water is a sign of better health for all the children in the household. One of the leading causes of malnutrition in Pakistan is diarrheal diseases. Diarrheal diseases are caused by water and sanitation issues. Presence of piped water in a household show that there are less chances of malnutrition due to diseases. Arif (2004) found a significant relation between diarrheal diseases and malnutrition. The connection between recovery of malnutrition and presence of piped water also needs to be explored.

Mother's education

An African study found recovery from malnutrition to be linked strongly with mothers' education than household income. The ways in which mothers' education influences child nutrition is not completely understandable. Mothers' education is linked to better understanding from media and identifying better quality healthcare. Studies from various countries indicate that knowledge and practices are the main reason of better nutritional status in children. A number of studies emphasize the role of mothers' education in improved nutrition. The need for maternal education and how it is linked with improved indicators of child health in children (Makoka, 2013; Buror, 2003; Cochrane, Leslie, & O'Hara, 1982; MC, M, S, & M, 1991; Oyekale & Oyekale, 2000; Arif, 2004). Child mortality was also found to improve with increased number of years of mothers' schooling. Evidence from Pakistan, Malawi, Tanzania, Zimbabwe, Ghana, India, Gambia and other parts of the world suggests that each added year of schooling for the mothers results in a positive effect on the nutrition of the children.

Family size

Malnutrition due to lack of protein intake is a global issue and is affecting a number of developing countries. This protein energy malnutrition is sometimes a result of presence of other siblings in the household. This can happen due to the fact that mothers get to spend less time with each child. Availability of food can also be an issue in families living in adverse conditions when the number of siblings increases. A comprehensive study by Tomar & Srivastava (1980) summarizes the effect of number of children in

the family have on the calorie intake. An increase in the number of children resulted in less intake of calories and more frequent signs of malnutrition. Malnutrition has been linked to low food consumption in Pakistan before due to poverty (Arif, 2004). World Bank explored the relation between child malnutrition and poverty to be positive using Pakistan Rural Household Survey (PRHS) in 2002. Some of the studies conducted by Ajao, Ojofeitimi, Adebayo, Fatusi, & Afolabi (2010); Tomar & Srivastava, (1980) and JD & A, (1969) concluded that family size adversely affected the nutrition of children. Children were found to show more signs of malnutrition with increasing sizes of the family. Decrease of protein consumption was associated with increase in the number of people in the family.

Chapter 4

Results and Discussion

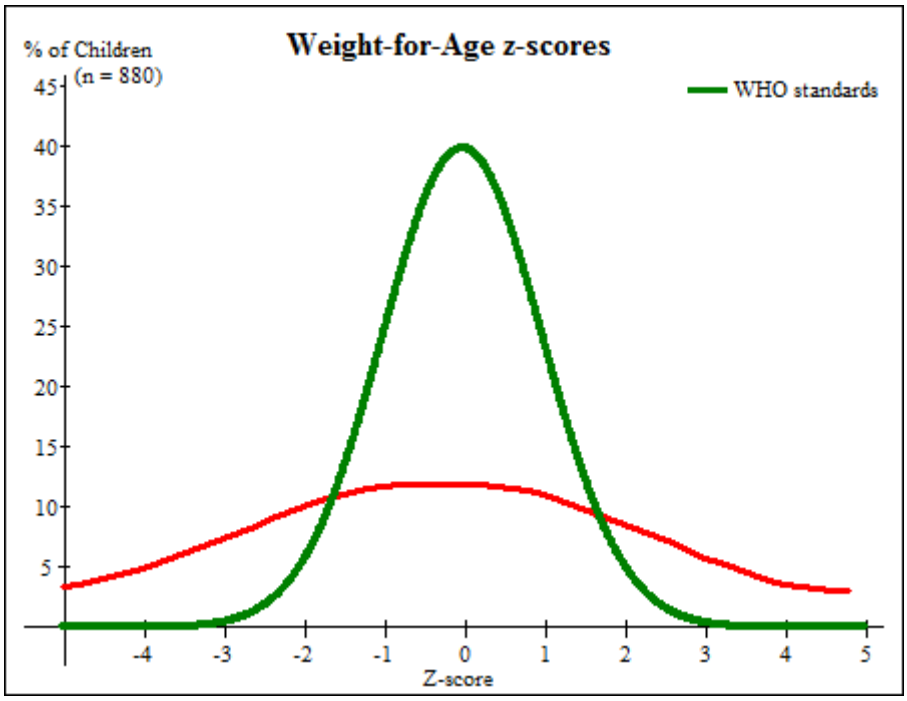
This chapter discusses the results obtained from the study. The nutritional situation in 2001 is discussed in the first section. In the second section the nutritional situation of children is assessed from the 2010 round of the panel data to see if there is any improvement or recovery from malnutrition.

4.1 Malnutrition in 2001

Nutritional status of 892 children is analysed using the data from Pakistan Rural Household Survey (PRHS) 2001. The ages of these children lie between 0-24 months. Weight-for-Age, Height-for-Age and Weight-for-Height z-scores are calculated for these children. BMI is calculated to compare the undernourished children in 2001 and 2010.

4.1.1 WAZ Analysis

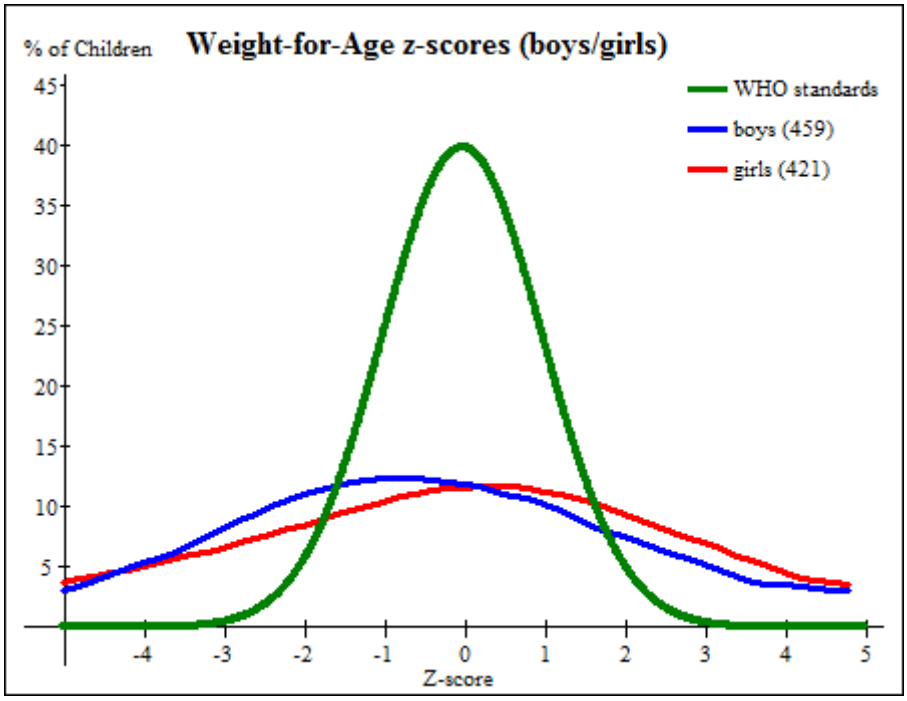
Figure 4.1 Weight for Age Z-scores



Out of the 880 children analysed for being underweight, 208 children are underweight. This makes up 23.6% of the total children. They are categorized by having a Weight-for-Age z-score of less than -2. Children with z-scores ranging from -6 to 5 are included in this analysis.

WAZ Analysis (boys/girls)

Figure 4.2 Weight for Age Z-score (boys/girls)



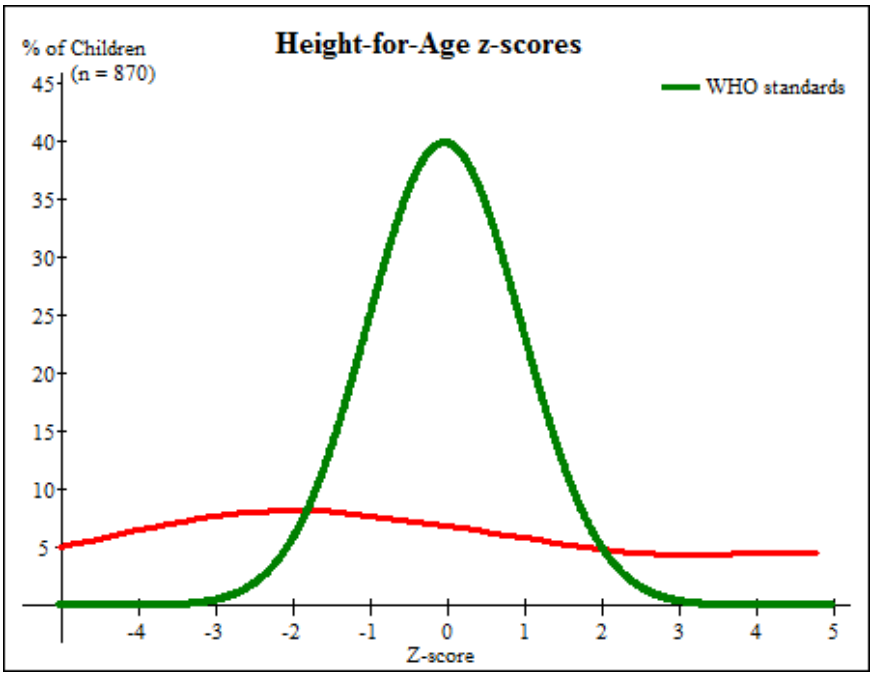
The percentage of boys who are underweight is 24.0% (110) while girls who are underweight are 23.3% (98) of the total children. The prevalence of moderately underweight children is 10% (88). These children have a Weight-for-Age z-score which lies between -2 and -3. The percentage of boys is 11.8% (54) while the girls who are moderately underweight are 8.1% (34). The severely underweight children are categorized as the ones whose Weight-for-Age z-score lies below -3. Among the severely underweight children are 13.6% (120), the boys who are severely underweight are 12.2% (56) and the girls are 15.5% (64).

Table 4.1 Weight for Age (Boys/Girls)

Weight for Age (Boys/Girls)			
Category	**Gender**	**Count**	**Percentage**
Underweight	Boys	110	24
	Girls	98	23.3
Moderate Underweight	Boys	54	11.8
	Girls	34	8.1
Severely Underweight	Boys	56	12.2
	Girls	64	15.2

4.1.2 HAZ Analysis

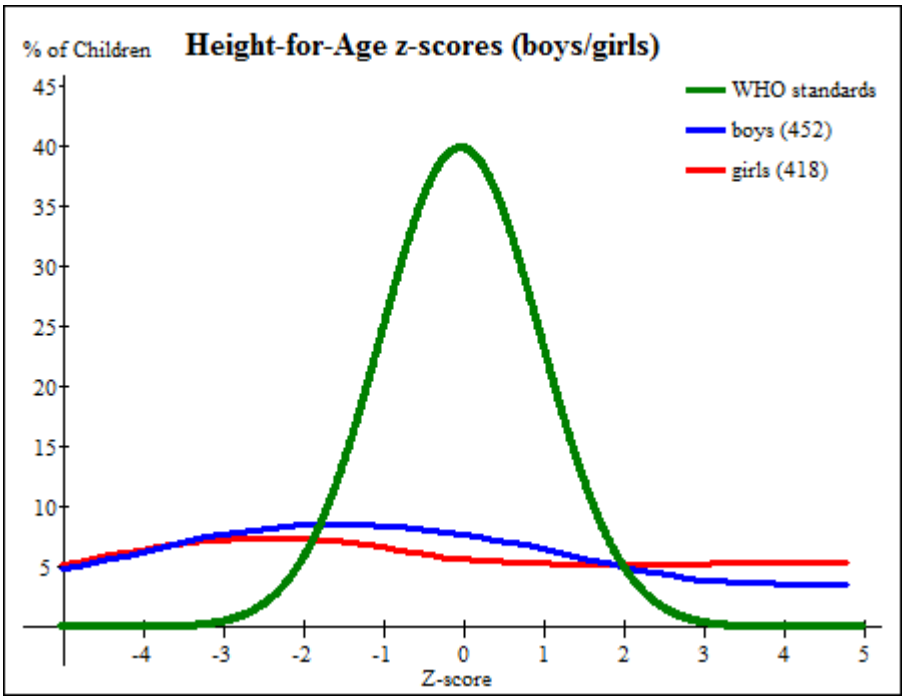
Figure 4.3 Height for Age Z-score



Height-for-Age measures the rate of stunting. Any child below the standard Height-for-Age z-score of 2 is categorised as stunted according to the standards by the WHO. HAZ measures stunting or chronic malnutrition. Children with z-scores ranging from -6 to 6 will be included in this analysis. The percentage of children who are stunted in 2001 is 30.0% (261).

HAZ Analysis (boys/girls)

Figure 4.4 Height for Age Z-score (boys/girls)



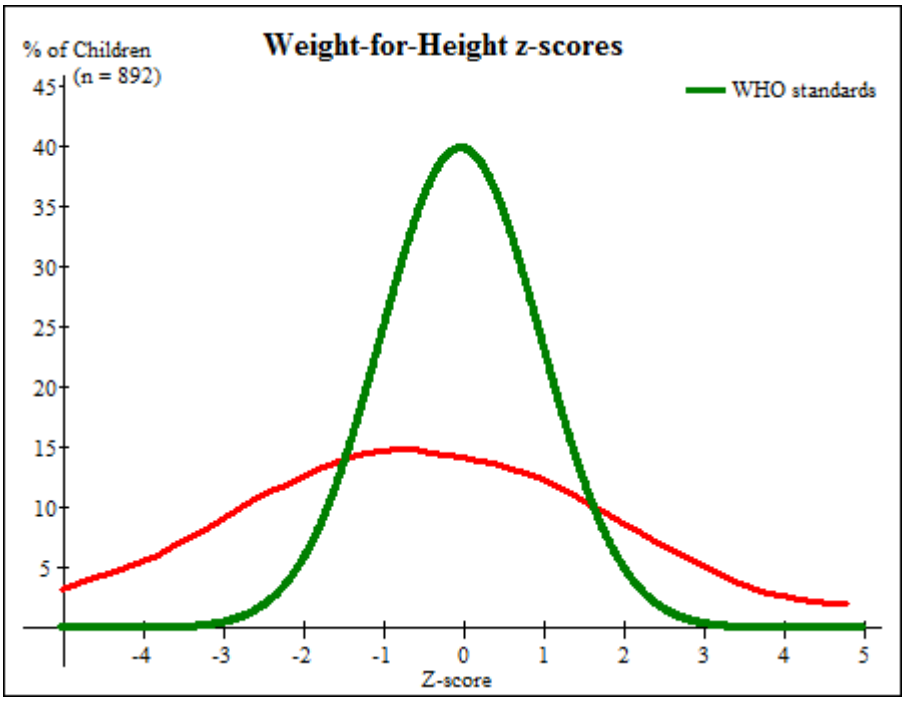
The 30.0% rate of stunting is an average of 29.6% (134) prevalence of stunting in boys and 30.4% (127) in girls. Moderately stunted children have a z-score of less than -2 but greater than -3. 6.6% (57) children lie in the range of moderately stunted children. The boys who are moderately stunted are 7.1% (32) and 6.0% (25) are girls. Severely stunted children have a z-score of less than -3. 23.4% (204) children in 2001 are categorized as severely stunted. 22.6% (102) boys are severely stunted while 23.4% (102) girls are severely stunted.

Table 4.2 Height for Age (Boys/Girls)

Height for Age (Boys/Girls)			
Category	**Gender**	**Count**	**Percentage**
Stunting	Boys	134	29.6
	Girls	127	30.4
Moderate Stunting	Boys	32	7.1
	Girls	25	6
Severe Stunting	Boys	102	22.6
	Girls	102	24.4

4.1.3 WHZ Analysis

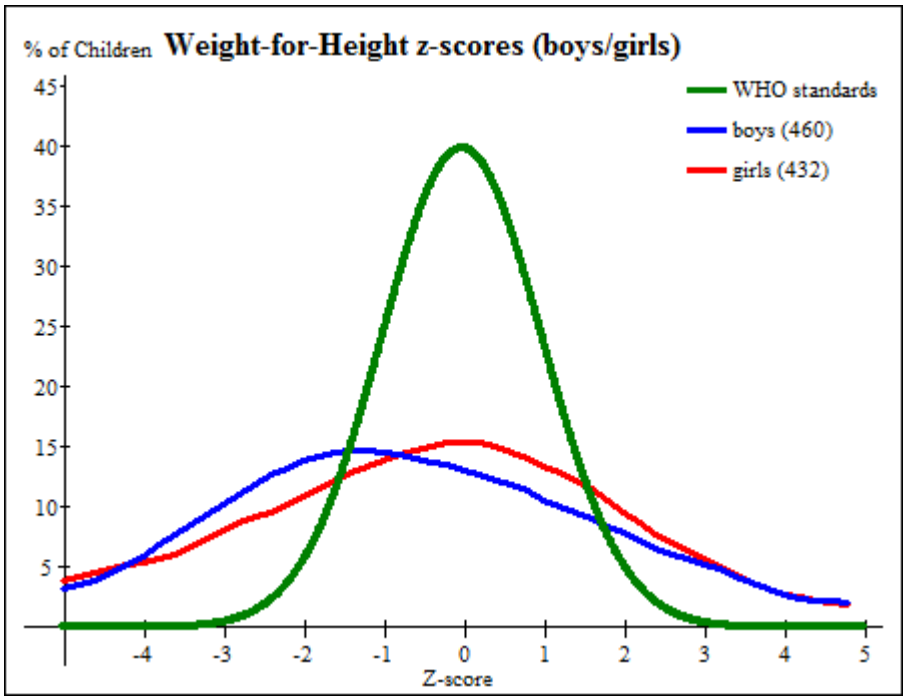
Figure 4.5 Weight for Height Z-score



WHZ is the Weight-for-Height z-score. It calculates the current nutrition condition in children. WHZ analysis includes children ranging from -5 to 5 z-scores. The percentage of children who are categorized as malnourished after checking for their Weight-for-Height z-score are 26.5% (236) of the total children.

WHZ Analysis (boys/girls)

Figure 4.6 Weight for Height Z-score (boys/girls)



The percentages of boys who are malnourished are 28.5% (131) while the girls who fall into the range of malnourished children are 24.3% (105). The rate is slightly higher for boys. Children are said to have moderate acute malnutrition when their z-scores are below -2 and more than -3. The percentage of children with moderate acute malnutrition in 2001 is 8.7% (78). This 8.7% is an average of 10.9% (50) of boys and 6.5% (28) of girls. Severe acute malnutrition happens when the z-score is less than -3. In 2001, 17.7% (158) children had severe acute malnutrition. The rate of children with severe acute malnutrition is almost the same for boys and girls. It is 17.6% (81) for boys and 17.8% (77) in girls.

Table 4.3 Weight for Height (Boys/Girls)

Weight for Height (Boys/Girls)			
Category	**Gender**	**Count**	**Percentage**
Global Acute Malnutrition	Boys	131	28.5
	Girls	105	24.3
Moderate Acute Malnutrition	Boys	50	10.9
	Girls	28	6.5
Severe Acute Malnutrition	Boys	81	17.6
	Girls	77	17.8

4.1.4 BMI in 2001

Body Mass Index (BMI) is calculated for 892 children using their anthropometric measures from the Pakistan Rural Household Survey (PRHS) data in 2001. The BMI is calculated using a simple formula i.e. weight in kilograms divided by the square of height in metres (kg/m2). BMI is used in the same way for both males and females. The children are assessed for being underweight, normal or overweight according to the criteria provided by WHO. In 2001 the results are as follows:

Table 4.1 Classification of Children According to BMI in 2001

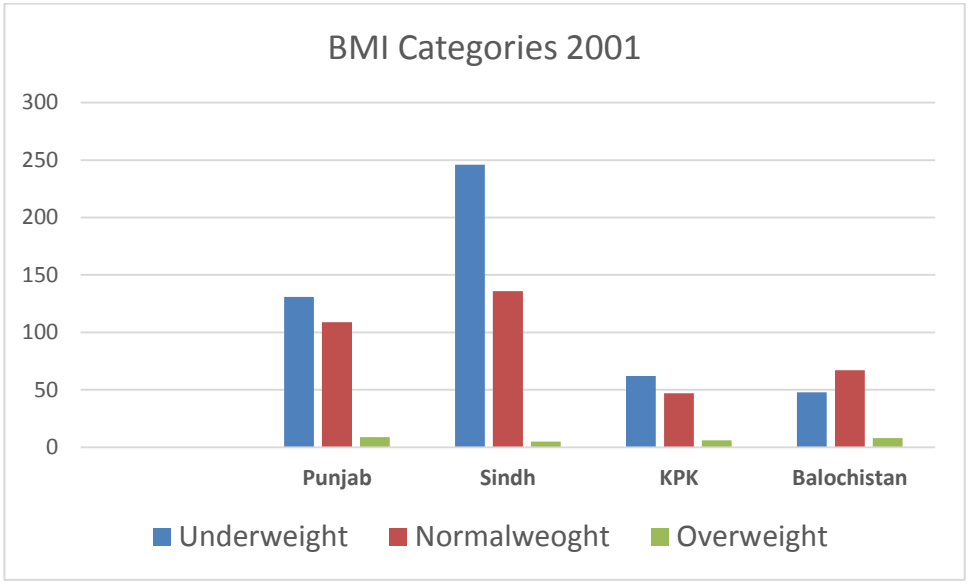
Classification	BMI Range	Percentage of children	Number of Children
Underweight	<18.5	55.72%	497
Normal	18.5-24.9	41.08%	366
Overweight	>=25	3.20%	29

Table 4.1 shows that 55.72% (497) of the total children (892) in 2001 were underweight according to the criteria. The children who come into the range of normal are 41.08% (366). Those falling in the range of overweight are

3.2% (29). These figures are then compared to the BMI of the same children in 2010 to assess if there is any recovery from malnutrition.

Provincial distribution of children according to the BMI categories

Figure 4.7 Provincial Distribution of Children according to BMI Catergories



In figure 4.7, Body Mass Index (BMI) is shown according to its distribution across provinces. The maximum underweight children are in Sindh followed by Punjab, KPK and Balochistan respectively. In Sindh, the number of underweight children is roughly the double of normal weighted children. In Punjab and KPK, the number of underweight children is slightly higher than the number of normal weighted children. The situation in Balochistan is different from the other provinces. The number of normal weighted children is higher than the number of underweighted children. The data used for calculating this provincial distribution of BMI is not representative at province level.

4.2 Malnutrition in 2010

BMI in 2010

Body Mass Index (BMI) is calculated again for the same children in 2010, when they have grown up to the ages of 9 to 11 years. These children are taken because after the age of 11 a transition phase starts when growth in stature and height is accelerated due to hormonal changes. This growth is different for each child. The BMI in 2010 is as follows:

Table 4.2 Classification of Children According to BMI in 2010

Classification	BMI Range	Percentage of children	Number of Children
Underweight	<18.5	43.48%	388
Normal	18.5-24.9	5.69%	51
Overweight	>=25	50.84%	454

Table 4.2 shows that almost 43.48% (388) of the total children (892) in 2010 are underweight according to the criteria as compared to the 55.72% (497) in 2001. The fall in the percentage of underweight children in 2010 is due to the fact that children have recovered from malnutrition. Children who were underweight in 2001 have grown up and have overcome malnutrition in 2010. They are either of normal weight in 2010 or are above their average BMI. The children who come into the range of normal are 5.69% (51). Those falling in the range of overweight are 50.84% (454).

Chapter 5

Recovery from Malnutrition

In the first section of the chapter a comparison is made between the situation of malnutrition in 2001 and 2010. In the second section the variables associated with the recovery are discussed in detail.

5.1 Recovery from Malnutrition

Figure 5.1 Percentage Distributions of Children Using BMI in 2001

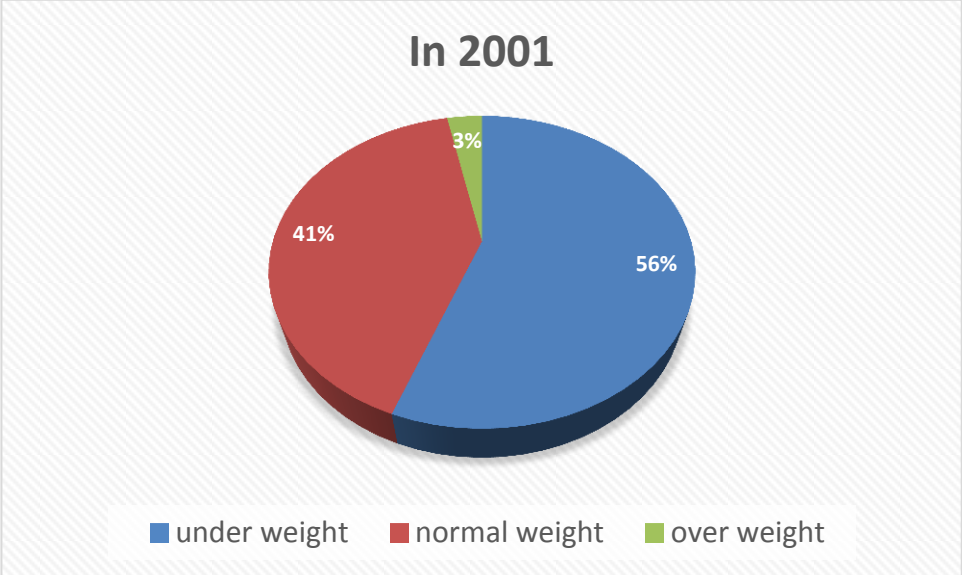


Figure 5.2 Percentage Distributions of Children Using BMI in 2010

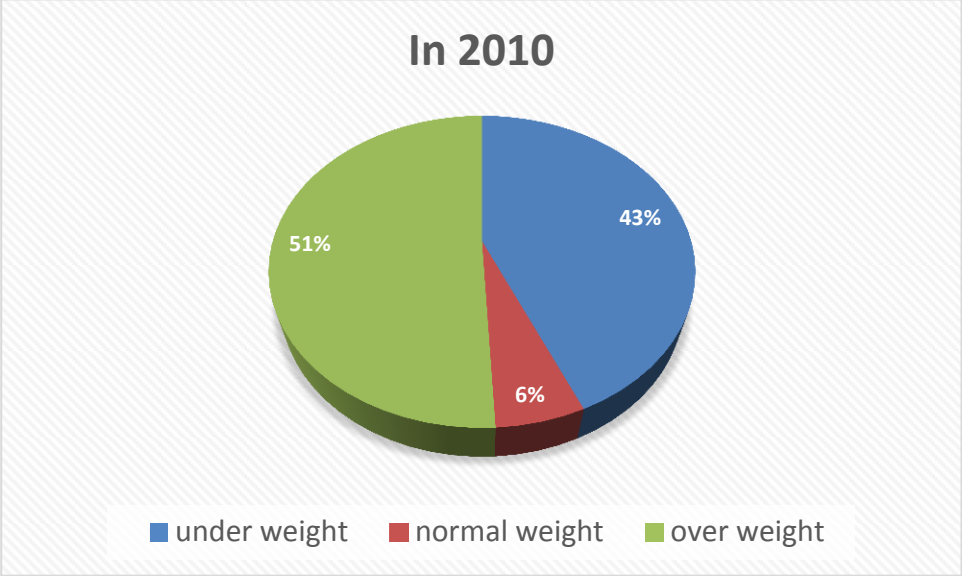
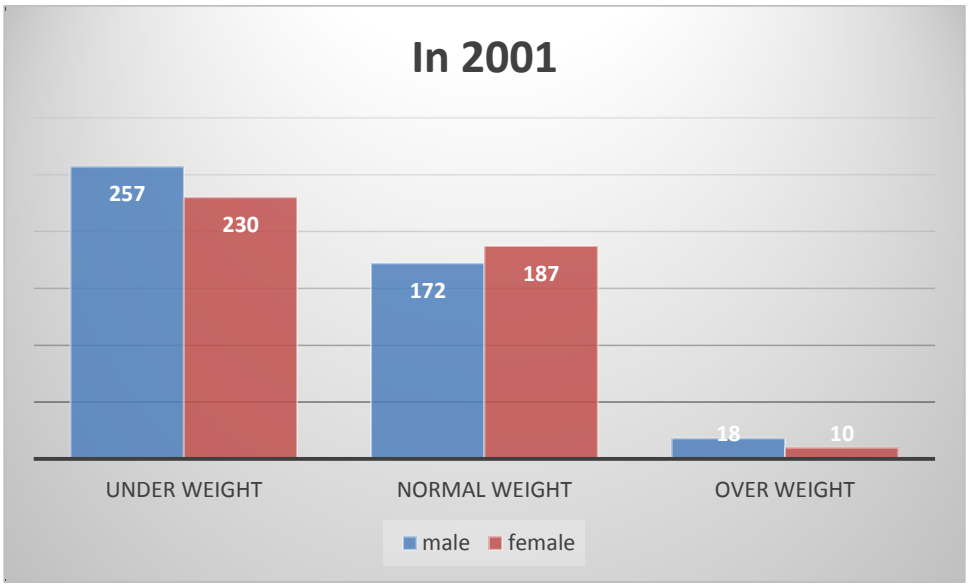


Figure 5.1 shows the percentage distribution of underweight, normal and overweight children. In 2010, there are considerably less children which fall into the category of underweight. The percentage of underweight children is 55.72% in 2001 while it has fallen to 43.48% in 2010. This comparison is based on the same children who have been studied over time. The results show the children who were malnourished in 2001 have recovered from malnutrition over the time of 9 years. These children have overcome their nutritional deficiencies.

Table 5.1 Percentage Distributions of Children Using BMI in 2001 and 2010

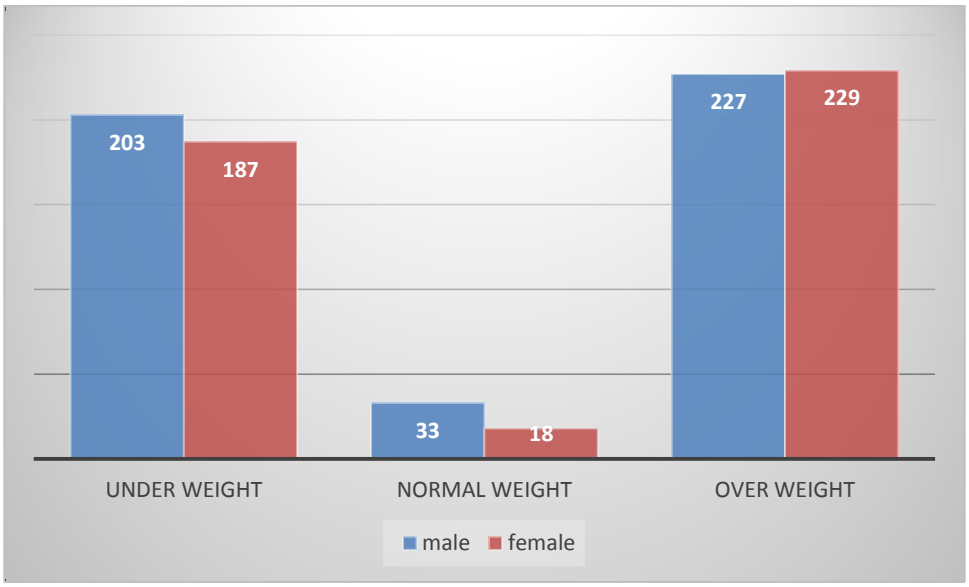
BMI	2001	2010
Under Weight	55.72	43.48
Normal Weight	41.08	5.69
Over Weight	3.20	50.84

Figure 5.3 Classification of Underweight, Normal weight and Over Weight by Gender in 2001



The bar chart shows the number of children who are underweight in 2001. Out of 874 children, 487 children are below their average normal weight. 257 of these are boys while 230 are girls. There are more male children who are underweight than female children in 2001. The number of children having normal weight is less than the underweight children. More female children have normal weight than male children.

Figure 5.4 Classification of Underweight, Normal weight and Over Weight by Gender in 2010



In 2010, the situation of underweight children has improved. There are less underweight children. Out of the 890 children, 390 children are underweight. There are 203 underweight boys and 187 girls who are underweight. The number of boys who are underweight is more than the girls even in 2010. The recovery of these children from malnutrition is linked to a number of different variables. They have been discussed in detail in the section below.

5.2 Determinants of Recovery from Malnutrition in 2001 using Probit Regression

The determinants of recovery have been calculated by using a probit model. The sample of 890 children is analysed for 8 different factors which can affect recovery. These include gender of the child, family size, mothers' age, mothers' education, child being a first born, ownership of assets, and number of rooms in the house and availability of piped water. Each of these was studied to see their impact on the improvement of nutrition of children in 2010. These variables directly or indirectly have an effect on the recovery of

malnutrition of children when they grow up. The summary of the results is given in the table 5.1.

Table 5.1 Results of the Probit Regression

Recovery	Coef.	Std.	z-value	p-value
Gender of the child	-0.8231	0.4123	1.98	0.046
Family size	-0.0052	0.00902	0.58	0.564
Mother's education	0.309593	0.096663	-3.2	0.001
Mother's age	0.045234	0.090467	-0.5	0.617
Child being a first born	0.055858	0.38127	0.15	0.884
Ownership of assets	0.652453	0.236329	2.76	0.006
Number of rooms	0.07033	0.035054	-2.01	0.045
Facility of piped water	0.49403	0.129995	3.8	0
Constant	-0.3134	0.125551	-2.5	0.013

The results given in the table 5.1 show the coefficient and p-value of each variable. The variables which have a significant impact on the recovery of children from malnutrition are the gender of the child, mothers' education, ownership of assets, number of rooms in a house and availability of piped water.

Sex of the child

According to the probit model applied on the variables, sex of the child has a significant impact on the recovery of children from malnutrition. Male children are less likely to recover from malnutrition as compared to female children. Although the literature suggests otherwise but the situation in rural Pakistan between the years 2001 and 2010 is different. More children who have recovered from malnourishment are boys.

Family Size

Children from larger family sizes are less likely to come out of malnutrition. The family size affects the recovery of children but the impact is not a significant one. Protein energy malnutrition is sometimes linked to the presence of other siblings in the house because the availibility of food is less to each individual. Family size is therefore a very impotant variable which is linked to malnutrition and recovery from malnutrition.

Mothers' Education

Children who have educated mothers have recovered more as compared to children with uneducated mothers. Mothers' education has a significant effect on children's nutritional status. The relevant literature also reinforces this relation between mothers' education and children's nutritional status. There is no direct relation between these two but awareness and better health practices lead to improved nutrition.

Mothers' Age

Mothers' age is positively related to the recovery of children from malnutrition in 2010. Children from older mothers are more likely to recover. However, mothers' age does not affect the recovery of children from malnutrition significantly.

Child being a first born

In some situations, the birth order of the children has an effect on their nutritional status. In the case of recovery from malnutrition, being a first born has a positive but insignificant impact. The relation between being a first born and being able to recover from malnutrition is positive.

Ownership of Assets

In the probit model, several assets were included to be assessed for having a relation with recovery of children from malnutrition. These assets included a car, refrigerator, motorbike, washing machine, air cooler, air conditioner, heater, geyser, cooking stove, cooking range, microwave oven, television, tractor, scooter, iron, telephone, computer etc. The ownership of assets show the socio-economic condition and the lifestyle of a household. There is a positive and significant relationship between the recovery of malnutrition and ownership of assets. The results show that more children are likely to recover from malnutrition if the household they live in owns more assets.

Number of rooms in the house

The number of rooms is a variable which shows the living conditions of a household. The probit analysis shows a positive and significant relationship between number of rooms in a house and recovery of children from malnutrition. Children are more likely to come out of malnutrition if there are more rooms in the house.

Availability of piped water

Availability of piped water is another indicator of good health. It indicates clean drinking water and a good sanitation system in the household. Availability of piped water in the household has a positive and significant relationship with the recovery of children from malnutrition. There is a greater probability of children coming out of malnutrition if there are more rooms in the house.

Chapter 6

Conclusion and Policy Recommendations

This chapter comprises of the concluding remarks, some policy recommendations which are based on the results and findings of the study and limitations of the study.

6.1 Concluding Remarks

Malnutrition is prevalent in most of the developing countries but it is highly prevalent and widespread in Pakistan. There has been little improvement in the nutritional status of children in the last two decades. Malnutrition is one of the leading causes of child deaths in the developing world. It affects the normal development and growth of children, hindering their educational performance. Understanding the reasons affecting the recovery from malnutrition may help reduce its prevalence.

Younger children are more prone to diarrheal diseases which are one of the major causes of malnutrition in Pakistan. The rate of undernourished children is very high among the younger age group of less than 2 years old in 2001. In 2010, some of the children have recovered from malnutrition and the basic reasons are explored. The main variables affecting the recovery of children significantly are either maternal factors or socio-economic ones.

Mothers' education plays a very important role in recovery of malnutrition. Awareness and better health seeking behaviour has an impact on children's nutritional status. Recovery from malnutrition is also linked to socio-economic and demographic factors. The number of rooms in a house and

facility of piped water are two of the main variables affecting malnutrition. These show the living conditions of a household. Chances of recovery are more if living conditions are better.

6.2 Policy Recommendations

Based on the results we can infer that recovery from malnutrition is possible and is strongly linked with some variables. These areas should be given special attention to make sure that the prevalence of malnutrition decreases and those suffering from malnutrition overcome the nutritional deficiencies as soon as possible. Recovery from malnutrition can help individuals lead a normal and healthy life.

Education of mothers should be given special attention in the rural areas of Pakistan. As the study is based on rural population it is observed that children who have educated mothers are less likely to be malnourished. Even the children who are malnourished are more likely to recover if their mothers are educated. Educated mothers are better aware about health and seek better quality healthcare.

Food requirements of both boys and girls should be met. There should not be any discrimination between male child and female child. Sex bias is very common in many of the South Asian countries. Sex bias should be kept in mind while dealing with children with malnutrition so that boys or girls are not ignored.

Piped water should be provided to all the rural households. Piped water is a solution to water borne diseases. Clean drinking water and proper sanitation systems should be provided to households in rural areas.

6.3 Limitations

Some of the limitations of the study are given below:

Catch-up growth or recovery from malnutrition is only calculated through one of the measures of malnutrition i.e. BMI.

Exposure to disease is a major cause of malnutrition. Children who suffer from constant illnesses cannot grow properly even if their dietary requirements are met.

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