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Impact of Economic Growth on Child Malnutrition in Pakistan: A Time Series Analysis

Seemab Gillani[1], Muhammad Nouman Shafiq[2], Muhammad Azhar Bhatti[3], Tusawar Iftikhar Ahmad[4]

[1] PhD Scholar, School of Economics and Finance, Xi'an Jiaotong University, Xi'an, Shaanxi Province, China.
Email: seemabgillani@yahoo.com
[2] PhD Scholar, School of Economics and Finance, Xi'an Jiaotong University, Xi'an, Shaanxi Province, China.
Email: muhammadnoumanshafiq@yahoo.com
[3] Associate Lecturer, Department of Economics, The Islamia University of Bahawalpur, Pakistan.
Email: azhar.bhatti219@gmail.com
[4] Assistant Professor, Department of Economics, The Islamia University of Bahawalpur, Pakistan.
Email: tusawar.iftikhar@iub.edu.pk

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ABSTRACT

Child malnutrition is of utmost concern since deprivation in early childhood often causes irreversible damage to physical and mental health, reduces learning at school, and leads to lower incomes as an adult. The study's primary purpose is to investigate the relationship between economic growth and malnutrition in Pakistan. There is a general view that if economic growth increases, malnutrition decreases. The present study examined the impact of economic growth on malnutrition in Pakistan. The study is based on time series data taking from the period of 1985 to 2021. The data are obtained from World Development Indicator (WDI) and United Nations Children's Fund (UNICEF). Six variables are used in the study, as malnutrition is the dependent variable while economic growth, immunization, health expenditures, mother education, and improved water are independent variables. The non-linear Auto-Regressive Distributed Lag Model (NARDL) is used for the empirical analysis. The results also show the long-run relationship between economic growth and malnutrition; if economic growth increases, malnutrition decreases in children.

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1. Introduction

The well-being of human beings directly relates to economic factors like income and consumption patterns. The role of income is mandatory in this regard, but many other social factors also contribute to the well-being level (Linnemayr, Alderman, & Ka, 2008). Health can be defined as a state of complete physical and mental health. It is difficult to identify the most relevant determinants for the measurement of the use of health care. In many developing countries, socio-economic factors such as safe drinking water, sanitation facilities, and health framework are important determinants of child health. The United Nations Children's Fund (UNICEF, 2009) divides children's nutritional determinants into three categories: (a) inadequate

food intake and disease incidence, (b) insufficient food for households, inadequate health services, poor sanitation, (c) inadequate resources available at household and society level. Therefore, child nutrition and health determinants are at the personal, family, and social level (UNICEF, 2009). In less developed countries, child health is a major symbol of quality of life. Childhood and nutritional morbidity are closely related to inappropriate childhood care and food deficiencies (Allen & Gillespie, 2001).

Developing countries have to face economic and social problems to achieve better health levels. Pakistan faces serious health problems like high infant mortality, child malnutrition, and low life expectancy. Child malnutrition is a serious ignoring issue. Globally half of the children die every year because of malnutrition (Cheah, Wan Abdul Manan, & Zabidi-Hussin, 2010). Child malnutrition indicates low calories intake. Child malnutrition indicates a severe hazard to their physical and mental well-being. A child with a low nutrition level has to face many difficulties in attaining better education (Alderman, Behrman, & Hoddinott, 2005; Chirwa & Ngalawa, 2008) and career-building (Babatunde, Olagunju, Fakayode, & Sola-Ojo, 2011). According to UN Standing Committee on Nutrition, 147 million pre-school age children face the serious issue of malnutrition in developing countries. Malnutrition and micronutrition issues like iron and iodine deficiency directly relate to mental issues. Mostly undernourished children belong to developing countries. Malnutrition is described by WHO (2020) as deficiencies, excesses, or imbalances in a person's energy and/or nutrient consumption. Childhood malnutrition is still a problem. In developing countries, this is a huge public health issue (Fagbamigbe, Kandala, & Uthman, 2020).

According to WHO (2020), there are 144.0 million children under the age of five in the world. Stunting affects 47.0 million and 14.3 million children under the age of five. 38.3 million People suffer from wasting and severe wasting, respectively, and 38.3 million are overweight. Every year, more than 3 million children die from preventable causes due to malnutrition (Cunningham, Ruel, Ferguson, & Uauy, 2015). Approximately 165 million children are undernourished in the world (Black et al., 2013). Malnutrition is the main cause of fifty percent of child death (Demissie & Worku, 2013; Meshram et al., 2012). Developing countries face the issue of child malnutrition (Muller & Krawinkel, 2005). Children with undernourishment are unable to fully participate in social and economic activities. It has been observed that 30% of children are severely stunted, and 19% are under-weighted (Stevens et al., 2012). Asia is more vulnerable to child health. Only 8% of children are wasted in Asia, 2/3 of the overall ratio lives in Asian countries (Asim & Nawaz, 2018).

Like other developing countries, Pakistan has to face serious child health issues, among which malnutrition is a widespread issue. While the underweight child issue has reduced during the last twenty years, but stunting is still problematic. Pakistan has to face severe child malnutrition issues in many places. A low level of income creates many problems suggested by previous studies: poverty increase low weight for age (Alderman & Garcia, 1993), malnutrition is highly related to diarrhea (Arif, Farooq, Nazir, & Satti, 2014). Pakistan is a highly populated country, with 42% of its population living below the poverty level. Vitamin A is vital source of child survival during age period 6-59 months and only 60% of child got benefit from this blessing. Pakistan Demographic and Health Survey determines the health status of a child by considering all required tests, including the prevalence of diarrhea, respiratory infections, immunization level, birth weight, etc. In Pakistan, children are mostly deprived of basic health care services due to births at home. 22% of children under 5-year age face serious diarrhea, more than 55% use ORS, and 14% of that ratio relies on herbs and homemade care.

Biologically malnutrition is defined as a low intake of calories and proteins level in the diet. Malnutrition causes anthropometric failures in kids who are wasting, underweight, and stunting. Many facts of life like the mother's nutrition level, availability of food and health

services, and prevalence of diseases involve the availability of nutrition level among children (Cheah et al., 2010; Linnemayr et al., 2008). Poverty is the main cause of malnutrition because people with low purchasing power cannot buy food and other health services (Chirwa & Ngalawa, 2008; R. E. A. Khan & Raza, 2014). Many studies consider economic growth a vital instrument for reducing malnutrition (Haddad, Alderman, Appleton, Song, & Yohannes, 2003). Whereas many scholars highlight the importance of public services in reducing malnutrition (Alderman & Garcia, 1994; Anand & Ravallion, 1993), the government should invest in human resources like the availability of Vaccines and improved sanitation and water facilities.

1.1 Effects of Malnutrition

Due to inadequate calories, protein, and other important nutrient intake child experience delays in physical and mental development, lower body weight, and a vicious circle of illness and malnutrition. The impacts of malnutrition on child health and development are a lifelong process. Therefore, these effects are categorized into two parts. In the shorter time period, lack of nutrition, particularly fetal undernutrition at a critical level, causes to permanent changes in the structure of the body, i.e., weight loss due to depletion of muscle mass and fat and metabolism even if there existed no nutritional insults subsequently, in later life this can cause to increase in the probabilities of chronic noninfectious disease. In the longer term, there is a strong correlation between the health of children and the economic growth of the country. When we relate the exogenous growth model with good health as a necessary condition to provide labor services, we use health that is produced under the condition of decreasing return. In contrast, human capital is produced under the condition of increasing return.

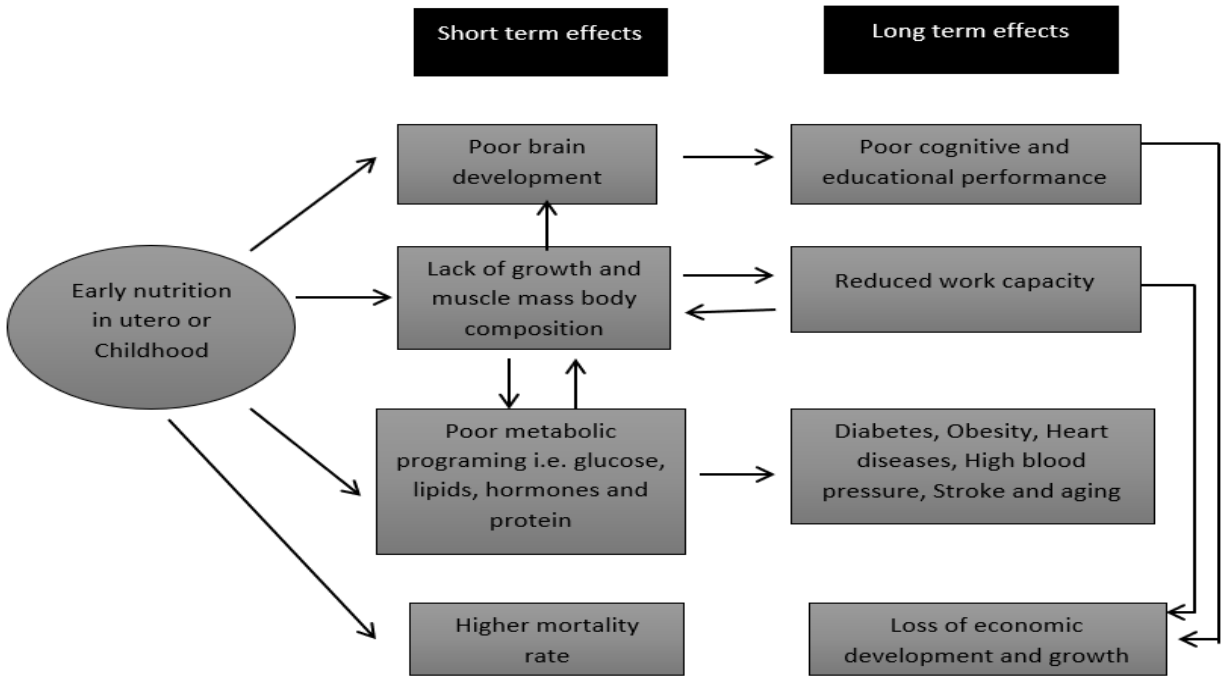

Figure 1: Short and long term effects
Source: Author's Construction

Socio-culture issues related to family, local, and national levels also cause children's malnutrition. In poor houses sex biasedness is the most common issue in Pakistan. Mostly parents favor their sons a lot than their daughters (Gupta, 1987). Mothers also give their sons better food and ignore their daughters by giving them poor-quality food (Mehrotra, 2006). Parents create this discrimination in food and education by considering that their son will have a

source of income and survival (Gupta, 1987). Illiteracy is also an important factor in malnutrition. An illiterate mother is more likely to affect by malnutrition than a literate mother. During pregnancy, illiterate mother unable to know which type of food or supplements necessary for her and her baby. This negligence creates severe health issues, including malnutrition (Ali, Chaudry, & Naqvi, 2011).

Although malnourished child either boy or girl is threat not only for victim child but also for the society, but malnourished female is serious problem for future generations. Malnutrition is not only one generation issue; affecting the entire life of the victim child and transfers to the next generation. It's a great risk factor for malnourished child to die or future ailment. Intake of nutrition is vital especially from birth period to 2 years because it indicates the growth of child in future. But in developing countries, mostly children face the severe issue of undernourishment.

Pakistan is a highly populated country and ranked at 6th number globally. 2% is its estimated growth rate. Mostly portion of the population is based on women and children. One-third of its population is living below the poverty line and unable to fulfill basic health facilities, resulting in health issues like malnutrition, etc. A malnourished child is a significant threat because it makes the child underweighted, wasted, and stunted. In Pakistan, malnutrition is the leading cause of child illness and mortality. According to the United Nations, chronic malnutrition stunts the growth of more than 44 percent of Pakistani children under the age of five. In comparison to other emerging countries, Pakistan has substantially higher child malnutrition rates. The high infant death rate and poor literacy rate are consequences of widespread hunger. Malnutrition in children is a major cause of illness and death in children worldwide. It also poses a threat to Pakistani youngsters' physical and emotional health. Some developing countries have reduced the issues of poverty, child mortality, and malnutrition through rapid economic growth. Pakistan has also sometimes experienced periods of rapid economic growth; however it has not been investigated whether better economic growth had any positive impact on reducing the level of child malnutrition in Pakistan or otherwise. So, this is a very alarming situation for developing societies like Pakistan and need to address this issue to get a better generation in the future. The current study will investigate the overall impact of economic growth on malnutrition in Pakistan.

Mostly studies investigated child malnutrition through primary analysis (Haddad et al., 2003). The main objective of this study is to highlight the importance of child health by considering the malnutrition issue in case of Pakistan. This study will examine the impact of economic growth on child malnutrition. The main objectives of the study are as follows: (1) To analyze the impact of economic growth on child malnutrition in Pakistan, (2) Contribute to the existing literature, (3) Check the effect of other control variables on child malnutrition, and (4) Give proper policy implications according to concluding results.

2. Literature Review

A healthy population is vital for economic growth and development. Similarly, healthy children are the future of a nation. Any society with malnourished children deprived from talented and skilled labor force. In this section literature review on malnutrition is discussed in detail. Yoon, Black, Moulton, and Becker (1997) found the impact of child malnourished on diarrhea and respiratory issues in Philippines city Cebu. Sample of the study consist of 9942 children born in the time period 1988-1991. Control variables used for the analysis are weight for age, and breastfeeding during a particular time period. Results obtained from Cox regression analysis indicate that 425 children died from diarrhea and respiratory issues. Similarly, line of work done in the literature as Majumder, May, and Pant (1997) studies the factors of child mortality in Bangladesh. Developing countries face many health issues related to children. The household's

financial condition is a major factor that has a higher impact on child health. Other factors are birth interim, birth arrangements, age of mother, survival facilities. Data is taken from Bangladesh fertility Survey for 1980. Linear logistic model is used for the analysis. Birth interim is the most crucial indicator of child death in Bangladesh.

Moreover, Mitra, Rahman, and Fuchs (2000) highlighted the factors involved in child malnutrition that further causes diarrhea and death. The study also indicates the factors engaged in gender discrimination. Survey-based primary data is taken from 559 patients, out of 354 patients were male children, and the remaining 205 were female patients. Results analyzed from SPSS. Whitteny and Chi-square tests were used to analyze categorical variables and continuous variables, respectively. Results obtained from multivariate logistic regression indicate that male children, compared to a female child, are more likely to be admitted to the ICU. Girls face severe diarrhea issues, so the female ratio of dying at home is higher than that of males.

Choudhury, Hanifi, Rasheed, and Bhuiya (2000) investigated the impact of gender inequality and malnutrition in rural areas of Bangladesh. Data were collected from 6-60 months kids from five unions of Bangladesh in 2016. Data is divided into two groups. A malnourished child with less than or equal to 125mm lies in one category, and greater than 125mm lies in the second category. Control variables consist of age, sex of children, and other household characteristics, including maternal health and education. Results obtained from the bivariate and multivariate analysis show that girls face severe malnourished issues compared to boys. Mother education and age also have a significant impact on the malnourishment level. Other factors of malnourishment include lack of immunization facilities and gender inequality. Haddad et al. (2003) found the effect of economic growth on malnutrition of children by using household survey data and secondary data for twelve countries. Results indicate that child nutrition level decreases with an increase in income suggested by both primary and secondary analysis. The study suggested the need for growth and nutrition programs. Chaudhary, Mishra, and Shukla (2003) analyzed that female child in the Varanasi district of India has access to basic health facilities like nutrition. Data consisted of 267 children. BMI and anthropometric measures were used to examine the nutritional level of children. The study found that two third of children were suffering from malnutrition and 13.7% of girls' children had deficiency of vitamin A. results obtained from anthropometric indices indicate that 68.5% of girls were living with undernourished status.

Harishankar, Dabral, and Walia (2004) analyzed the factors of malnourishment level of children with age less than 6 in Allahabad in 2002. Data is obtained through a stratified multistage sampling technique. Height and weight were used as outcome variables. Other control variables were caste, age, religion, access to safe drinking water, and environmental factors. Four hundred thirty-six children were taken for analysis. Results revealed that 32.2% of children aged 13-24 were undernourished, and 43.5% of malnutrition increases with birth order three. The education of females reduces maturation, according to the results. Birth order increases malnutrition among children. It is recommended that public services be monitored to provide better health facilities to rural areas. Similarly, Rutstein (2005) found the impact of birth spacing and child mortality on malnutrition in 17 developing countries. Stunted, underweight, and wasted were used as a proxy for malnutrition. Birth interval is measured in months. Bivariate and multivariate models are used for the analysis. High birth spacing reduces malnutrition suggested by the results of bivariate analysis. Similar result found in case of multivariate analysis. The study suggested the need for 36 months spacing between children in order to reduce malnutrition.

Alasfoor et al. (2007) investigated the malnutrition level in 6-71 months age children in Egypt for the time period 1998. Data is collected from two-stage cluster sampling technique. Data is taken from 1200 children. Social, environmental and economic factors are used for the estimation. Logistic regression results indicate that 7.3% of children were unweighted with low

socio-economic structure; poor environmental conditions caused 15% of children with stunted status. The study recommended the importance of social and economic improvement clean environmental structure, which improves the health status of children suffering from malnutrition and other related diseases. Farahani, Subramanian, and Canning (2009) investigated the impact of change in short and long-run health resources on infant mortality. Five years of average data is taken from 1960 to 2000 for 99 countries. Control variables used for the analysis are GDP per capita, years of schooling, and physicians. A dynamic regression model is used for the analysis. Estimated results indicate that an increasing number of doctors decreases infant mortality by 15%. In the short run, the impact is clear and significant, but in the long run, the impact is minimal.

Silveira, Alves, Ferreira, Sawaya, and Florêncio (2010) analyzed the determinants of malnutrition in children of Maceio, Brazil. The survey-based study consists of a probability sample of mothers and children. The result suggested that 8.6% of children face severe malnutrition, and mothers with malnutrition causes 38.8% of short heighted children and 45.6% of overweight children. Gunther and Fink (2010) found the impact of water and sanitation facilities on child health through a survey. Data is taken from 70 developing countries from 1986-2008. Logistic regression and OLS techniques are used for the analysis. Variables consisted of household size, residential quality, and sanitation and water infrastructures. Results indicate that safe and secure water and sanitation setup is beneficial for child health and reduces child health-related issues many times.

The importance of water and sanitation on infant health was discovered by Fink, Günther, and Hill (2011). From 1986 to 2007, data was collected from 171 surveys in 70 low and middle-income countries. A logistic model is used for the analysis. Result suggests that clean water reduces infant-related health issues, including diarrhea and stunting. Samples of the children suggest that children with poor access to clean and pure drinking water are more vulnerable to health issues and caused even death. Fink, Gunther, and Hill (2014) found the impact of slum habitation on child health in developing countries. Slum population cover major portion of urban population. Data is taken from 73 developing countries. Health is poor in slum areas. Bagriansky, Champa, Pak, Whitney, and Laillou (2014) found the impact of income level on child malnutrition by using the consequence model for Cambodia. Results indicate that income level has a significant impact on reducing child malnutrition. Other factors like breastfeeding and maternal behavior also affect malnutrition.

Malnutrition is ultimate cause of poverty and disease which further cause mental health issues (Islam & Biswas, 2020; Singh, Srivastava, & Chauhan, 2020). Himmerich, Kan, Au, and Treasure (2021) discovered that the main causes of malnutrition in emerging nations was a lack of food consumption due to a drop in production and inefficient production distribution routes, poverty, disease, and illiteracy. According to the study, the repercussions of malnutrition in school-age children include mental harm, which hinders their capacity and performance in school, poor growth with long-term impacts of reduced productivity after school, reduction in individual income, and the country's GDP. UNICEF (2021) states that an adult suffering from malnutrition is predicted to lose 22 percent of their annual income.

Numerous academics, however, have explored many sorts of variables impacting child malnutrition, and a number of research publications have been published on this topic in the past by many countries throughout the world (Ghimire, Aryal, Gupta, & Sapkota, 2020; Igbokwe et al., 2017; J. Khan & Mohanty, 2018). The enormous number of publications has proved the current issue's importance. Researchers have given a lot of attention however, studies on various types of economic and non-economic drivers of child malnutrition have been constrained by a review of past empirical evidence. Mostly studies used primary data to find the determinants of

malnutrition (Alasfoor et al., 2007; Bagriansky et al., 2014; Chaudhary et al., 2003; Choudhury et al., 2000; Haddad et al., 2003; Harishankar et al., 2004; Mitra et al., 2000; Rutstein, 2005; Silveira et al., 2010; Yoon et al., 1997). This study will find the impact of economic growth on malnutrition in the case of Pakistan by utilizing time series analysis.

3. Data and Methodology

The development of acceptable methods and approaches was the most important aspect of any research project. The impact study was a waste of time without the proper approach and analysis. As a result, the adoption of a systematic and proper technique was a very vital and significant aspect of any analytical study. The research technique was thought to be highly helpful in evaluating any research problem because it fully detailed the entire approach used in the relevant research project. The collection, methods, description, and analysis of the data used in the research study are all highlighted in the research proposal. It assists the researcher in allocating his limited resources by allowing him to select specific procedures from a list of alternatives (Sekaran, 1992). As a result, the primary goal of this chapter was to explain the numerous tools and techniques used in the research study and sample selection, data collecting, analysis, and interpretation, all of which were related to the research problem under examination. As a result, this chapter explains the approach used to determine the influence of economic growth on child malnutrition in Pakistan. This chapter also included the data description, source of data, and data analysis methods.

3.1 Data Source and Description of Variables

Using the NARDL model, this paper explores the asymmetric relationship between child malnutrition and economic growth in Pakistan, covering the period of 1985 to 2021. The data has been obtained from United Nations Children's Fund (UNICEF) and World Development Indicator (WDI). The variables in this study are malnutrition index (generated by using 3 components, stunting, wasting, and underweight) which is a dependent variable, while explanatory variables are economic growth measured by GDP growth (annual %), health expenditure measured by total current health expenditure (% of GDP), improved water measured by improved water source (% of the population with access), mothers education measured by female secondary school enrollment (% gross), and immunization measured by immunization DPT (% of children ages 12-23 months).

3.2 Functional Form

According to UNICEF, child malnutrition is affected by economic, social, and political factors (Black et al., 2008). This paper used the mentioned functional form, which means that the econometric technique was applied to data.

$$MAL_t = \beta_0 + \beta_1 GDP_t + \beta_2 IMM_t + \beta_3 HE_t + \beta_4 MEDU_t + \beta_5 IW_t + \varepsilon_t \quad (1)$$

In the above equation, β used to show the value of the coefficient, β shows the change in the dependent variable due to the change in the independent variable. Different symbols are used to indicate the variables MAL (malnutrition index), GDP (economic growth), IMM (immunization), HE (health expenditure), MEDU (mother education), IW (improved water), and ε used to show the error term.

3.3 Econometric Methodology

The symmetric assumption that the explanatory variable linearly influences the dependent variable is used to estimate long-run association using the cointegration test. In

reality, changes in a variable might occur in either a positive or negative direction. Using the recently developed non-linear ARDL approach proposed by Shin, Yu, and Greenwood-Nimmo (2014). The current study attempted the asymmetry relationship between variables by considering positive and negative changes in an independent variable. Following Bahmani-Oskooee, Halicioglu, and Mohammadian (2018); Bahmani-Oskooee, Economidou, and Goswami (2005); Delatte and López-Villavicencio (2012), and Verheyen (2013) the present study decomposed the independent variable into two additional sets of series based on positive and negative changes in the process of formulating non-linear ARDL. By separating the positive and negative effects of economic growth in equations 2 and 3.

$$POS\,(GDP) = \sum_{L=1}^{t} GDP_L^{+} = MAX \sum_{L=1}^{T} (\Delta GDP_L, 0) \tag{2}$$

$$NEG(GDP) = \sum_{L=1}^{t} GDP_L^{-} = MIN \sum_{L=1}^{T} (\Delta\, GDP_L, 0) \tag{3}$$

Now rewrite Eq. (1) in a non-linear form by integrating a new series of positive and negative modifications. The non-linear ARDL looks like this:

$$\begin{aligned}\Delta\,(MAL_t) = \beta_0 + \sum_{i=1}^{n} \mu_1\, \Delta\, GDP_{t-i} + \sum_{i=1}^{n} \mu_2{}^{+}\, \Delta\ POS\,(GDP)_{t-i} + \sum_{i=1}^{n} \mu_2{}^{-}\, \Delta\ NEG\,(GDP)_{t-i} + \sum_{i=1}^{n} \mu_3\, \Delta\, IMM_{t-i} \\ + \sum_{i=1}^{n} \mu_4\, \Delta\, HE_{t-i} + \sum_{i=1}^{n} \mu_5\, \Delta\, MEDU_{t-i} + \sum_{i=1}^{n} \mu_6\, \Delta\, IW_{t-i} + \gamma_0\, GDP_{t-1} + \gamma_1^{+}\ POS(GDP)_{t-1} \\ + \gamma_1^{-}\ NEG(GDP)_{t-1} + \gamma_2\, IMM_{t-1} + \gamma_3\, HE_{t-1} + \gamma_4\, MEDU_{t-1} + \gamma_5\, IW_{t-1} + \omega_t\end{aligned} \tag{4}$$

The coefficients of 1 to 6 in Eq. (4) reflect short-run elasticities in the model, while the coefficients of 0 to 5 denote long-run elasticities. The Wald test was used to assess both long-run and short-run asymmetric testing. In addition, n stands for optimal lag, which was calculated using the Akaike information criterion (AIC). According to Shin et al. (2014), the limits test approach can also be used to confirm long-run cointegration by comparing the F-statistic (Wald test) with the critical value, as proposed by Pesaran, Shin, and Smith (2001). The null hypothesis is $\gamma_0 = \gamma_{1+} = \gamma_{1-} = 0$

Most of the time-series data have trends, making them non-stationary, which leads to the problem of false regression. It is required to evaluate the stationarity of data before running a cointegration test. This study uses the Augmented Dicky-Fuller test at the level and the first difference for this aim.

The NARDL has raised concerns about the co-integration level "Bounds Test" approach, which is based on the OLS estimate of the alternative's unrestricted error correction model for co-integration study (Pesaran et al., 2001). The sequence of variables in NARDL must be either I(0) or I(1). It cannot comprehend the results of F-statistics supplied by Pesaran et al. (2001) in the presence of variables I(2). The NARDL coefficients depict a long-run equilibrium connection, whereas the ECM coefficients exhibit short-run dynamics with long-run equilibrium. This approach, which was used in this investigation, offers several advantages, including the ability to handle tiny samples quickly. The key benefit of this test is that it can be used to assess cointegration whether the variables are integrated to order zero or one. That is, the "Bounds Test" can be used even if the variables do not have the same order of integration.

4. Results and Discussion

This chapter presents the empirical data on the relationship between economic growth and malnutrition. The first section discusses unit root tests, which are used to determine the order in which the variables in the research are integrated. The rationalization approach (NARDL) for testing cointegration is discussed in the next section, followed by a discussion of the estimated results.

Although there is no need to check the stationarity of the series for the NARDL Bound test, but this test is still conducted to check that none of the series is integrated of order 2 or higher, because inclusion of any variable, with I(2) complicates the F-statistics. In doing so, Augmented Dicky-Fuller (ADF) is used for the current analysis. Table 1 indicates that all variables are integrated at order 0 or 1.

Table 1
Augmented Dickey Fuller (Unit Root) Test

Variable	Level Test Statistics (Prob)	First difference Test Statistics (Prob)	Decision
MAL	-2.019696 0.5712	-6.031008 0.0001***	I(1)
GDP	-3.211123 0.0285**	-7.335378 0.0000***	I(0)
IMM	-3.061920 0.1305	-6.531840 0.0000***	I(1)
HE	-1.179121 0.8999	-4.668885 0.0034***	I(1)
MEDU	-1.631999 0.7600	-5.016133 0.0014***	I(1)
IW	-2.001263 0.5798	-2.470057 0.0397**	I(1)

Note: Asterisks ***, ** and * showed that the coefficient is significantly different from zero at 1%, 5% and 10% probability, respectively.

Table 2 shows the test for the existence of the level of relationship in NARDL model. In NARDL model, the validity of the model is confirmed through the Bound test. The calculated value of the F-static is 4.596775, which is higher than the upper bound critical value at 1%, 2.5%, 5%, and 10% levels of significance. This shows that the null hypothesis of no cointegration is rejected, and the variables have a cointegration relationship.

Table 2
Bounds Testing Analysis

Model Estimated	MAL = f(GDP, IMM, HE, MEDU, IW)	
F-Statistics	4.596775	
Selected Lag Length (Criteria)	2 (AIC)	
Critical bound values	**Lower Bound Value**	**Upper Bound Value**
10%	1.66	2.79
5%	1.91	3.11
2.5%	2.15	3.4
1%	2.45	3.79

In the next step, the long-run coefficients of the NARDL model are reported. The long-run estimates show the positive and negative shocks in the case of economic growth, mother education, and health expenditures. The significant variables in the long run for malnutrition are economic growth (negative shock), mother education (positive shock), health expenditures, and improved water. On the basis of these results, we can reject the null hypothesis that there is no

effect of economic growth, health expenditures, mother education, and improved water on malnutrition and will accept the alternative hypothesis that there is an effect of economic growth, health expenditures, mother education and improved water on malnutrition because these variables are significant in our results.

Table 3 indicates the results obtained from NARDL technique which provides the positive and negative shocks and their impact on child malnutrition. The upper part of Table 3 provides long-run impact and lower part indicates the short-run impact on child malnutrition. In long-run GDP growth in case of a negative shock, mother education in case of positive shock, health expenditures in both positive and negative shocks, and improved water have a long-run impact on child malnutrition. In case of positive shock, the impact of GDP growth on malnutrition is negative. One percent increase in GDP growth reduces malnutrition by 0.008 units. Economic growth increases household purchasing power, so they easily provide better health facilities to their children. Households can purchase health facilities so it can be said that the health status of children improves through GDP growth. The result of GDP growth is consistent with Black et al. (2008); Israr, Razum, Ndiforchu, and Martiny (2000); Victora et al. (2008); Waters et al. (2004). Whereas, in case of a negative shock, the impact of GDP growth is positive. One percent decrease in GDP growth raises malnutrition by 0.028 units.

Table 3
Non-Linear ARDL Model Long Run and Short Run Results

Dependent Variable: Malnutrition (MAL)				
Long-run results				
Variable	**Coefficient**	**Std. Error**	**T-statistic**	**Prob**
GDP_POS	-0.007550	0.009817	-0.769111	0.4530
GDP_NEG	0.028494	0.007001	4.069679	0.0009***
IMM	0.015775	0.090990	0.173375	0.8645
MEDU_POS	-0.025806	0.003969	-6.501608	0.0000***
MEDU_NEG	0.006476	0.007875	0.822407	0.4229
HE_POS	0.335612	0.054227	6.189038	0.0000***
HE_NEG	-0.370815	0.059180	-6.265944	0.0000***
IW	0.904233	0.072381	12.492688	0.0000***
Short-run results				
D(MAL(-1))	0.581844	0.237613	2.448705	0.0262**
D(GDP_POS)	-0.007083	0.009854	-0.718817	0.4826
D(GDP_NEG)	-0.011415	0.010082	-1.132187	0.2742
D(GDP_NEG(-1))	-0.017022	0.006790	-2.506760	0.0234**
D(IMM)	0.142182	0.079932	1.778790	0.0943*
D(IMM(-1))	0.235493	0.084652	2.781905	0.0133**
D(MEDU_POS)	-0.024210	0.006868	-3.525170	0.0028***
D(MEDU_NEG)	-0.006955	0.008681	-0.801127	0.4348
D(HE_POS)	0.170775	0.075124	2.273226	0.0371**
D(HE_NEG)	-0.150855	0.118889	-1.268870	0.2226
D(IW)	22.163120	11.942677	1.855792	0.0820*
CointEq(-1)	-0.938153	0.260933	-3.595384	0.0024***
Diagnostic Tests				
R-squared			0.959579	
Adjusted R-squared			0.916633	
Durbin-Watson stat			2.553375	
J-B Normality Test			[1.766936] (0.413347)	
Breusch-Godfrey Serial Correlation LM Test			[3.327701] (0.0657)	
Heteroskedasticity Test: ARCH			[1.238848] (0.3410)	

Note: The [ ] bracket shows the F-statistic value and ( ) bracket shows the prob-value, respectively.

Whereas, the impact of mother education with positive shock on malnutrition is negative. One unit increase in mother education reduces malnutrition by 0.02 units. An educated mother is highly aware of low-cost sources of nutrition consumption. Educated mothers know the importance and knowledge of food which is necessary for children health with passage of time Das Gupta (1990); (Pongou, Salomon, & Ezzati, 2006). Health expenditures on malnutrition have a negative and significant impact in case of a negative shock. As, government health expenditures play a vital role in child health (Bokhari, Gai, & Gottret, 2007). Health expenditures by the government not only improves household to divert their money towards other projects but also provide better facilities, including primary and secondary care services; however positive impact is obtained in case of positive shock in health expenditures which can be interpreted as high expenditures may cause corruption or insufficient health expenditures that have no effective impact to reduce child malnutrition.

The lower part of Table 3 indicates the short-run impact of variables on child malnutrition. As in the case of positive and negative shocks, GDP growth has a negative and insignificant impact in both cases on child malnutrition. With a one-year lag in case of a negative shock, One percent increase in GDP growth reduces malnutrition by 0.017 units in the short run. The impact of immunization on malnutrition is positive it can be interpreted that immunization resources are not enough to reduce malnutrition. The impact of improved water on malnutrition is positive. One unit increase in improved water rises malnutrition. Although water is basic need and survival source but same water in case of impure has an adverse impact on child health. A positive sign indicates that water quality is not improved yet to reduce child malnutrition. Overall, results show that economic growth is negative and positive with positive and negative shock respectively to effect child malnutrition in the long run is found. At the end of the table, the diagnostic tests show that the model satisfies all reported diagnostic tests.

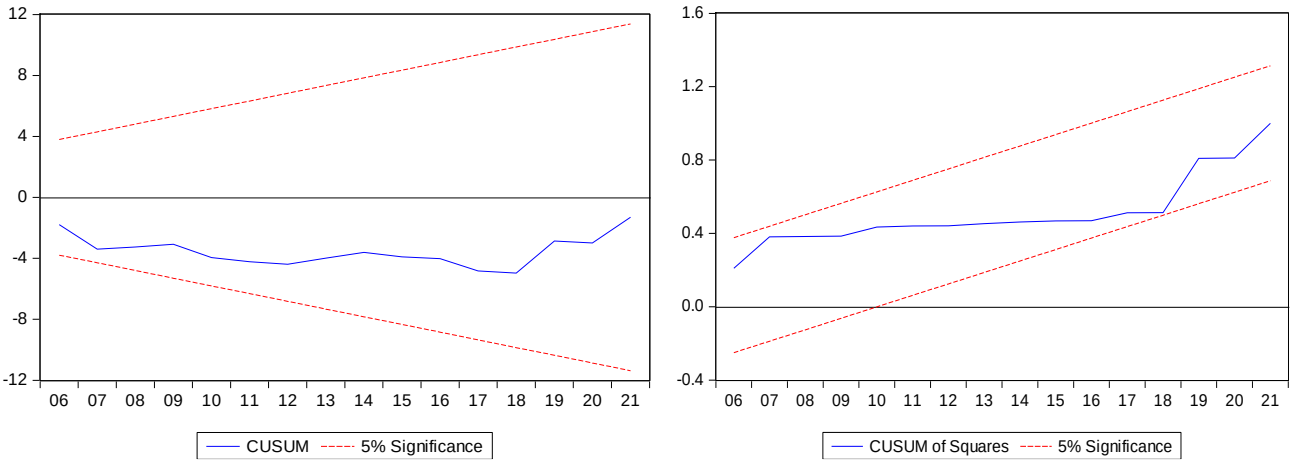

Figure 2: Stability Test

Above mentioned figures indicate the long-run relationship between GDP growth and child malnutrition. Figures depict the same understanding as results of NARDL shows that there is a long-run relationship between economic growth and child malnutrition.

5. Conclusion and Recommendations

Child malnutrition is a phenomenon in both developed and developing countries. Child malnutrition affects the individual as well as community levels. The majority of malnourished children live in Asia; that's why Asia is considered a highly child malnourished region. In spite of efforts, Pakistan is also suffering from child malnutrition issues. Social, political, and economic conditions reflect the health status of society (Farag et al., 2013). Child malnourishment is

related to many factors, including income, mother education, availability of health care facilities, and healthy food, which ultimately cause child malnutrition. Literature on child malnutrition is mostly based on primary research. This study used secondary data for the Time series analysis for Pakistan. The time period consisted from 1985 to 2021 to find the impact of economic growth on child malnutrition. Malnutrition (dependent variable) is measured by generating an index of stunting, wasting, and underweight. Economic growth is an independent variable measured through GDP growth. Other control variables include health expenditures, improved water, mother education, and immunization.

The results obtained from NARDL techniques indicate economic growth reduces child malnutrition in Pakistan. The result indicates that control variables have negative impact on child malnutrition, whereas immunization revealed an insignificant impact. In light of the above results, it is suggested that the government should provide basic health care facilities to its citizens. In backward areas, different types of facilities like clean drinking water and different health centers should be maintained to improve the lives of children. The level of employment should be enhanced because when the level of income is high, then child health will be better and make sure the education of females as well if they are highly educated they can care their children in a better way. Moreover, the major causes of Dirreaheal and several infectious diseases are lack of mother education and lack of nutritious food containing vitamin-A and iron for 6-23 months of children. So, awareness policy program should organize that can help to reduce the diseases such as diarrhea and respiratory infectious diseases in children. Micronutrient deficiency in pre-school children (3-5 years of age), particularly iron and vitamin A deficiency, reduces children's cognitive development. So, an active program through media and health departments is needed to educate mothers about the importance of micronutrients in the early years of a child's life.

Conflict of Interests/Disclosures

The authors declared no potential conflicts of interest w.r.t the research, authorship and/or publication of this article.

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