



Unraveling the Impact of Food Insecurity on the Prevalence of Double Burden of Malnutrition among Children of Pakistan

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ABSTRACT

Food insecurity is a significant cause of the double burden of malnutrition among children in the developing world. Despite being self-sufficient, Pakistan contains 60% of the food-insecure population. Moreover, about half of under-five children are stunted, and one-tenth are overweight. The coexistence of undernutrition and overnutrition among under-five children is not well investigated in the same household. Infants and young children are more vulnerable to dietary quantity and quality. However, children of poor populations consume a poorly diverse diet, primarily starchy staples with no or little meat, fruits, and vegetables. Thus, a diversified diet is necessary to fulfil the nutritional needs of under-five children. Therefore, the dietary diversity score is used as a proxy to measure food insecurity among children. Children's dietary diversity score used in this study is categorized into eight food groups, including starches, legumes, eggs, meat, dairy products, vitamin A-rich fruits and vegetables, other vegetables and fruits, and sugars. It is widely used as a proxy for nutrient inadequacy and food insecurity. This study unravels the impact of food insecurity on the prevalence of double burden of malnutrition among under-five children by employing 2018 Pakistan Demographic Health Survey data and hierarchical mixed effect logistic regression. A sample of 3,625 6-59 months old children was included. The results state that child food insecurity increases the risk of double burden (OR: 1.49, CI: 1.03-2.16) after adjusting for household and community-level socioeconomic and demographic factors. This study used the interaction term of educated and empowered mothers and showed that 51% of children suffered from the double burden. The interaction term of poor households and improved toilet facilities have been created at the household level. This indicates that in a poor home with improved toilet facilities, 25% of children suffer from double-burden malnutrition. Similarly, at the community level, overweight and obese mothers have been used; if the community has more than 63% overweight and obese mothers, then their children are at high risk of double the burden of malnourishment. The results indicate that the occurrence of the double burden of malnutrition increases among food-insecure children. Food security and nutrition programs should be targeted to prevent the early childhood double burden of child malnutrition to avoid future productivity losses.



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1. Introduction

Food insecurity is a public health challenge for under-five children worldwide. It refers to the situation where individuals do not have physical, social, and economic access to the nutritious food that fulfils their daily dietary needs all the times (FAO, 2012). Lack of quality, quantity, and diversity in consumer's food basket leads to food insecurity. Addressing food insecurity is necessary for preventing malnutrition in young children. Malnutrition is a condition subsequent from eating a diet, in which one or more nutrients are either deficient or surplus that leads to health problems (WHO, 2018b). Malnutrition encompasses two forms: undernutrition and overnutrition. The United Nations Sustainable Development Goal (SDG) 2 focuses on achievement of zero hunger and food security by all people till 2030 (SDG, 2019). The progress on SDG2 is measured by SDG indicator 2.1.1, which indicates the prevalence of undernourishment among poorly nourished populations to ensure an active and healthy life. Undernutrition is a major problem among under-five year's children. Worldwide, around 816 million children are undernourished (Unicef, 2019). However, around 60 million children are moderately undernourished, and 12 million children are severely undernourished. Undernourishment causes around 11 million children's death every year (Asfaw, Wondaferash, Taha, & Dube, 2015). Therefore, adequate nutrient intake is a significant factor affecting child health.

Infants and young children are more vulnerable to dietary quantity and quality. To fulfil the nutritional needs of under-five children, the World Health Organization (WHO) has recommended complementary diet including cereals, animal source products, seasonal fruits and vegetables for infants of 6 months old, besides breast milk (Ochola & Masibo, 2014). Although children of poor population consume poorly diverse diet, which comprises mostly starchy staples with no or little meat, fruits and vegetables (WHO, 2010). Dietary diversity is the overall intake of food items within 24 hours (Hoddinott & Yohannes, 2002). Dietary diversity score is calculated by summing variety of food groups consumed by individuals, irrespective of quantity. Children dietary diversity score is categorized in eight food groups including starches, legumes, eggs, meat, dairy products, vitamin A rich fruits and vegetables, other vegetables and fruits, and sugars, recommended by WHO (WHO, 2010). Poor dietary diversity is widely used as a proxy of nutrient inadequacy and food insecurity. Children consuming food from less than 5 food groups are considered as low dietary diverse or food insecure and those consuming more than 5 food groups are highly dietary diverse or food secure (Ali et al., 2019; Arimond & Ruel, 2004; Bukania et al., 2014; Caswell, Talegawkar, Siamusantu, West Jr, & Palmer, 2018; Unicef, 2019; WHO, 2010). Addressing food insecurity is critical for children to grow mentally and physically.

Food insecurity is associated with increased burden of malnutrition. For under-five children, UNICEF has reported three anthropometric measures of undernutrition as stunting, wasting, underweight, and one measure of overnutrition as overweight (Unicef, 2019). According to WHO child growth standards, stunting is defined as height for age z-score below -2.0, wasting as weight for height z-score below 2.0, and underweight as weight for age z-score below -2.0, and overweight as weight for height z-score above 2.0 (WHO, 2010). UNICEF has reported that worldwide 22% (149 million) children are stunted, 19% (110 million) children are underweight, 7.3% (49 million) children are wasted, and 1.9% (8.2 million) children are overweight (Unicef, 2019). Stunting is chronic malnutrition and is observed to be linked with inadequate nutrient intake, poor sanitation, cognitive and socioeconomic factors (Bloss, Wainaina, & Bailey, 2004). Stunting has long term consequences as it transfers over generation. Underweight is acute or

chronic malnutrition, which leads to starvation and illness. Wasting is acute malnutrition and is associated with failure to gain weight due to frequent waterborne illnesses (diarrhoea) and respiratory illnesses (phenomena) (Unicef, 2019; WHO, 2010). Overweight/obesity is an issue persistent in the long run and increases the multiple acute and chronic medical problems, which leads to psychological issues and orthopaedic complications such as abnormal bone growth (Wills, 2004). These deficiencies have adversely affected children's physical, mental and intellectual growth. In the long run, it deteriorates the economic growth of a country by diminishing productivity levels of undernourished population. Previous studies have reported that lower physical and cognitive performances result in 8% loss in world GDP (Bhutta et al., 2013; Horton & Steckel, 2013). Thus, food insecurity poses negative effects on active and healthy life. In developing countries, multiple forms of malnutrition exist among under-five. Double burden of malnutrition is the most common form. The coexistences of undernutrition (e.g., stunting) and overnutrition (e.g., overweight) in children is referred as children's double burden of malnutrition (Shrimpton & Rokx, 2012; WHO, 2010). To measure children's double burden of malnutrition, several indicators have been used. The most commonly used indicators are stunting as a proxy of undernutrition and overweight as a proxy of overnutrition.

Developing world still bears the double burden of malnutrition, despite its significant improvement globally. One third of all children in developing world are malnourished, causing untold human sufferings (Pelletier, Frongillo Jr, Schroeder, & Habicht, 1995). Literature has shown that overnutrition is highly prevalent in urban area, while undernutrition is associated with rural areas (Kulkarni, Kulkarni, & Gaiha, 2014). Co-existence of underweight and overweight are emerging health concerns among children and women in developing world such as India, China, Brazil, Colombia, Bangladesh, Nepal, Pakistan, and Myanmar, Kenya, and Sub-Saharan Africa (Anik et al., 2019; Kimani-Murage et al., 2015; Kulkarni et al., 2014; Nugent, Levin, Hale, & Hutchinson, 2020; Sarmiento et al., 2014; Vaz, Yusuf, Bharathi, Kurpad, & Swaminathan, 2005; Wojcicki, 2014). These studies have pointed that double burden of malnutrition among children is influenced by marginalization in socioeconomic factors such as inadequate feeding practices, less physical activities, dietary pattern and market transitions, rural and urban area differences, wealth status, and overweight/obese women.

For children's health and development, the nutritional status of mother is one of the most influential socioeconomic factors (Garrow, 1988; WHO, 2010). Mother's overweight/obesity is recognized as a pandemic for children's health. Different studies have documented that women have high prevalence of overweight and low prevalence of underweight. High prevalence of overweight in mothers leads to the problem of children's undernutrition and overnutrition (Bailey & Ferro-Luzzi, 1995). Thus, mother's overweight or obesity is a risk factor, which is less "preventable", leading to extreme micronutrient deficiencies during pregnancy that negatively affect children's growth and development. However, this study uses children's dietary diversity score as a proxy to measure food insecurity. The study used eight food groups recommended by FAO, such as starches, eggs, dairy products, legumes, meat, vitamin A-rich fruits and vegetables, other vegetables and fruits, and sugars (WHO, 2010). To determine whether children are food secure or insecure, the threshold of 5 has been used. Children who consume more than five food groups are food secure compared to children who consume less than five (Ali et al., 2019; Arimond & Ruel, 2004; Bukania et al., 2014; Unicef, 2019). Thus, tackling food insecurity is a pathway to eradicate the double burden of malnutrition for children's mental and physical growth.

1.1. The Situation of Malnutrition Measures in Pakistan

Malnutrition is a major health problem among poor households in South Asia. UNICEF has reported that South Asia is ranked second in terms of prevalence of undernourishment in the world throughout 2005-2018 as shown in Figure 1 (Unicef, 2019). Because of undernourishment, Asia loses as much as 11% GDP (Maitra, 2018). Malnutrition status of young children is poor in South Asia. Around 55% stunted children are lived in South Asia (Unicef, 2019). Similarly, 47%

of overweight children lived in Asia and 24% lived in Africa. There is an increasing trend in overweight children in Asia (40%) (Unicef, 2019).

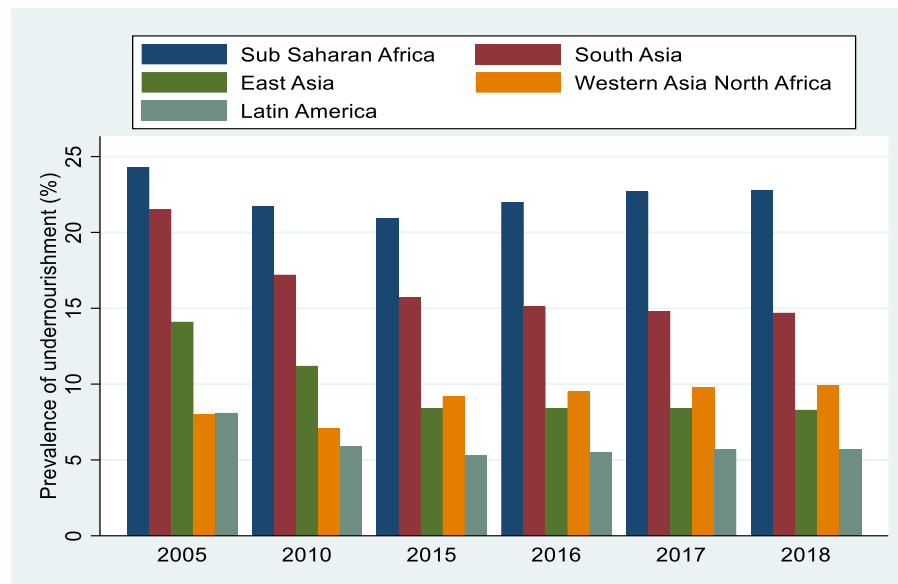


Figure 1: Prevalence of Undernourishment in the World

Source: UBICEF: SOFI (2019)

In the South Asian region, Pakistan is stood at second after India in terms of the highest proportion (40%) of stunted children under-five years (Abbasi et al., 2018). The 2018 National Nutrition Survey has also reported poor nutritional intake and health status of young children in Pakistan. According to this survey, 40.2% children are stunted, 28.9% children are underweight, 17.7 % children are wasted, and 9.5% are overweight (Na, Aguayo, Arimond, & Stewart, 2017). WHO (2010) has recommended critical thresholds of $\geq 40\%$, $\geq 30\%$, and $\geq 15\%$ for severe stunting, underweight, wasting, and overweight among under-five children, respectively. According to these critical thresholds, the nutritional status reveals a continuous deteriorating rate of malnutrition among children in Pakistan. The prevalence of malnutrition has worsened, despite sufficient improvement in production and availability of staple food. Moreover, the proportion of households is increasing, consuming daily calories less than the WHO critical threshold (Kureishy et al., 2017).

Malnutrition and hunger are problems of distribution rather than production. Being an agrarian economy and availability of huge natural resources, Pakistan is ranked as 23rd largest economy in the world in nominal GDP (FAO, 2012). Approximately, 62% rural population depends on agriculture sector. Agriculture provides 45% employment opportunities and being a leading producer of many agriculture goods, it contributes 19% to country's GDP (GOP, 2018). Despite of all these facts, 20% of the population is undernourished (FAO, 2019). Rural areas are more affected from food insecurity. They have to deal with the uncertainty in the provision of food items (FAO, 2012). It is generally accepted that food production is stable but there is deteriorating trend in the accessibility of food. Thus, availability of food does not indicate that economy is food secure, in fact its accessibility determines quality and diversity of food basket.

According to food security risk index, Pakistan is ranked at 11th out of 148 nations, indicating high risk to food security status in the country due to price volatility, natural hazards, terrorisms and political instability (Ali & Amir, 2018). In Pakistan, 60% (more than 113 million) people are food insecure according to the United Nation World Food Program (WHO, 2018a). Poor nutrition adversely affects children's growth and cognitive performance by weakening their immune systems (Akhtar, 2016). Malnutrition increases mortality by 69% among under-five children (Unicef, 2019). Despite considerable increase in income, the prevalence of

undernourishment in young children does not decrease apparently. In the long run, malnutrition endangers individual's productivity, compromises economic growth and impedes national development. UNICEF has reported that malnutrition leads to the loss of 2-3% in GDP of some developing countries and 11% in Asia and Africa each year (Unicef, 2019). Investment in all development sectors is challenging in the society where malnutrition is the cause of high morbidity and mortality (FAO, 2012).

Poor economic situation leads to food insecurity. In return, the nutritional inadequacy reduces labor productivity and causes low socioeconomic status of the communities. Therefore, poor people are unable to give diversified and balanced diets i.e., eggs, milk, meat, fruits and other products to their children on daily basis. The value of diversified diet has been recognized long ago to meet the nutrient requirements for children growth and development. Nonetheless, the major problem in developing world is that children are not fed by diversified complementary food. They feed by starchy staples and seasonal vegetables but no or few animal source foods are given. However, for children's physical and mental growth, energy rich and nutrient-dense foods are required.

The status of child malnutrition varies across geography and gender in Pakistan. The prevalence of stunting among children of rural and urban areas are 41% and 31%, respectively; wasting in rural and urban areas are 7.3% and 6.7%, respectively; underweight in rural and urban areas are 25% and 19%, respectively, while overweight in rural and urban areas are 9.4% and 9.6%, respectively (WHO, 2018b). Thus, rural areas have poor malnutrition as compared to urban areas in Pakistan.

2. Literature Review

Earlier literature has highlighted that children in developing countries often face malnutrition, which impact their physical growth and development. Few studies explore food insecurity as a potential source to minimize malnutrition.

Khan, Zaheer, and Safdar (2019) worked on the determinants of child malnutrition, as it was basic health issue in Pakistan, by using PDHS survey 2012-13. The sample size included was 3,071 Pakistani children of aged 0-59 months. To measure malnutrition, they used proxy variables weight for age, height for age, and weight for height. They used univariate as well as multivariate binary logistic regressions, to observe the connection among mother socio demographic in addition with child level variables. Empirical results stated that in rural areas children were suffering from high rate of malnourishment; similarly, educated mothers and those who visit doctor frequently during pregnancy, their children were less affected by malnutrition. Malnutrition burden could be reduced by preventing the factors causing it like mother's age at marriage, level of education and nutritional status.

(Kumar, Abbas, Mahmood, & Somrongthong, 2019) examined the existence and factor related with underweight. This was cross sectional study done in Pakistani Punjab. The sample of 24,042 children under aged five were included, they used multilevel multivariate logistic regression analysis. The dependent variable was underweight and covariates were age of child in months, size of child, sex of child, smoking mother, gender of household health, diarrhoea, and breast feeding. The results showed that underweight was significantly associated with child age, and gender (more girls are underweighted as compare to boys), and birth order was significantly linked with underweight.

Anik et al. (2019) investigated the comparative study among Bangladesh, Nepal, Pakistan and Myanmar. To assess the double burden of malnutrition at household level by using socioeconomic inequalities and feeding practices. The study used children, mother, household characteristics and community variables to measures these inequalities. The econometric

technique used was logistic regression. The results indicated that prevalence was persistent in all countries. However, in urban areas, the prevalence of the double burden of malnutrition was high as compared to rural areas.

Abbasi et al. (2018) observed the determinant of malnutrition among Pakistani children age less than five years by using DHS data of 2012-2013. The study included 3071 children. Malnutrition was taken as endogenous variable. The exposure variable was determined on characteristics at individual, household and community levels. Multistage cluster sampling was used. Logistic statistical analysis for rural and urban areas were separately drawn. However, the results revealed that parental education that was indicator of malnutrition was high in all domains of stunting, wasting and underweight, also socioeconomic status, child size at the time of birth, place of residence had major contribution in malnutrition. Lack of education led to less awareness and lack of nutrition intake, so the children were underweight, stunted and wasted. They also stated that living conditions like vaccination, drinking water, toilet conditions affected the child health, so the results indicated that rural areas where the clean drinking water and toilet facilities were not given children's malnutrition was high. The study suggested counselling to prevent malnutrition people, health budget should be increased and on large scale trends should be verified by using DHS upcoming data.

Iqbal, Zakar, Zakar, and Fischer (2017) examined the association of infant and young children dietary diversity in Pakistan. They used secondary data from DHS 2012-13. For healthy life adequate nutrient intake and optimal level of feeding is necessary for children and dietary diversity was used as proxy variable to measure nutrition intake. Other cofounding variables were included such as individual, mother, household and community. The study had been including the sample size of 1,102 infant children under aged 6-23 months. Seven food groups were frequently consumed by all included in sample. The technique used in analyses was multiple linear regression. The results indicated a positive and significant relationship among children DD and other cofounded factors. Variation in consumption of food was because of different age groups such as young, middle and older children and stated that in middle age food dietary diversity increased, also mother education and knowledge given to them by health workers had significant positive impact on health. Hence, the socioeconomic factors and DD had been positively associated with child health.

Na et al. (2017) investigated poor complementary feeding practices was the risk for children health as feeding is crucial for children proper development and growth. They used Pakistan DHS data from 2012-13. The total 489 communities were included and total 2,827 children were including under age bracket of 6-23 months. The econometric technique used was multilevel logistic regression. Exposure variables were including from three level individual, households and community. Empirical results showed that overall diet of children was poor in quality.

Kureishy et al. (2017) investigated that mother and children malnutrition were major health issues and despite of significant increase in availability of food, nutritional status was decreasing and malnutrition was crossing the WHO thresholds. This studied was done among children under-age five at Sindh province to avert stunting. The sample size included was 5000, the participants included was pregnant women, lactating mothers and children under-five years. The descriptive statistics had been used in analyses. The results indicated that food intervention was building block to control stunting. This study was done in control environment so did not account for local and environmental factors.

Khan et al. (2016) examined the existence of malnourishment and determining factors among children less than five years. This study was done in Thatta district of Sindh. The targeted population were mother and children. The total number of children were 3,964 used to investigate the malnourishment. The data was collected through questionnaire on mother

education, parity, children morbidity and socioeconomic status. Underweight, wasting and stunting were measured by using the given growth standards of WHO. The technique used in the study was multivariable logistic regression. The results revealed that males were more stunted than females. Wasting and stunting were high in poor households as compared to wealthier. Children were underweighted because of diarrhoea. However, 48% were wasted, 39% children were stunted and 16% were underweight.

Leroy, Habicht, González de Cossío, and Ruel (2014) evaluated the prevalence of malnutrition among children less than five years. This study was done in flood affected district Sanghar in Sindh. The study had included the sample size of 511 children by measuring MUAC. The questionnaire had been using to collect data of socio economic status. Thus, to examine continuous variable frequency distribution and descriptive statistics had been used and for categorical variable frequency distribution was using. The results indicated that among female there existed high level of malnourishment.

Haider and Zaidi (2017) observed the change in consumption patterns of Pakistani household depend on eleven food groups. The dataset used in this study was microlevel survey conducted by HIES from 2000-01 till 2012-14. They used technique known as quadratic almost ideal demand system to see how household response against the variation in prices and salary. They used food consumption pattern disparity as dependent variable and total spending (expenditure per capita), demand, prices, and total food expenditure were taken as independent variables. The results supported the hypothesis that there was regional as well provisional disparity in food consumption. Average calories intake was still less than standard amount 2,350 Kcal inspite of increase in food intake and per capita income increment. One of the reasons may be that they were not taking diversified food. The results indicated that 30% children were underweight, 11% were stunted and 45% were wasted.

Ullah et al. (2014) investigated prevalence of malnourishment among under-five children in Swat. The cross sectional study was done among children using Gomes classification. Thus, the results indicated that children with uneducated mothers were more prone to malnourishment as compared to educated mothers. Number of siblings were positively correlated with malnutrition and thus the prevalence was same among male and female; family size, lack of education, teenager pregnancy was cause of malnutrition.

Afridi, Khushdil, Riaz, and Ehsan (2014) conducted a studied in Swat Mingora to observe the nutritional status of children (2-5years age). Anthropometric data was collected by measuring weight and height and then juxtaposing it with NCHS standards. Sample size included was 550 children. the estimation technique used in this studied was descriptive analyses. The results indicated that 8% children were stunted and wasted. While 14% were underweight.

Gul and Kibria (2013) examined the existence of malnutrition among less than three years old children. The study was done in Peshawar, the study sample included was mother and children. Data was collected through questionnaire. Thus, the results indicated that in two rural areas i.e. Sarband and Pishtakhara, prevalence of malnutrition was 35% and 71%. Both maternal and socioeconomic factors were responsible.

Mushtaq et al. (2011) examined the nutritional status relative to international growth standards, height and weight specific to gender and age among school going children in Lahore. The targeted population was 1,860 school going children, age five to twelve years. The descriptive analysis had been done. Thus, the results indicated that child malnutrition was high because of poverty, lower income and education and overcrowded houses. The height of male and female remained same.

Mushtaq et al. (2011) investigated the existence of stunting and underweight and socio-economic factors affecting them. This study was done in urban areas of Lahore with sample size of 1,860 children. Stunting was measured through HAZ and thinness was measured by BMI. The study conducted were using descriptive and multivariate logistic regression. The results indicated that malnutrition was not significantly linked with gender, around 10% children were wasted, and 8% were stunted.

Khattak and Ali (2010) observed the incidence of malnourishment in Swabi. To evaluate the nutritional status in both male and female children, primary data was collected. The sample size was around 140 children. The variables included to investigate the correlation were age, income, household size, number of children, gender of child, child stature/age/weight z score. The study stated that 50% children were malnourished, and the family income and size were major factors.

Studies conducted in different part of the world had documented that limited work had been done on child double burden of malnutrition. Earlier literature has evaluated child malnutrition using descriptive analysis mostly (Afridi et al., 2014; Krasevec, An, Kumapley, Bégin, & Frongillo, 2017; Leroy et al., 2014; Mushtaq et al., 2011). However, descriptive statistics could not help to identify factors determining child malnutrition that are required for policy formulation. Some studies have used ordinary least square estimator to evaluate the impact of socio-economic factors on the occurrence of children malnourishment (Frempong & Annim, 2017; Iqbal et al., 2017; Motbainor, Worku, & Kumie, 2015; Tiwari, Ausman, & Agho, 2014). Least square estimator is not appropriate for a dependent dummy variable. Logistic regression estimator is more appropriate and is used in few studies (Adhikari, Shrestha, Acharya, & Upadhaya, 2019; Farooq, Shah, & Yaseen, 2019; Khan et al., 2016; Wolde, Berhan, & Chala, 2015). Though one-level logistic estimator could not incorporate hierarchy in data collection procedure. Recently, few studies have used multi-level mixed effect logistic regression estimator to investigate the determinants of child malnutrition partially (Krasevec et al., 2017; Kumar et al., 2019). However, these studies have either considered stunting, wasting or underweight as child malnutrition measure. Moreover, only few studies have examined the association between diverse diet and child stunting (Ali et al., 2013; Arimond & Ruel, 2004; Saaka, 2012). Furthermore, the study done separately and comparatively in Bangladesh, Nepal, Pakistan, and Myanmar suggested major risk factors of double burden of malnutrition at household level depend on poor breastfeed, media exposure, and wealth-index (Anik et al., 2019; Khan et al., 2019). This study included different socio-economic and demographic determinants. As well as economic and food market indicators that increase the risk of malnutrition which leads to economic burden (WHO, 2018a). Thus, there is not a single studied that investigate the double burden of malnutrition in Pakistan by using PDHS dataset as well as dietary diversity. In the light of above background, this study supports to the extant literature by evaluating the impact of food insecurity on child double burden of malnutrition in Pakistan using PHDS recent and large dataset and multi-level mixed effect logistic regression estimator.

Previously studies evaluated burdens of malnourishment either through being underweight or overweight. So far, in Pakistan, work on the dual burden of malnutrition focused on underweight children and overweight or obese mothers (Black et al., 2013; Das et al., 2019; Oddo et al., 2012). So to the best of our knowledge, none of the studies focuses on stunting and overweight under-five children at the individual, mother, household, and community levels through the latest nationally representative dataset to evaluate a wide range of areas such as health and nutrition. While using the dataset, this study examined the prevalence of undernutrition and overnutrition among under-five children, along with socioeconomic and demographic factors. This study also used other cofounded factors, such as food insecurity, child gender, and maternal age at first birth, as any significant impact on children's well-being or not. This work also established a unique interaction term of poor households and improved sanitation, significantly reducing children's double burden of malnutrition. Further, the mother level

introduced an interaction term of educated and empowered mothers to estimate the impact on child health and nutritional status. Similarly, overweight and obese mothers at the community level affect the children's health and increase malnourishment (Raphaël, Delisle, & Vilgrain, 2005).

In the light of existing literature, this study is established by using the nationally represented Pakistan Demographic and Health Survey (PDHS) 2017-18 data. The dataset is hierarchical, so multilevel mixed effect logistic regression is best to tackle the double burden of malnutrition among children. This study's objective is to evaluate the food insecure children suffer from the double burden of malnutrition by using socioeconomic and demographic variables, producing severe effects on child health and mortality rates. However, this study used undernutrition and overnutrition simultaneously, so it will help the policymakers find a more holistic way to tackle the double childhood burden of malnutrition.

3. Research Methodology

To estimate the impact of food insecurity on the prevalence of malnutrition among children, this study used PDHS 2017-18 data and employed a two-level mixed effects logistic regression model. The theoretical grounding of this study is based on household production function and social ecological theory.

3.1. Household Production Function

The theoretical model for this study was to give a general theoretical background for the empirical model. The details of the variables are explained in the practical section. The household utility-maximizing model, by specifying the theory of household production function, had been used to assess the impact of food insecurity on the prevalence of malnutrition status among under-five children (Becker, 1965; Strauss & Thomas, 1995). Households use inputs like food, human capital, and other goods to produce the final interest, i.e., health. To study the impact of food insecurity on child health, this model was adapted to include individual (child, women), household, and community-level characteristics and their relative dimensions. The health status of a family is affected by income; likewise, household income is affected by health. Assume homes have a strictly concave utility function (Huffman, 2011). Family maximizes utility from consuming a vector of commodities consumed C , leisure L and quality of health as shown below:

$$U = U(C, L, H) \tag{1}$$

Where;

U represents the household utility function

C means goods consumed by the household. This particular study represents a diversified diet consumed by children mainly.

L represents leisure time spent by the household

H represents household health. Here, it means child health and is measured by the child's nutritional status.

The utility function is maximized subject to several budgets and nutritional health constraints. The child's nutritional health status (N) is influenced by the child's physical characteristics, availability, access, safety and diversity of diet, morbidity, access to health facilities, environmental conditions, and quality of care at home. The child's nutritional status measured by standard anthropometric measures, recommended by WHO (2010), can be expressed as:

$$N = (C, F, M, H, E, CC, \mu) \tag{2}$$

Where C represents consumption, including eating from diversified food groups by children, F represents children's characteristics such as age, gender, birth weight, and food insecurity status. M represents mother characteristics such as age, education, employment,

empowerment, and obesity, H represents household characteristics such as family size, wealth index, E represents household environmental conditions such as status of sanitation facilities, drinking water quality, CC community characteristics such as place of residence, provinces and overweight and obese mothers of communities, μ is child specific error term.

Although child nutritional status N is estimated using anthropometric measures of height for age z-score (HAZ), in equation 2. WHO 2006 recommended reference populations have been used to compute z-scores. For example, the weight for age z-score (WAZ) of i th child is calculated by taking the difference between each child's weight w_i and the median weight w_r for the same age and sex of the reference population of children. It is divided by the standard deviation SD of the reference population as follows:

$$WAZ = \frac{w_i - w_r}{SD} \tag{3}$$

3.2. Multilevel Mixed Effect Logistic Regression Estimator

The data of the Pakistan Demographic Health Survey (PDHS) have a hierarchical structure that indicates individuals (like children and mothers) live in households, and households settle in communities. The flat or one-level model can underestimate the coefficients leading to imprecise standard error as it incorporates only household-level variables. Consequently, it influences the null hypothesis decision. However, in this PDHS dataset, individuals belonging to the same community have similar characteristics compared to those nested in other communities in the country. The PDHS violates the assumption of a flat model, i.e., the independence of observations and equal variances across communities. As data with hierarchical structures considers the lack of freedom between cases, multilevel models are best suited (Kamanda, Madise, & Schnepf, 2016). Using a two-level mixed effects logistic regression estimator is suitable to evaluate the impacts of individual, household, and community factors on children's health. It has fixed and random effects; fixed effects are estimated directly, similar to typical regression coefficients. On the other hand, random results are presented by estimated variances and covariance and are indirectly measured. Considering the assembled idea of the dataset, if the dependent variable is binary, then utilize the two-level mixed effects logistic regression technique (Williams, Zimprich, & Rast, 2019).

The data are fitted into two-level mixed effects logistic regression model as expressed below:

$$\log\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \beta_0 + \beta_1 K_{1ij} + \beta_2 K_{2ij} + \dots + \beta_k K_{kij} + \alpha_1 M_{1ij} + \alpha_2 M_{2ij} + \dots + \alpha_L M_{Lij} + \gamma_1 H_{1ij} + \gamma_2 H_{2ij} + \dots + \gamma_m H_{mij} + \lambda_1 CC_{1ij} + \lambda_2 CC_{2ij} + \dots + \lambda_n CC_{nij} \tag{4}$$

$$\beta_{oij} = \beta_o + v_{ok} + e_{oij} \tag{5}$$

Where,

Child-level variables: K_1, K_2, \dots, K_k

Maternal-level variables: $M_{1,2,\dots}, M_L$

Household-level variables: $H_{1,2,\dots}, H_m$

Community-level variables: $CC_{1,2,\dots}, CC_n$

In fixed effects equation 4, children are depicted by i , and the clusters/communities are represented by j . The response variable $\log\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right)$ represents the logistic distribution of malnutrition measured as double and triple health burdens for the child I in cluster j . K represents a vector of child-level predictors, and their parameters are represented by vector β . The mother-level predictors are indicated by vector M and its parameters by vector α . H is a vector of household-level predictors, and its associated parameters are denoted by vector γ . Vector and its parameters show, and community-level predictors are depicted by vector λ . To estimate the

random effects, equation 5 has been used. At the cluster level, ν_{ok} is the random intercept to show the variability of nutrition status among children from different clusters. With zero mean and variance equal to σ^2 , ν_{ok} is usually distributed. The variance is indicated by e_{oij} . $ICC = [\sigma_u^2 / (\sigma_u^2 + n/3)]$ has been used to estimate the Intra-Class Correlation between cluster and within-cluster variances. Fixed and random effects are estimated by equations 4 and 5, respectively. The odds Ratio (OR) expressed the fixed effects size of all predictors. The Likelihood Ratio test has been done to recognize the joint significance of the group variable (cluster), which helped us to choose between a multilevel or flat model. This also helped in determining the contribution of random and contextual factors.

4. Data

The study used Pakistan Demographic and Health Survey (PDHS) 2017-18. This survey covers all the provinces, Azad Jammu and Kashmir (AJK) and the former Federally Administrated Tribal Areas (FATA), Gilgit Baltistan (G.B.); for Islamabad Capital Territory (ICT). USAID has provided financial assistance to collect health, socioeconomic and demographic information. The two-stage sample design stratification has been followed. In the first stage, 580 clusters were included, from which 19 groups were dropped because of security reasons, and in the second round, 28 households per cluster were selected. The total sample size was 16,240 households, and women 15-49 years old were interviewed to collect information; the response rate was 96%. A sample of 3,625 children under 6-29 months was included in this work after excluding the missing values. This study used multilevel mixed-effect logistic regression because of the hierarchical nature of the PDHS dataset. The model captured both random and fixed effects. Five models have been estimated; the first model was an empty model that included only the dependent variable; in the second model, children characteristics were incorporated; the third model included mother characteristics; the fourth model included household characteristics; and the last model, community variables, were incorporated. Odds ratios represent fixed effects, and ICC was an intra-class correlation. Joint significance was estimated by using the likelihood ratio test.

4.1. Outcome Variable

To understand the double burden of malnutrition in Pakistan, this study used undernutrition and overnutrition as the dependent variables. Stunting was used as a proxy for undernutrition, and overweight was used as a proxy for overnutrition. Undernutrition among under-five children was measured by anthropometric indices height-for-age that represent stunting. On the other side, nutrition was determined by weight-for-height, identifying overweight. Thus, if the child's z-score is <2.0 , then they are undernourished (stunted), and if the child's z-score is >2.0 , then they are overweight (WHO, 2010). The dummy variable is constructed as a dependent variable, i.e., dichotomous. If children suffer from the dual burden, "1" is assigned; otherwise, "0".

4.2. Independent Variables Children's Characteristics

Children's food insecurity, age, gender, and weight at birth is included in this study. This study used food insecurity to meet under-five children's nutritional needs and health status. PDHS does not contain food insecurity information. Therefore, this study has constructed a food insecurity variable by asking women for 24-hour recall of food items given to children. This information is classified into eight food groups, i.e., starchy staples, dairy products, eggs, flesh food, legumes, vitamin-A-rich fruits & vegetables, other fruits and vegetables, and juices. Further, to convert the variable into binary form, assign the value of "1" if children are consuming five or more five food groups and "0" otherwise; if they consume less than five food groups considered highly food insecure. This analysis includes Children aged 6-59 months; age is a continuous variable. To construct gender, i.e., male/female as a binary variable, assign value

"1" if female and "0" otherwise. Weight at birth is included in this study as household food insecurity is linked with low birth weight. It further increases the risk of stunting among under-five children, which has long-term consequences in the future, leading to overweight/obesity (Maitra, 2018).

4.3. Mother Characteristics

This study includes the mother's age at first birth, education level, empowerment, and interaction term constructed as educated mothers and empowered women. Mother decision-making authority is significantly associated with child health. PDHS data contain different questions like who made spending decisions on the husband's earnings, health decisions, family visit decisions, and household purchase decisions. This study used the decision of spending earnings either they both took the decision or women alone; then she is empowered otherwise not empowered. An interaction term educated and empowered mothers has been constructed, stating that if the mother is educated and given authority to make spending decisions, then the dual burden of malnutrition has been reduced.

4.4. Household Characteristics

At the household level, sanitation facilities, improved water, wealth status, the interaction term of poor households, and improved sanitation have been used to investigate the impact of these factors on child health. Sanitation facilities have been captured, whether or not they used flush pit toilet facilities. Improved water facilities indicating they used tap water. The wealth index consists of poorer, poorest, middle, wealthy, and more affluent households; this study interacts with the more impoverished variables and constructs the poor household variable. Similarly, a poor household with improved sanitation has been built, indicating that if sanitation had improved in poor households, it would significantly impact health.

4.5. Community Characteristics

This study incorporated provinces (Punjab, Sindh, KPK, Balochistan, and others), places of residence, and overweight and obese mothers. Being overweight is identified by corresponding values ($25 \leq \text{BMI} < 30$) (Sengupta, Angeli, Syamala, Van Schayck, & Dagnelie, 2014; WHO, 2010). If communities have 50% overweight and obese mothers, the chances of children suffering from the double burden of malnutrition have increased.

5. Result and Discussion

5.1. Descriptive Statistics

In Table 1, descriptive statistics are used to analyze the double burden of malnutrition among children, mothers, households, and community characteristics. The table reported a t-test and chi-square test to evaluate the difference between continuous and categorical variables. Furthermore, percentages identifying categorical variables and mean values with standard deviation represent continuous variables.

Table 1 demonstrates that food insecurity increases the double burden of malnutrition among under-five children, i.e., 90% of children suffer from dual burden issues, which is statistically significant at the 5% level. However, the occurrence of burden is less in food-secure households, i.e., 87%. Child aged 6-59 months are included in this analysis; the results indicate that double burden and age does not show any significant association. There is no significant difference between males and females. However, males are more affected by the burden, i.e., 52%, compared to females, i.e., 48%. Birth weight is an essential determinant of normal growth. It is statistically significant at 10%, and children with low birth weight suffer from dual burden are 15%.

Mother age is a crucial variable stating that as a mother's age increases, with the experience, she can take good care of children. No statistical difference exists between the mother's age and the children's double burden in this work. However, a one-year increase in age leads to a decrease in the suffering of children by 21%. There exists a significant difference between educated and illiterate mothers' children. However, illiterate mothers have more double-burdened children, i.e., 49%, compared to educated mothers, i.e., 4%.

Moreover, the empowered mothers have fewer malnourished children, i.e., 7%. It is commonly observed that when people are free to make decisions, they will work better. Similarly, when women are given the authority to make decisions about household chores and have proper knowledge about nutritional importance, it significantly affects the child's health status. Therefore, the result indicates that educated and empowered mothers' children suffer a double burden of 51% compared to not empowered women's children, i.e., 93%.

Households using improved toilet facilities have better health status and fewer health issues. In this study, the improved toilet facilities are statistically significant at a 1% significance level. The results state that 88% of children suffer from the double burden; one of the reasons might be that more people using the same bathroom will affect their health because of hygiene issues. Similarly, households with poor backgrounds and using improved flush pits have better health status. It shows a significant association at a 1% level. Thus, low-income families increase the prevalence of double the burden of malnutrition, which is statistically significant at a 1% level.

Place of residence, rural and urban areas show statistically significant differences. Urban areas have more children suffering from the double burden, i.e., 55%, compared to rural areas where the load is 45%. The overweight and obese mothers have more children suffering from the double burden of malnutrition, 63%. KPK and Sindh are significant at a 1% level. Other provinces have no significant difference in the prevalence of double burden among under-five children.

Table 1
Prevalence of Double Burden Among Under-five Children Frequency
(Percentage) or Mean (Standard Deviation), PDHS 2018

Variables	Children suffering from DBM	Children who are not suffered from DBM
Children characteristics		
Age (months)	32.93 (15.29)	32.28 (15.74)
Female (%)	48.29 (0.49)	49.12 (0.50)
Male (%)	51.71 (0.49)	50.88 (0.50)
Birth-weight (%)	15.20* (0.36)	17.21 (0.38)
Food insecurity (%)	89.74** (0.30)	87.22 (0.33)
Mother Characteristics		
First birth age (years)	21.15 (3.97)	21.06 (3.95)
Illiterate (%)	44.81*** (0.49)	56.46 (0.49)
Educated (years)	3.99 (1.40)	3.90 (1.38)
Empowered (%)	6.65** (0.25)	11.82 (0.32)
Not empowered (%)	93.34*** (0.25)	88.07 (0.32)
Educated*empowered (%)	51.34*** (0.49)	39.10 (0.48)

Household Characteristics		
Improved toilet facility	88.03*** (0.32)	73.18 (0.44)
Improved water facility (%)	85.16** (0.36)	83.13 (0.38)
Poor (%)	42.92*** (0.49)	0.56 (0.49)
Poor * Improved toilet facility (%)	25.33*** (0.43)	31.50 (0.46)
Community Characteristics		
Rural residence (%)	44.99*** (0.49)	62.30 (0.48)
Urban residence (%)	55.01*** (0.49)	37.69 (0.48)
Over-obese women (%)	63.31*** (0.48)	23.15 (0.42)
Provinces		
Punjab (%)	22.47 (0.42)	21.44 (0.41)
Sindh (%)	13.19*** (0.34)	22.34 (0.42)
KPK (%)	21.79*** (0.41)	12.68 (0.33)
Balochistan (%)	10.74 (0.31)	12.43 (0.33)
Others (%)	7.08 (0.26)	7.55 (0.26)

***, **, * Significant at 1%, 5% and 10% level, respectively.

Note: Mean values are shown with standard deviation in parenthesis.

The t-test is used for continuous variables, while the chi-square test is used for categorical variables to recognize the the difference in mean values. Data source: Pakistan Demographic and Health Survey 2017-18.

Figure 2 illustrates the double burden of malnutrition across food insecurity and provinces. This is high among under-five food insecure children compared to food-secure children across all provinces of Pakistan except KPK. Food secure children of KPK have the highest prevalence of double burden, while children of Sindh have its lowest prevalence.

Figure 3 illustrates the incidence of the double burden of malnourishment age and obesity of mothers. There is the highest prevalence of double duty among children of obese mothers compared to normal-weight mothers. If mothers are obese, the majority of the double burden is almost the same across all age groups of children. Thus, obesity in mothers increases the risk of coexistence of stunting and overweight among children.

Exerting the multilevel mixed-effects modeling helped to unsnarl the gaps related to lifestyle, demographic, and socioeconomic behaviors in the existing literature and their correlation with the prevalence of double burden of malnutrition among children. The impact of food insecurity on the prevalence of double duty of malnourishment among under-five children has been unraveled after controlling for individual, household, and community-level characteristics with the help of a multilevel model in Table 2. This table has five versions of analyses.

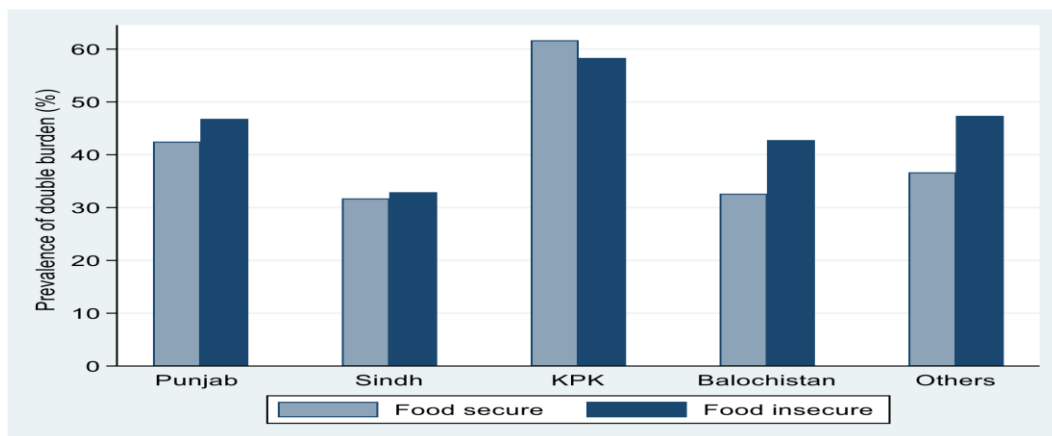
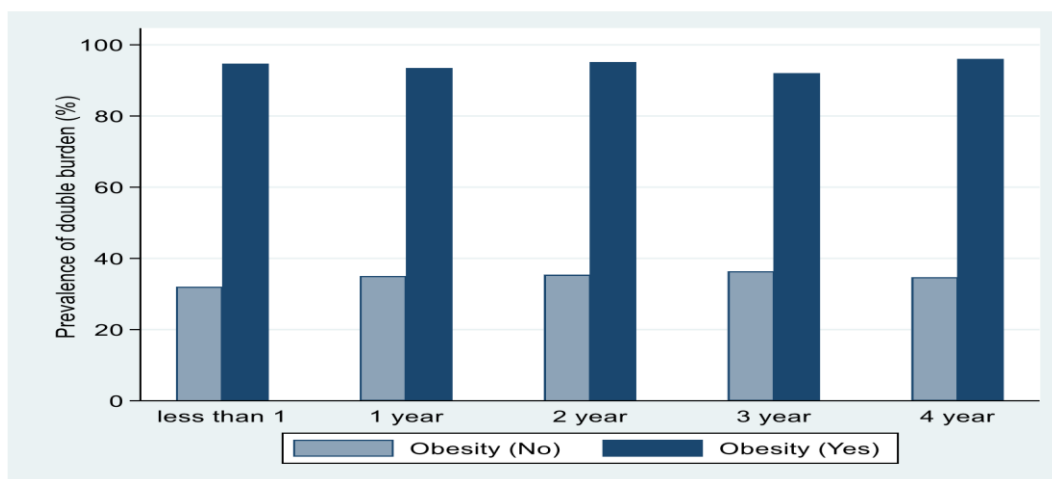


Figure 2: Prevalence of Double Burden Among Under-Five Food Insecure/Secure Children Across Different Provinces Of Pakistan
 Source: Author's calculation



Source:

Figure 3: Prevalence of Double Burden Among Obese Mother's Children
 Author's calculation

5.2. Results of Multilevel Mixed Effect Logistic Regression Estimators for Determinants of Double Burden of Malnutrition

The analysis begins with estimating the empty/intercept model (model 1) to evaluate the total variance in the occurrence of children's double burden of malnourishment. The intercept model does not carry out any variable; it divides total variance into a sum of the individual and community level variance, which gives Residual Intra Class Correlation (ICC) approximates. As shown in Table 2 in the empty model, the ICC value is 0.299, which connotes that 29% variation occurs between clusters in the prevalence of double burden of malnourishment among under-five children. This is a non-trivial amount. This indicates that instead of using flat/single-level logistic regression, it is preferable to use two-level mixed-effect logistic regression.

The multilevel model proceeds by computing odd ratios with confidence intervals in Table 2. In model 2, children's characteristics such as age, gender, birth weight, and food insecurity status are introduced to assess their relationship with the double burden of malnutrition. However, a child's age, gender, and low birth weight have no significant effects on the prevalence of double burden of malnutrition. However, a child's food insecurity status significantly impacts

most of the double burden of malnutrition. The odds ratio of food insecurity demonstrates that 1.237 folds increase the odds of a double burden if a child is food insecure. The children who are given a less complementary diversified diet are more likely to face the problem of the double burden of malnourishment as compared to those children who have been fed with a more diversified diet. This implies that food insecurity, measured through food quality, leads to a double burden of malnutrition.

In model 3, mother-level characteristics, including the mother's age at first birth, education level, employment, and empowerment, are assimilated along with children's features. The estimation state that the age of the mother at first birth and the mother's education has no significant difference in the prevalence of double burden among children. Likewise, children of employed mothers have a lower risk of a double burden than children whose mothers stay home. If a mother is currently employed, then 0.602-fold decrease in the odds of double burden malnutrition among under-five children. These findings are consistent with (Farooq et al., 2019). This implies that women's employment helps to reduce the financial constraints of the household, which has subsidizing impact on reducing the double burden of malnourishment.

Moreover, women empowered to make the health decision should have children with a lower risk of the double burden of malnourishment than those without the authority to make decisions. However, the odds ratio of mother's empowerment reveals that if the mother is empowered, there is a 1.610-fold increase in the odds of the double burden of malnutrition among under-five children. These findings are consistent with (Alaofè, Zhu, Burney, Naylor, & Douglas, 2017). Alaofè et al. (2017) included six dimensions of women's empowerment to measure its impact on child nutritional health. It has been noted that empowerment increases the risk of malnutrition in two dimensions. However, this study shows that increasing women's self-confidence improves children's health. The literature highlighted different sizes of women's empowerment, like women's violence, economic security, leadership role, free mobility, and non-family marriage domains. The lack of concrete information on the women empowerment domain in PDHS may result in unexpected results in this study.

Household characteristics, including improved toilet facility, improved water facility, and wealth index variables, are incorporated in model 4, along with children and mother characteristics. The analyses show that improved toilet facility has a statistically significant effect on under-five children's double burden of malnutrition. The presence of improved toilet facilities leads to 3.466 folds' increase in double burden prevalence. Better sanitation facilities increase the risk of double burden among under-five children. This contrasts with the existing literature (Zeray, Kibret, & Leshargie, 2019).

Despite significant improvements in access to sanitation facilities, still, 25 million people practice open defecation (Unicef, 2019). Similarly, the PDHS 2018 report highlighted that 28% of the population used flush toilets with piped sewerage systems, 24% used flush toilets to septic tanks, and just 13% used flush-to-pit toilets. While, ventilated improved pit toilets and pit latrines with slabs were used by 0.1% and 0.4% of households, respectively. However, mothers disposed of 42% of children's stools appropriately. According to the PDHS report, 70% of households use improved toilet facilities, but just 13% do not share facilities with others. Sharing common toilet facilities leads to hygienic problems triggering diseases like diarrhea among under-five children. The unexpected results in this analysis point out that the improved sanitation facility in Pakistan is not meeting health standards, e.g., inadequate cleaning and leakage of a septic system, etc. However, improved water facilities and wealth status were not significantly associated with children's double burden of malnourishment.

Table 2
Determinants of Double Burden Among Under-Five Children of Pakistan

Variables	Intercept Model	Child Model	Maternal Model	Household Model	Community Model
Fixed Effects					
Children characteristics					
Age (months)	-	1.002 (0.997-1.007)	1.004 (0.998-1.012)	1.004 (0.997-1.012)	1.005 (0.997-1.012)
Female (dummy)	-	0.951 (0.815-1.110)	1.035 (0.823-1.301)	1.034 (0.822-1.301)	1.022 (0.814-1.284)
Low birth weight (dummy)	-	0.834 (0.672-1.035)	0.937 (0.678-1.295)	0.959 (0.693-1.327)	0.997 (0.722-1.377)
Food security	-	-	-	-	-
Food insecurity (dummy)	-	1.237* (0.959-1.594)	1.547** (1.049-2.282)	1.513** (1.024-2.235)	1.507** (1.022-2.223)
Mother characteristics					
First birth age (years)	-	-	0.974 (0.943-1.006)	0.961** (0.930-0.993)	0.959** (0.929-0.991)
Education (years)	-	-	1.051 (0.964-1.146)	1.057 (0.969-1.153)	1.049 (0.963-1.143)
Currently working (dummy)	-	-	0.602** (0.403-0.899)	0.641** (0.428-0.962)	0.636** (0.426-0.949)
Not working	-	-	-	-	-
Empowered (dummy)	-	-	1.610*** (1.254-2.069)	1.592*** (1.237-2.048)	1.689*** (1.314-2.172)
Not empowered	-	-	-	-	-
Household characteristics					
Flush pit (dummy)	-	-	-	3.466*** (2.125-5.651)	2.908*** (1.783-4.742)
No flush pit	-	-	-	-	-
Tap water (dummy)	-	-	-	0.754 (0.505-1.127)	0.781 (0.526-1.159)
Poor (dummy)	-	-	-	0.831 (0.623-1.109)	0.749** (0.558-1.006)
Not poor	-	-	-	-	-
Community characteristics					
Rural (dummy)	-	-	-	-	0.445*** (0.318-0.624)
Urban	-	-	-	-	-
Punjab (dummy)	-	-	-	-	1.507** (1.013-2.240)
Sindh (dummy)	-	-	-	-	0.759 (0.475-1.212)
KPK (dummy)	-	-	-	-	2.845*** (1.698-4.768)
Balochistan (dummy)	-	-	-	-	1.379 (0.709-2.680)
Others	-	-	-	-	-
Random Effects					
Cluster level variance	1.401	1.396	1.509	1.431	1.143
Variance (S.E.)	0.175	0.175	0.285	0.276	0.240
Residual Intraclass Correlation (ICC)	0.299	0.298	0.314	0.303	0.258
ICC (SE)	0.026	0.026	0.041	0.041	0.040
Observations	3,625	3,625	1,769	1,769	1,769

***, **, * Significant at 1%, 5% and 10% level, respectively.

Note: Odds ratio with 95% confident intervals are shown with standard errors in parenthesis.

Data source: Pakistan Demographic and Health Survey 2017-18

Community-level characteristics comprising the place of residence (rural versus urban) and region are included in model 5 and incorporated with children, mothers, and household-level

features. The estimation depicts a significant negative association between children's double burden and rural residency compared to urban residents. Previous literature reports similar findings (Abbasi et al., 2018; Khan et al., 2019). A healthy environment and better availability of fresh food in rural areas lead to improved child health. However, people migrate to urban areas to improve their standard of living. Contrarily, increased urbanization results in congested dwellings and reduced employment opportunities, possibly negatively affecting child health. Likewise, children living in Punjab and KPK regions have a significant and positive association with the double burden of malnutrition compared to those living in Sindh, Balochistan, and other areas.

The highest prevalence of double burden in KPK could be increased food insecurity and reduced farm income due to dry spells and high temperatures at the peak of wheat sowing months in the last decade, which was predicted to reduce crop yield by 50%. Climate change would negatively impact poor household purchasing power and child health (WHO, 2017). The second highest risk of double burden in Punjab could be the lowest duration of breastfeeding due to more working mothers in the region. Moreover, Punjab is highly populated and has the second highest migrant ratio after ICT, i.e., 48% and 13%, respectively (PDHS, 2018). Another reason for the higher double burden in Punjab could be increasing food insecurity in Punjab since 2009; only eight districts remain food secure. Energy shortage could be another reason for the double burden in Punjab as it reduces industries' output and employment of workers. These were notable reasons that despite significant development in Punjab, the region faces a higher prevalence of double burden of malnutrition. This study's findings were consistent with (WHO, 2017). This finding is consistent with Subramanian, Perkins, and Khan (2009) too, which concluded that the prevalence of double burden of malnutrition at the national level varies with income inequality. Rapid economic growth leads to unequal distribution of resources among different socioeconomic groups.

6. Conclusion

This study has helped to better understand the importance of food insecurity on the prevalence of malnutrition status among children. International organizations and communities long ago are familiar to the significance of food security. However, developing countries like Pakistan has not accorded the groundwork for nutrition security it deserves, therefore, nutrition deprivation endures substantial challenge to exact a devastating human, social, and economic toll. Every child needs appropriate and balanced food that must be adequate in quality and quantity to meet their dietary needs. One of the challenges here is to shine a light on food diversity so that child malnutrition can be eliminated. To make this happen, the policy makers at different levels must take actions to formulate appropriate policy for health sector, in order to provide better facilities that lead to healthier child in the country. By using multi-level mixed effect logistic regression, this study suggested a number of settings and interventions to overcome the problem of double burden of malnutrition.

Firstly, this study emphasizes a holistic approach to tackle the issue of double burden of malnutrition by engaging all stakeholders including policy makers, food suppliers, community-based organizations, households and mothers. Secondly, government should target to improve national food security by subsidizing food prices, ensuring quality food and improving household's access to diversified food. Thirdly, while designing policy interventions to enhance children health status, due consideration should be given to mother, children, households and community characteristics. Fourthly, at individual level, the role of mother is essential to prevent child double of malnutrition and to ensure food security at child and household levels. Though, women are fostering the nutrition and health status of family. Moreover, mother's literacy is critically linked with child nutritional status, therefore, this study strongly recommends women nutrition education interventions for addressing the malnutrition problems. By educating mother about healthy and balanced diets in particular prioritizing complementary diets along with breast feed

after six months of child birth may lessen the prevalence of double burden of malnutrition as recommended by (Leroy et al., 2014). Moreover, such intervention programs will educate mothers to take nutritional diet during pregnancy and to give healthy diets to children in their early life. Fifthly, this study also suggests empowering women in the direction that will enable to choose healthy food for children. Sixthly, to prevent issues of overweight among children, there is need of proper strategies to promote healthy and balanced dietary intake through minimizing food inequalities in households and increase physical activities. This will definitely help to break the cycle of double burden of malnutrition. Seventhly, better sanitation and improved drinking water facilities and income opportunities for households would help to mitigate double burden of child malnutrition. Lastly, equal development of rural areas for reduction of inequality and poverty by providing well-paid jobs to prevent a further influx of urbanization and related problem of malnutrition. In short, in Pakistan malnutrition is high because of lack of knowledge related to nutritional status. Therefore, different awareness and counselling sessions with mothers by health workers to aware them about diversified diet are required for child health. Awareness sections at individual, household, and community levels may also beneficial for children future health. Educating mothers about the adverse effects of untreated water and sanitation facilities is essential for future health outcomes. Moreover, government of Pakistan can step forward to break the vicious cycle of poverty as it increases child malnutrition.

Authors Contribution

Rabia Sultan: Study's design and data analysis.

Afshan Iram: Interpretation of the results and proof read the manuscript.

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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