ASSOCIATION BETWEEN WATER, SANITATION AND UNDER NUTRITION IN PAKISTAN: A GENDER-DISAGGREGATED ANALYSIS USING PDHS 2017-18

By

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CERTIFICATE

This is to certify that this thesis entitled: "**Association Between Water, Sanitation and Under nutrition in Pakistan: A Gender-Disaggregated Analysis Using PDHS 2017-18**" submitted by **Rafit Saheed** is accepted in its present form by the PIDE School of Social Sciences, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in Master of Philosophy in Public Policy.

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Declaration

I Rafft Saheed solemnly declare and affirm on oath that; I attended this M.Phil. Thesis with my own work and means and have not used any further means but those which are explicitly mentioned in this research. All the items which are copied form internet or other written sources have been properly mentioned in quotation mark and with a reference to the source of citation.

Rafit Saheed

Dedication

Dedicated to my beloved
Parents, Siblings, Friends
&
My Super-senior ***Mr. Muhammad Shahid***

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During preparation of this thesis, I have received a lot of encouragement, support, advice, suggestions and assistance from many sources. Mentioning all of them is necessary.

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ABSTRACT

Contaminated drinking water and unhygienic methods for disposal of waste or sanitation for a large proportion of population are common realities in developing countries. The impact of sources of pollution on different dimensions of well-being of human race have been extensively investigated as it can largely affect physical health and cognitive abilities of preschool children. Impact of unclean water and poor sanitation on child undernourishment is not clearly investigated in Pakistan, although this link is one of the most prominent cause of children fatalities globally. This thesis studies the impact of the drinking water quality and sanitation service on the probability of being malnourished among children in Pakistan. This study specifically accesses the association of malnutrition with social and economic factors, in general, and environmental factors, in specific, such as sanitation facilities and drinking water sources for Pakistan. Moreover, this research examines the determinants of male and female child malnutrition in Pakistan while, in specific, the role of the sanitation facility and drinking water source in gender analysis. The study used a sample of 1,004 under-three children extracted from the data of Pakistan Demographic and Health Surveys 2017-18. Composite Index of Anthropometric Failure (CIAF) was generated to measure malnutrition among children based on height for age Z score (HAZ), weight for age Z score (WAZ), and weight for height Z score (WHZ). In the study we used binary logistic regression to analyze the probability of malnourishment among children. The results of the study depict that the mothers with five years of schooling and 10 years of schooling, had 65.5% [primary (CI: 0.42-1.04] and 40% [high (CI: 0.23-0.72)] lower chances of malnutrition prevalence among their children. Household belongs to richer and richest quantile, had 57.9% [richer (CI: 0.34-0.99)] and 40.3% [richer (CI: 0.22-0.74)] lower probability of undernutrition prevalence among their children. The results further portray that households who have improved water source, had 71.5% (95% of Confidence Interval: 0.51-1.01) lower chances of undernutrition prevalence among their children. Same as, the households who have improved toilet or sanitation facility, had 68.9% (95% CI: 0.52-0.91) less chances to experience the occurrence of malnutrition among their children. The binary logistic regression results for gender-disaggregated analysis show that households who have improved water sources had 62.1% (95% Confidence Intervals: 0.37-1.03) lower probability to experience the undernutrition among their male children. Sanitation variable was insignificant in male model. Similarly, households who have improved sanitation facility had 64.1% (95% Confidence Intervals: 0.43-0.95) lower chances of undernutrition prevalence among their female children. Water variable was insignificant in female child model. This study concludes that human development projects like education to every child Ahsaas Program etc. should be expended more for human development along with the plans to advance water and sanitation facility should be entered into the priority lists to not only save human from water and sanitation borne diseases but also could reduce child malnutrition as well as it also uplifts the standard of living of common folk.

Keywords: Malnutrition, Pakistan Demographic and Health Surveys, Sanitation Facility, Water Source, Wealth Index

Chapter 1

INTRODUCTION

1.1. Background of the Study

Sustained economic growth cannot be attained without ensuring the improvement in health of community. Better health status is one of the parameters that certify the active participation of community in economic activities. The nutrition status is the key element of nations' health status and development of future generation. It is track to the 3rd sustainable development goal regarding child and maternal mortality. In this regard, South Asian countries are struggling to alleviate all forms of malnutrition from last two decades.

Among South Asian countries, Pakistan, India, and Bangladesh are facing very high rate of child malnutrition, one out of three children are malnourished. In Pakistan, infant malnutrition is mainly caused by poor nutritional status of mother (Khalid N, 2017). Poverty, illiteracy, and dietary deficiencies of micronutrients are primary causes of undernourishment of pregnant females in Pakistan (Khalid N, 2017). According to UNICEF, WHO and World Bank (2013), there are estimated 52 million children globally among which 8% under five-year age are facing the problem of either undernourishment or malnourishment, although the numbers are gradually decreasing over the past two decades, but the current pandemic again raise the figure. According to Global Nutrition Report (2018) that 22% of children under five years of age are with stunted growth. Black (2008) estimated that among the global underweight population of young children (112.4 million), 70 % were in Asia (more than 90% of this in South Asia) and 28% were in Africa. South Asia is home to the largest population of stunted children worldwide as more than 50% of the world's underweight population of children that account almost 30 million inhibits in South Asia (Global Nutrition Report. 2018). In 2014, 37% (65 million) of total world population of stunted children less than 5-year age live in South Asia (UNICEF, 2015). In the low-income countries and lower middle-income countries, Stunting is a common phenomenon. Almost 37.8 million affected children are in low-income countries where average income is less than $2.80 per day (Global Nutrition Report. 2018).

Undernourishment during childhood is one of the most important risk factors for worldwide death and disability (Victora, 2008). Moderately or severely wasted children have increased chances of fatalities (Global Nutrition Report. 2018). According to Rikimaru (1998) and Ruel et al (1999) economical socio demographical and biological factors affect the health of both child and mother. Malnutrition in children is most importantly determined by poverty and illiteracy of mother (Van. 2007).

In many low-income countries overweight coexist with child and maternal undernourishment (Kennedy ET. 2005). The two dimensions of malnutrition elaborate the evidence that child and maternal malnutrition could increase the risk of adult chronic diseases related to nutrition, stunted growth, and reduced income (Victora, 2008). Children who survive malnutrition have higher risk of recurrence of infectious diseases. Malnutrition also leads to learning disabilities which later results in inability of active participation in economic activities and thus hinders the full potential of contribution in economic development (Victora, 2008). By reducing child mortality rates and

disease by improving the nutrition and health, cognitive ability and work capacity will increase, and will result productivity and economy increase which further reduces poverty in both economic and health form. According to Shekar (2006) that nutritional poverty persists the cycle of poverty and malnutrition through numerous billions of dollars in every year spend on malnutrition and the countries faces economic losses in term of loss in GDP. Horton & Steckel (2013) calculated that the economic losses accrued from various forms of malnutrition counts almost 11% of GDP in Asia and Africa annually. Adults, as stunted childhood likely to earn 20% less than the adults with normal childhood (Grantham-McGregor, 2007). They have 30% more chances to be poor and have little chances to do job as a trained worker (Hoddinott, 2011). A little investment on nutritional improvement programs can increase the improvement speed not in term of health but in economic also. The Copenhagen Consensus Center has estimated that decreasing 40% number of stunted children by 2030 would result a return of $45 for each dollar spent, which is one of the most cost-effective nutrition interventions for the development of world (Hoddinott, 2013; Copenhagen Consensus Center 2015). Despite all given information investment in nutrition is insufficient in South Asia. Britain gross domestic product (GDP) were increased one third of total GDP between the period of 1790 to 1980 and the main cause of this improvement was health improvement more specifically improvement of public health, nutrition and in medical facilities (Fogel, 1994). The studies elaborate very high economic returns of nutrition intervention programs. According to Hoddinott (2013) that investing one dollar in key interventions for stunting reduce, Pakistan would generate an economics return of 30 dollars.

Insufficient maternal nutrition intake is one of main factor of infant mortality, morbidity and other poor birth outcomes that include child malnutrition and neonatal mortality in developing economies. Maternal undernutrition (i.e., energy and micronutrient insufficiencies) ranges from 10% to 40% in South Asia; representing an alarming situation in the region (BDHS. 2007). 25% to 50% of intrauterine growth restriction [IUGR] is incidental due to maternal undernutrition in South Asia (Bhutta, 2004). A continued Vicious cycle of undernutrition pass down over generation, implying affected children would remain unable to catch up growth in future. So, such children will be representing a vulnerable group of the society that would enter school late, would not learn well and would remain less productive (Begum. 2005). According to Global Nutrition Report (2018) that wasted adolescent girls has increased from 5.5% to 5.7% during the period 2000 to 2016. Globally, there is a higher occurrence of being overweight in women. At the same time almost 32.8% of women aged between 15to 45 are anemic. These three health phenomena (Obesity, anemia and underweight) have greater implication of not only females' health status but also imply the health status of their children (Global Nutrition Report. 2018).

In last few years, studies on determinants of child and maternal malnutrition found water, hygiene, and sanitation as a prominent determinant more specifically much prominent in South Asia (Harding, K. L, 2018). Lack of improved water and sanitation leads to disease. Poverty and infancy are highly correlated with the diseases resulted from poor water and sanitation facilities and accounts almost 10% of total burden of disease globally (Prüss-Üstün, 2008). At any point in time, almost 50% of urban population in Asia, Latin America and Africa get illness due to poor hygiene,

contaminated water and poor sanitation (WHO, 1999). Availability of clean water, adequate sanitation and energy are the basic needs for sustainable sustenance. Unfortunately, South Asia lack in these needs also mentioned in SDG 6 (UNESCAP-2018). From an estimate almost 45% of South Asian population have access to proper sanitation implying 960 million people lack proper sanitation. A more alarming situation is that around 610 million people practice open defecation (UNESCAP-2018). For good health and socioeconomic development of people, clean water, proper sanitation, and hygiene are few basic elements (Singh M, 2008). Improvement in quality of life of population especially of children depends fundamentally on access of the above-mentioned facilities. This also results in reduction of morbidity and incidence of diseases related to poor sanitation and hygiene in developing world (. Merchant, 2003).

Faecally-transmitted infections (FTIs) like cholera and diarrhea are mainly caused by improper WASH. These diseases are the second main reason of under-five child mortality and morbidity (Murray et al, 2015). Probability of undernourishment and hence stunted growth is higher among the children who suffer with FTIs and environmental enteropathy which are linked to improper WASH and open defecation (Cumming & Cairncross, 2016). In middle income countries and low-income countries, health care facilities lack safe WASH which is very first and the most important need for good health of both mother and newborn. (Willmott, 2016). Improper washing facilities and poor sanitation are highly correlated with children's attendance in school and academic performance especially for girls. (IASC, 2015), Moreover unavailability of toilets and adequate sanitation may increase the risk of sexual assault as women who use open defecation sites like open fields are likely to get raped when compared with women using a home toilet (Hutton, 2015). More than 80% of UN participating nations express that they do not have enough budget to meet the target of safe WASH (UN-Water, 2018).

A UNICEF-2016 report about water and sanitation situation concluded that in 2016 more than 600 million population lack the basic facility of clean drinking water and around 1 billion people practice open defecation. In case of South Asia about 663 million of population was unable to access clean drinking water in year 2015 (UNICEF, 2016). More than 2.3 billion world population does not have fundamental sanitation services and around 892 million people practicing open defecation while 4.5 billion of population don't have access to properly managed sanitation services (UNICEF, 2017). Nearly two billion population of the world live in countries where water stress is very high and almost 70% of global water is used in agricultural activities (WHO, 2017). Annually almost 1.6 to 2.5 million people die because of the diseases caused by poor water and sanitation globally, among these majority deaths are in developing countries' children under age five (Mathers, 2006). Many studies propose that provision of adequate sanitation can result in reduction of diarrhea and related disease by 32% to 37% (Waddington & Snilstveit, 2009). The relationship between diarrheal disease and malnutrition is linked to poor water and sanitation facilities and bad hygiene causing 50% of the underweight condition in children and mother. (Victora, 2008). Better sanitation facilities not only improve health but also help in reaping socioeconomic benefits. These benefits are widely experienced by Households (Water Supply and Sanitation Collaborative Council, 2003). Although the primary objective of improved sanitation programs is improvement in health, but it is well noticed that these programs are very helpful in securing and empowering female segment of the society specially. As the provision of sanitation

at household level mitigate the risk of rape which is higher when they must use public toilets or bushed for defecation. And sanitation facility in school result increased school attendance of girls who otherwise avoid visiting school during menstruation (Mahon & Fernandes, 2010).

Positive spillover effect of improved sanitation is reduced cost of health system by decreasing the leaves from school or at work because of sickness or taking care of sick family member. Improved sanitation also results in more economic benefits by giving chance of more effective time utilization (Hutton, et al 2007). In addition to spill over benefits, the better sanitation and availability of clean water also produce direct economic benefits through reduction of health system cost by decreasing sanitation and water related diseases. $7 billion per year by reducing disease incidence, in addition $3.6 billion are more saved, the amount calculated by discounting expected earnings of value of death averted (Hutton, & Haller, 2004). Cairncross & Valdmanis, (2006) estimated that $10 of economic returns could be generated by spending only $1 on sanitation one dollar spent on sanitation which is just behind the value of DALY loss averted i.e., $11.5 (Cairncross & Valdmanis, 2006). Majority of the population lacking sanitation facilities are poor and earning less than $2 per day thus high-cost technological solution for sanitation improvement is incongruous for them (Cairncross & Valdmanis, 2006). A report by Hutton and Haller (2004) for the WHO on developing countries explained that returns of investment amount US$ 1 on water and sanitation improvement ranges from US$5 to US$28. Their study evaluates that cost of improving water and sanitation facilities to every man deprived of this facility presently. According to their estimates per head expenditure would be US$10.7 per year that rounds to US$22.6 billion for developing countries altogether. This intervention would yield, they estimate, $262.8 billion in economic benefits (Hutton and Haller 2004). Similarly WASH shows high-cost effectiveness; returns on average, for every $1 investment are about 4 dollars (Hutton, 2015). According to UNESCAP-2018 report's estimates $5.50 returns for each $1 expenditure on sanitation through improving health and thus productivity of people. Better sanitation facilities and road access are highly correlated with good health and education outcomes. Moreover, electricity access is also associated with better education outcomes.

Montgomery and Elimelech (2007) findings show that the investment on water and sanitation is highly cost effective while considered in health perspective. This study examines the effect of improvement of water and sanitation facilities on child undernourishment. Findings of this research may be used in identifying the public policy solutions for combating child malnutrition and morbidity. It also highlights the enticements for investment in water and sanitation facilities improvement.

Data from PDHS is used in this study for investigating the status of child under nutrition to answer whether improving the drinking water quality and sanitation facilities impact child under nourishment significantly or not.

1.2. Overview of Child health, water and sanitation situation

WHO recommended the standard measurement of anthropometry such as HAZ, WAZ and WHZ. These three used for standard measurement for child's nutritional status. (i) Stunting (HAZ), is defined as "if z-scores of height for age is <−2 S.D. of the median value of World Health Organization (WHO) guidelines"; (ii) Underweight (WAZ), is defined as "if z-scores of weight for ages is <−2 S.D. of the median value of World Health Organization (WHO) standards;", (iii) Wasting (WHZ), is defined as "if z-scores of weight for heights is <−2 S.D. of the median value of World Health Organization (WHO) guidelines. While In mother prolonged energy insufficient undernourishment is measured by Body Mass Index next refer as BMI. It is a standardized measure of wasted growth to investigate the continuous decrease in body energy of humans in the third world countries.

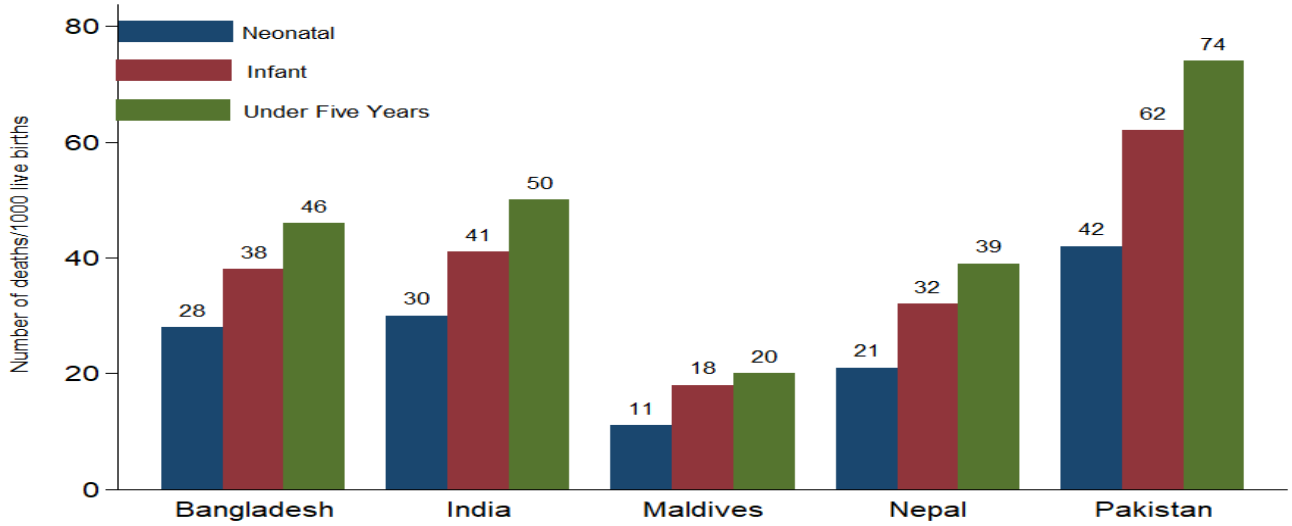
The malnutrition status of children is measured through HAZ, WAZ and WHZ. The mortalities are in children occurs due to worse situation of these indicators. The causes of making these indicators worse are mostly socio-economic conditions, specially water and sanitation conditions. Below in tables and graphs is the overall situational overview of child health indicators, mortalities, and water and sanitation in Pakistan with comparison to SAARC countries.

Table 1. Child mortality rates by Country

Country	Neonatal deaths/1000 live births	Infant deaths/1000 live births	Under-five deaths/1000 live births
Afghanistan	22	45	55
Bangladesh	28	38	46
India	30	41	50
Maldives	11	18	20
Nepal	21	32	39
Pakistan	**42**	**62**	**74**

Source: DHS SAARC

Graph. 1. Child mortality rates by Country



Source: Author's estimation (SAARC DHS data)

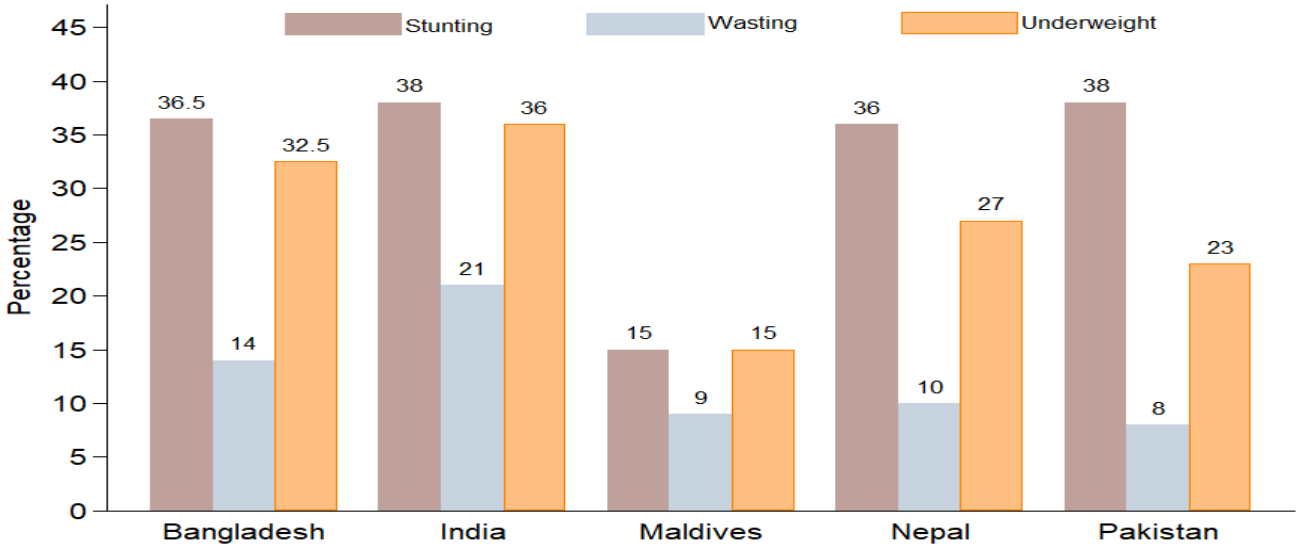
The Graph-1 shows the child mortality rates for SAAC countries given in Table-1. The graph depicts that in neonatal, infant and under five mortalities Pakistan stands on top while Maldives lies at bottom.

Table 2. Child Anthropometry Prevalence by Country

Country	Stunting	Wasting	Underweight
Afghanistan	Variables missing		
Bangladesh	36.5%	14%	32.5%
India	38%	21%	36% NFHS-4
Maldives	15%	9%	15%
Nepal	36%	10%	27%
Pakistan	**38%**	8%	23%

Source: DHS SAARC

Graph. 2. Child Anthropometry Prevalence by Country



Source: Author's estimation (SAARC DHS data)

The Graph-2 sketches the situation of child anthropometric rates for SAAC countries given in Table-2. The graph explain that the stunting rates are high in Pakistan, Bangladesh, India, and Nepal while Maldives lie in bottom among countries. Wasting rates are slightly higher in India that are 21% than other countries while Pakistan remain at bottom in wasting among SAARC. The rates of underweight are high in Bangladesh and India while Maldives stood at bottom in underweight.

Table 3. Water and Sanitation by Country

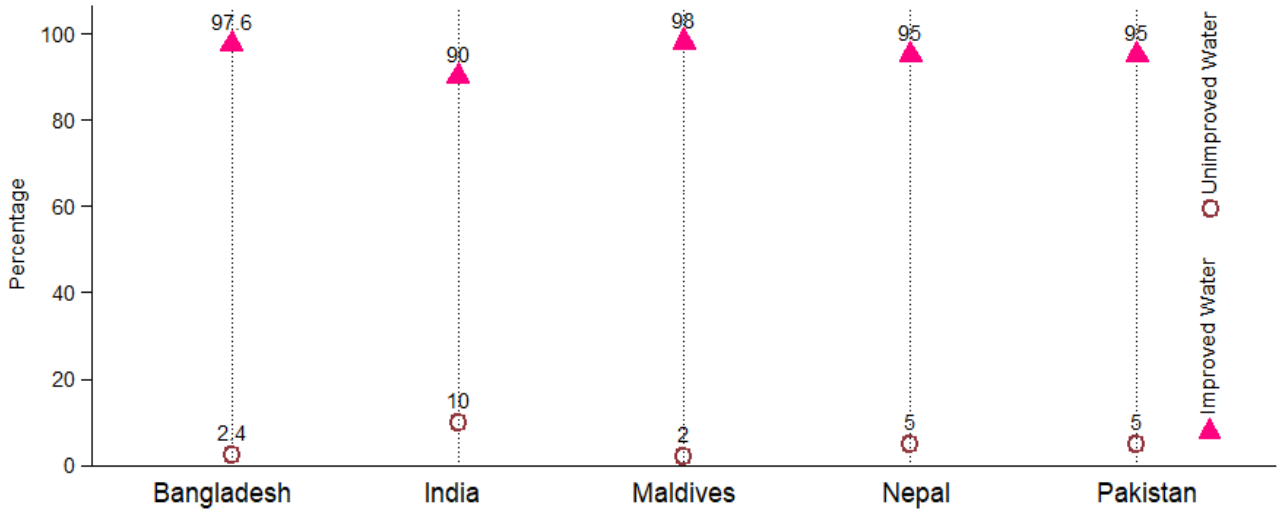
Country	Improved drinking water	Un-Improved drinking water	Improved Lavatory facility	Un-Improved Lavatory facility
Afghanistan	65%	45%	25%	75%
Bangladesh	97.6%	2.4%	68.7%	31.3%

India	90%	10%	48%	52%
Maldives	98%	2%	98%	2%
Nepal	95%	5%	62%	48%
Pakistan	95%	5%	70%	30%
South Asia	92%	8%	45%	55%
World	91%	9%	67%	33%

Source: DHS SAARC and UNESCAP-2015

Table 3. explains the water situation in SAAC. The graph shows that almost all SAARC countries, except India, have 95% improved water while India have 90% improved water access. All SAARC countries facing less than 6% unimproved water while India facing 10% unimproved water.

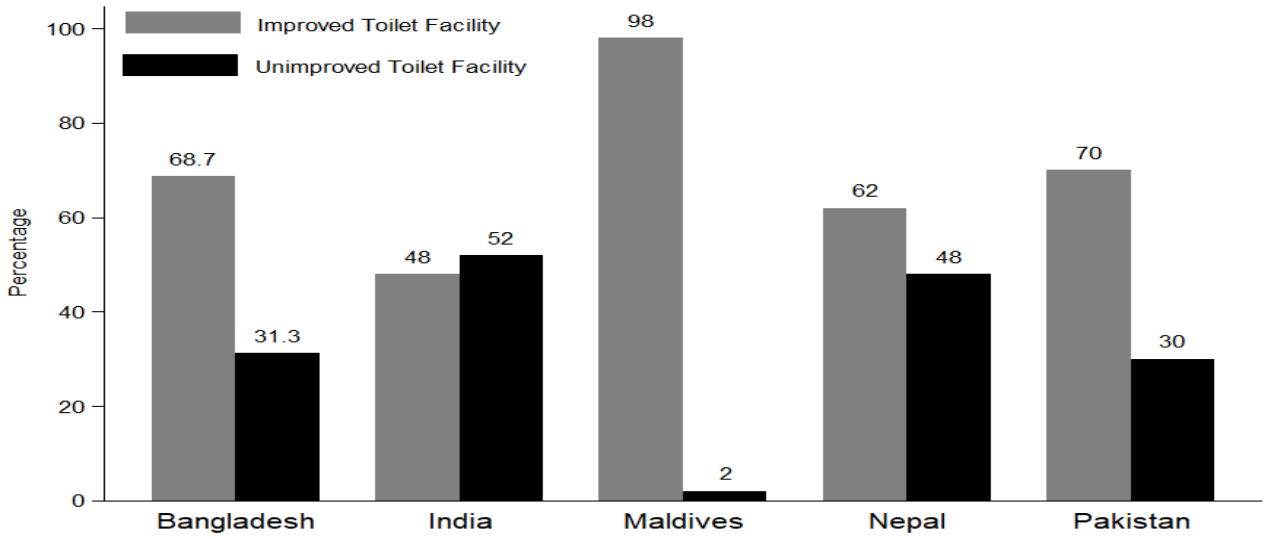
Graph. 3.a. Improved Water by Country



Source: Author's estimation (SAARC DHS data)

The Graph 3.a. explains the water situation in SAAC given in Table-3. The graph shows that almost all SAARC countries except India have 95% improved water while India has 90% improved water access. All SAARC countries facing less than 6% unimproved water while India facing 10% unimproved water.

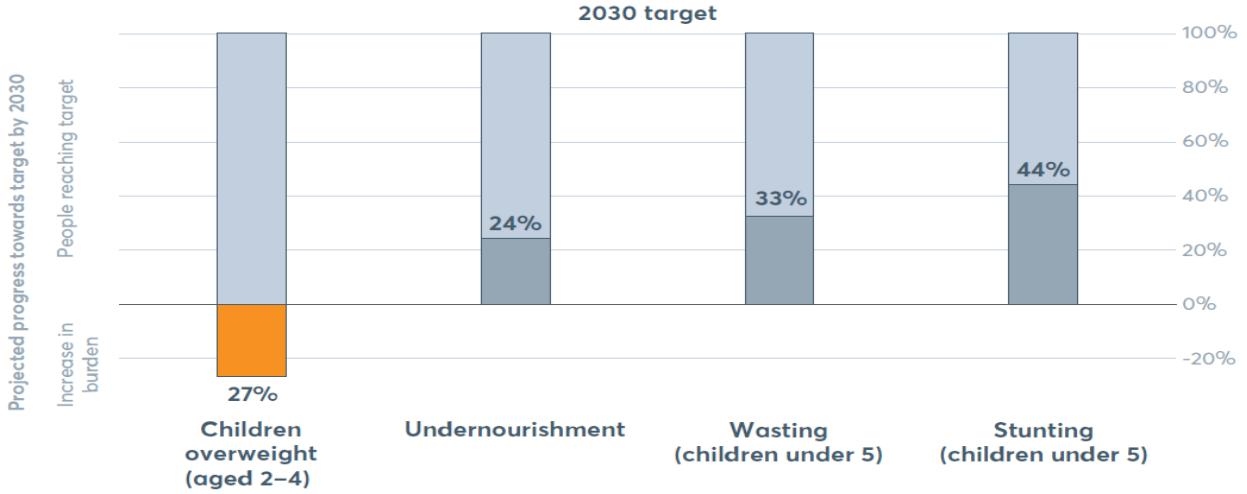
Graph. 3.b. Type of Sanitation Facility by Country



Source: Author's estimation (SAARC DHS data)

The Graph 3.b. explains the toilet facility situation in SAAC given in Table-3. According to the graph Maldives have ideal improved toilet facility. In this context, Pakistan and Bangladesh are slightly better. While India has worse situation in improved toilet facility which is less than the half. While in case of unimproved toilet facility, Maldives have ideal situation while India is on bottom.

Graph. 4. Projected Progress Towards SDG Target by 2030.



Source: Global Nutrition Report-2018

The Figure 4 displays that only 44% of the nutrition related disease burden will be reduced globally by the end of 2030 and so on. In case the present projection become true, around 660 million population of the world will remain malnourished which means 8% of global population will even then have to experience vulnerable health conditions in 2030. Furthermore almost 15 % (100 million) of children of age less than five years will show stunted growth, 6% (40 million) of children will remain wasted and 22% (90 million) of children of age between 2 to 4 years will remain overweight by the end of 2030 in view of current projections.

1.3. Achievements in Sustainable Development Goals

At the end of Millennium Development Goals (MDGs) in 2015, All 193 Participant countries and states of the United Nations General Assembly made a unanimous agreement for "*Transforming our world: the 2030 Agenda for Sustainable Development* (the 2030 Agenda)". This Agenda 2030 is an action plan for the global prosperity and peace.

Targets: *SDG (Goal-1)* states end of extreme poverty, measured by no. of people living below $1.25 per day, from the globe by 2030 while part-b of goal-1 says to decrease all dimensions of poverty for all age group people at least by half till 2030. *SDG (Goal-3)* targets the reduction of maternal death rate to less than 70 percent per 1000 lives globally by 2030. While part-b of goal-3 states that by 2030, reduce avoidable mortality ratio of infants to 12 per 1000 live births and decrease the death rate of children under age five to 25 per 1000 live births. *SDG (Goal-6)* targets to attain global and equal access to clean drinking water by 2030, while part-b of goal-6 states the attainment of improved sanitation and hygiene and ending of open defecation globally by 2030.

The progress of (Goal 3) is not up to the mark but it is progressing in positive direction slowly. According to a report of Asia Pacific on SDGs progress (2019) that the South and South-West Asia sub region's progress level is far ahead than other sub region leads other sub regions in the areas of health and well-being (Goal 3). On the other hand, progress in accessing clean water and sanitation is not in right direction (Goal 6). Access to clean water, improved sanitation and sufficient energy are basic elements for sustainable sustenance, but till 2015 only 45% of the people in south Asia had access to clean water and sanitation which implies that almost 960 million people had no access to sanitation and 610 million people were practicing open defecation (UNESCAP-2018).

According to the table 4, in achievement of SDGs goals the progress of SAARC is very slow no country has achieved any goal out of these three except Maldives in only Neonatal mortality targets, but it is very close to achieve the (Goal 6). In (Goal 3) SAARC progress is slow but in positive direction.

Table 4. Sustainable Development Goals Achievements

Country Achievements in SDGs	**Afghanistan**	**Bangladesh**	**India**	**Maldives**	**Nepal**	**Pakistan**
SDG Goal-1: ***Reduce poverty at least by half the proportion in people of all ages living in a poverty***						
Percentage of population living in poverty at $1.25 per day in 2005 PPP		43.3	23.6	1.5	23.7	12.7
% of Population living below the national poverty line	35.8	31.5	21.9	15.7	25.2	29.5
SDG Goal-3: Reduce MMR to <70, Neonatal and Infant mortality <12, Under 5 year mortality < 25						
Maternal Deaths per 100,000 live births	396	176	174	68	258	178
Neonatal Deaths per 1,000 live births	22	28	30	11	21	42
Infant Deaths per 1,000 live births	45	38	41	18	32	62
Under-five Children Deaths per 1,000 live births	55	46	50	20	39	74
SDG Goal-6: ***Achieve the access to adequate equitable water and sanitation for all and end open defecation***						
Access to improved water sources (% of population)	65	97	90	98	95	95
% of population having adequate sanitation service	25	68.7	48	98	62	70

Source: UNESCAP report September-2018 based *on ESCAP Database and official source, SAARC DHS.*

1.4. Objectives

1. To analyze combined impact of water and sanitation quality on child undernutrition in Pakistan.
2. To assess the link of water and sanitation quality with malnutrition by gender difference (disaggregated analysis) in Pakistan.
3. To Suggest the policy recommendations for improving the child nutritional status in Pakistan.

Chapter 2

LITERATURE REVIEW

2.1. Child Malnutrition

Malnutrition is a significant factor contributing to child (under five age) mortality in developing world. In different studies the global disease burden caused by under nutrition is estimated differently. The WHO reports that 35% deaths of children under five are because of malnutrition (Black et al. 2008). A study by Caulfield et al. (2004) shows that malnutrition causes almost 53% of young one's death. W.H.O reports that in middle- and low-income countries almost 20% of children under five are underweight while 32% are with stunted growth and one out of ten are wasted (WHO/UNICEF, 2010).

Child malnutrition is not just characterized by individual specific characteristics. Literature regarding child malnutrition showed that most of the factors that contribute to child malnutrition are especially household, maternal, social, economic, and environmental. A study by Cohen et al (2017) for 194 low- and middle-income countries analyzed that reduction in child mortality is highly correlated with vaccination and education. Immunizations and education were steadily related with the decrease in child mortality across all mortality levels. Bellagio Child Survival Group globally reviewed the child death and found that almost 34% of child mortality and two third of malnutrition burden of the world is in the region of South Asia is associated with malnutrition (Bhutta et al, 2004).

Moreover, in South Asia and Southeast Asia, 50% of global maternal deaths are also reported (Bhutta, 2004). While in case of maternal malnutrition, literature review for Bangladesh from 2007 to 2017 by Hasan et al (2017) indicates that age of the females, locality of dwelling, wealth index and education are the most important factors which are determining the nutritional status of female. Whereas Frieda Sossi (2019) conducted a literature review for determinants of undernutrition in women from 1998 to 2019 and concluded that the imbalance diet is the significant factor of malnutrition and is found to be associated with poverty in terms of income, nutritional education, and poor health services. Social discrimination and poor environmental conditions and unsuitable geographical characteristics for agriculture are few other reasons for malnutrition.

Mistry, S. K (2019) analyzed research on maternal and household factors associated with stunting in Bangladesh. Nation wide cross-section survey was conducted using two stage cluster random sampling while employing modified Poisson regression model. Estimates showed that almost 29.9% children experience stunted growth. The major factors contributing to stunted growth were low weight at the time of birth, gender, mother education, age of mother at first pregnancy, area of dwelling, mother nutritional status, social and economic factors, food insecurity and accessible sanitation condition to improved sanitation.

Hasan (2017) reviewed the incidence of health issues associated with malnutrition among Bangladeshi women over the period 2007 to 2017. They found that the incidence of being underweight and stunted growth among women decreased in a very large ratio during the past decade. But still one out of four are underweight and one out of five are stunted and 50% of women

are experiencing micronutrient deficiencies. The detrimental elements of female nutrition status in Bangladesh are age, locality, education, and wealth index.

Nguyen (2017) evaluated the Maternal, Newborn and Child health Program of Bangladesh to assess the causes of malnutrition practices in Mother. They employed Logistic regression and multivariate regression technique using the data of survey conducted at household level to study nutrition practices of expectant or just delivered females. Findings showed that the interval of consumption is 94 ± 68 IFA and 82 ± 66 calcium tablets (out of 180 as recommended) among females during pregnancy, and 50% of the expectant ladies consumed an appropriate balance diet with variability. Consumption of balanced diet, IFA and calcium pills is associated with a good information about healthy intakes. The study elaborates that the increased knowledge, study showed that improving knowledge, self-assurance and the conception of social values and norms, timely registration for health care and supply of free food supplements can help in large scale progress of improved nutrition practices among females.

Rabbani (2016) discussed the trends and factors determining socio economic inequalities in children stunting in Bangladesh. The study was conducted using data over the period 1997 to 2014. To measure and analyze the inequality absolute and relative measures and concentration curves and indices were used. Findings suggested that inequality among child stunting under the age of five has raised about 56% and the concentration index has raised to double between the periods 1997 to 2014. Results indicated that comparative increase of stunting inequality among children of age less than five is 56% and the concentration index has increased by more than 50% between 1996/97 and 2014. Decomposition analyses results suggested that the economic status measured by wealth, mother education and short stature are the key factors contributing to the inequities in children stunting and its change over time.

Rabbi & Karmaker (2015) assessed the factors determining malnutrition in children from Bangladesh using BDHS-2007. They used Multivariate techniques which showed the results that socio-economical, biological, and bio-social are contributing to malnutrition.

Ahmed (2012) studied the incidence of the problem of maternal and child malnutrition and micronutrient deficiencies globally. They found that four micronutrients iodine, iron, zinc, and Vitamin A are commonly deficient and a significant direct or indirect cause of more than 50% under five child mortality around the globe. Poor economic status, food insecurity, illiteracy, unawareness, improper practices of children feeding, high incidence of infectious diseases, bad hygiene and improper sanitation are the key determinants of child and mother malnutrition in developing world.

Shannon, K (2008) examined the low birth weight (LBW) and maternal malnutrition practices in rural Bangladesh. A survey based on semi-structured interviews and five focus group discussions from the sample of 30 expectant females from a village was carried out. 50% of the women reported no change or decrease in food intake during expectancy. Dietary restrictions and food dislikes was commonly practiced. Usually, females get the food in small share and at the end during mealtime. These findings suggest that there is a need to highlight traditional food intake restriction, norms, and preferences.

Sharma, D. (2019) conducted a study in India and the objective was to review the recent situation of nutrition status and factors determining it, and he assessed the policies and programs which were started to improve nutritional status. In this study he used National Family Health Survey (NFHS-4). The result indicates that malnutrition is decreasing but the numbers are still large. Study further explained that some government programs are beneficial but not on full potential. He recommended that in India, there is a strictly multi-sector and synchronized approach is needed to be able to attain nutrition targets.

Pratim Roy, M. (2019) conducted research on demographic correlates of underweight children in east India. He used National Family Health Survey 2015-16. The study covered 81 districts from three states in Eastern part of India. Finding indicates that female literacy and improved sanitation decreased the incidence of malnutrition. Four gynecological visits (ANC), institutional distributions, full immunization, early mother feeding, and balanced and sufficient diet decreased the incidence of child malnourishment.

Nie (2019) analyzed the demographic and socio-economic determinants of changes in the nutritional status change among children of age 0 to 5 years in India using data of Indian Human Development Survey over the period 2004–2005 to 2011–2012. For under nourishment, they used CIAF index as a dependent variable and employed linear and non-linear decompositions and unconditional quintile technique. The findings indicate that the percentage of children being stunted and underweight dropped by 7% and 6% respectively. Economic status of HH, Education and BMI of mother are major determinants of variation in child nourishment, and mother empowerment is also related with the decrease in stunting and being underweight.

Nguyen (2019) assessed Social, biological, and programmatic factors relating young pregnancy and early childhood malnutrition using India's National Family and Health Survey 2016. They used multivariable regression and structural equation models for analysis. The findings show that the children of a younger mother have greater risk of undernourishment because most of the time teenager pregnant mother are less educated, under nourished, don't have access to health and less aware of complementary food needed for a child.

Sinha, R. K (2018) studied the determinants of stunting, wasting, and underweight for two states of India. Primary data of demographic and socioeconomic features of HH were collected. Anthropometric measurement was also carried out. The results of binary logistic regression analysis indicate that food insecurity, method for defecation, BMI of mother are few determinants of stunting and being underweight among children. In addition to that diarrhea and respiratory infectious diseases are significant determinants of stunting and being underweight.

Menon, P (2018) conducted research on geographical burden of stunting in India for diverse states and districts using National Family and Health Survey 2015-16. Understanding the longitudinal differences in distribution of stunting, the study employed mapping and descriptive statistics and further population-weighted regressions was carried out to identify the determinants of stunting. Decomposition's analysis was done to elaborate group differences between districts with higher and low incidence of stunting across India. Overall, 38.4% children exhibit stunted growth, but the incidence varies from 12.4% to 65.1% across different districts. 239 out of 640 districts have stunting prevalence more than 40% and 202 have the ratio between 30%–40%. The differences in

low and High burden districts lies because of the differences in BMI of women, education level, children's dietary habits, assets, method of defecation, age at the time of marriage, gynecological treatment and care and household size. The decomposition analysis shows that almost 71% of observed differences in the prevalence of stunting are due to explained variations. He recommended that in addition to highlight district wise determinants of inequality and incidence of stunting among children, addressing the preventive measures of stunting is also inevitable.

Chatterjee (2016) analyzed the social factors that determine inequality in malnutrition in the district of Gumla, Jharkhand, India. Survey was conducted in 32 villages of Gumla District divided in 4 blocks. Findings from multivariate regression exhibits that poverty is the most significant determinant of child malnutrition. Almost 70% of children who belong to poorest quintile were found to be underweight. Mother education was found to be another significant factor in determining malnutrition among children. Comparing the mother education and the incidence of child malnutrition, there were 43% more chances for a child whose mother's education was less than ten year of schooling and 23% more chances to be severely underweight.

Shahjada (2014) studied that the impact of time duration between two consecutive births on child malnutrition in Peri-urban area of Madhya Pradesh, India. Cross sectional study was designed for calculation of empirical results in which urban health and training center, index medical college hospital and research center Indore (M.P), India were major practice areas for calculation of data. Total sample size of 500 children was taken. Results revealed that most of the undernourished children were due to lower birth interval (<24 months). Children with lower birth interval <24 prevailed stunting, wasting and underweight of 51.03%, 42.78% and 57.21% respectively compared to children who have gap between siblings age more than 48 months and contain stunting, wasting and underweight of 29.62%, 22.22% and 25.92% respectively. This result showed that longest birth interval is positively related to good nutrition status.

Das & Sahoo (2011) explored the factors determining child malnutrition in Madhya Pradesh, India. They did bivariate as well as multivariate regression analyses on the data obtained from National Family Health Survey III, 2005-06. In the study four different indicators (three anthropometric, one non anthropometric) of nutritional status were used. In addition to them, the iron deficient Anemia was also used as an indicator of nutrition deficiency. Results from logistic regression showed that poor economic status, mother education, birth order, mother malnutrition and social group membership were few significant determinants of child nutrition status.

Adeela and Seur (2015) studied the effect of socioeconomic parameters on stunted growth of children in Maldives using data of DHS. The findings indicated that Z score was lowest among height of the children of age between 6 to 29 months. They found that height of mother, size of child at birth, time span of mother feeding, economic constraints faced by mother in acquiring health and unavailability of health facilities were major factors describing the prevalence of stunted growth.

Golder (2009) assessed the factors determining macro nutrient deficiency as well as micronutrient deficiencies in traditional Maldivian food. A sample of 333 women having children of age 1 to 4 without breast feeding was interviewed, using a 24-hour recall. Blood sample of 15 women were also collected to measure the quantity of Vitamin A and E, β carotene, HB and homocysteine.

Findings suggest that 22%bof females have BMI less than 18.5 and they also found that 41% of children had stunted growth, 14% of children were wasted and almost 51% of children were underweight. The food of both mother and children was enriched with proteins and carbohydrates but lack the elements of fatty acids. Low concentration of plasma indicated the insufficient consumption of β carotene. Although Blood HB was normal, but iron intake was also found to be insufficient.

Frieda Sossi (2019) analyzed the factors determining undernourishment among women by reviewing the literature over the period 1998 to 2019 and found that imbalance diet with only few items in daily diet along with poverty, inadequate information for healthy nutrition intake, poor health services, social injustice, unfavorable climate, and geography are few main determinants. They also found that the data for pregnant ladies is not available in the literature to get a clearer picture for nutrition status of women in Nepal.

Lama (2018) explored the factors determining the nutritional status of the expectant females availing the gynecological care from the hospital in western region. Systematic sampling technique was adapted to get the cross-sectional data of 282 pregnant women. MUAC and antenatal card was used to collect information. Pregnant women having acute malnutrition (MUAC <23 cm) were 24%, low gestational weight gain was 67% and anemic were 12%. Food security, ethnicity and dietary diversity were found to have significant relationship with the nutritional status of pregnant women.

Adhikari (2019) studied the determinants of stunting in Nepal using NDHS for year 2006, 2011, and 2016. The results revealed that the common reasons for child stunting in all three surveys were short stature at birth time, prevalence of anemia and belonging to the highest equity quintile.

Karki (2017) examined the correlated of child malnutrition for Nepal using the data of NDHS-2011. In result, education of mother, immunity power, disease history, Sex of children, feeding of colostrum, only breastfeeding, history of illness, receiving of iron tablets, and place of delivery were found significant.

Pravana (2017) assessed the determinants of SAM in the Bara district, Nepal through primary survey. The occurrence of SAM was almost 4.14% among children of age less than five. SAM was found to be significantly related with poor socioeconomic condition, Age of mother less than 25 or greater than 35 at the time of birth, less than two-year birth interval, uneducated father, bottle feeding and only milk feeding at the age of six months without the complementary intake.

Dhungana (2017) checked the impact of different factors on child malnutrition for Lamjung, Gorkha and Tanahun Districts. for this purpose, he carried out a cross-sectional study design adapting systematic sampling through structured questionnaire. For the analysis logistic regression was carried out. The results indicate that 10.6% of children were wasted, 53.9% were stunted and 20.8% were underweight. And this ratio was more in boys compared to girls. Breast feeding duration, mothers' profession, size of the family, place of delivery, height, and age of mother at the time of delivery were significantly contributing to malnutrition.

Cunningham et al (2017) explored the factors defining the improvement in maternal and child nutrition in Nepal. Based on interview method and quantitative analysis of DHS datasets, their

results indicated that there occurred betterment in four major factors of nutrition that include improvement in health service sector, sanitation facility, education, and income of people. But the relative effectiveness of each factor is different. For example, better health services are strongly associated with linear growth of children while improved sanitation results increase in weight of both mother and children.

Khan et al (2019) examined the determinants of malnutrition using PDHS 2012-13 data. The result showed that Children whose mothers lived in countryside, were of age greater than 18 years at the time of marriage and had visited antenatal clinic more than three times during the period of expectancy, had low chances of being stunted. Low level of education of mother, short physique, and smaller size of infant at the time of birth, and BMI of mother were prominently related with underweight child status. Children whose mothers were illiterate had greater chance of being wasted.

Khan, R. E. A (2018) examined the impact of socio-economic determinants of child malnutrition. They employed logistic regression using PDHS 1012-13 data. The result showed that probability of malnutrition decreases with greater birth intervals, possession of asset by mother, more family members, mother's education, large size at birth, and major role of mother in household decision making.

Tariq, J (2018) studied the impact of social, demographical, nutritional, and health-related factors on Child malnutrition under two years of Age in Pakistan using the data of Pakistan Demographic health survey 2012-13. They also adopted binary logistic regression analysis for exploring the determinants. The findings suggested that Lower BMI of mother, Birth order of a child, unavailability of information, marriages within relatives, education of father, settlement in villages, poor latrine facilities, and lower consumption of vitamin had significant impact on child malnutrition.

Asim, M., & Nawaz, Y (2018) studied the literature review on child malnutrition in Pakistan. they concluded that marriages at young age, family size, higher fertility with smaller gap between birth of children, poor economic status, having no mother feed, and limited to breastfeeding only were some main determinants in the reviewed literature.

Khalid N (2017) elucidated the effect of malnutrition of mother on child development and found that in south Asian countries like Pakistan, India, and Bangladesh almost 33% of children are malnourished. Child malnutrition is mainly caused by maternal malnutrition in Pakistan. Poor economic status, high rates of illiteracy, micronutrient deficiencies are primary causes of malnutrition in pregnant women in Pakistan. Malnourished mother has prominent and severe effects on her child growth.

Arif (2012) studied the trends and factors determining malnutrition in Pakistan. Pakistan panel household survey (PPHS, 2010) was used to measure the empirical results. They mainly focused on children, households, and community variables to measure the differences in nutritional status. Illness of malnourished child, health condition of mother and economic status of household were used as key variables. Their findings determined that economic status of household is not significant in determining children malnourishment because of few basic reasons. Illness like

diarrhea reduced the metabolic activity of child to transform food into energy that severely caused malnutrition.

Rubeena Gul, Zeeshan. K. (2013) conducted across sectional study two rural communities of Peshawar (Sarband and Pishtakhara). They were selected a sample of 200 respondents. Applied multistage sampling technique to collect sample. To collect data from mothers and under 3 age children for collecting information face-to-face, a re-tested questionnaire was used. The amount of male children was 121 and female were 79 out of sample of 200 children. In results, malnutrition was observed in 3 grades of 50^{th} percentiles which were anthropometric measurements standards of Harvard. Majority of children were in age of 0-2 years. Out of 70 malnourished children, 24.3% children were in grade 1 category, while 32.8% children were in grades 2, while 42.8% were in grade 3 category. At end they found socio-economic factors that causes malnourishment were larger size of family, deprived socio-economic status, illiteracy of mothers.

2.2. Improved Water and Sanitation

Improved sanitation and water facility are highly correlated with good health. Many studies have documented the water, sanitation and health nexus (Montgomery and Elimelech 2007). A study by Cohen et al (2017) for 194 developing countries from the group of low- and middle-income countries expressed that clean water and adequate sanitation facility result in decreasing child mortality ratio. Moreover, the studies on the region of South Asia and Sub-Sahara Africa also elucidates the similar association between child health and improved water and sanitation facility. Safe drinking water and good sanitation facility directly or indirectly results in lowering mortality, morbidity, and malnutrition among the children of age under five years (Anand & Roy, 2016).

Further (Harding, K. L, (2018) examined the determinants of wasted growth among children under five in South Asia and concluded that gender, birth order, illiteracy of mother, short stature of mother, poor economic status of HH are the significant factors determining wasted growth. Research done on (WASH), elucidated that WASH is responsible for child development at early stage by reducing the probability of being stunted and anemic (Ngure, 2014). A study by Benova, L (2014) examined the relationship between water and sanitation facility on maternal mortality and concluded that improper water and sanitation facility was related with increased maternal mortality.

A study by WHO calculated that 34% of diseases burden among children is associated with the poor environmental conditions (Prüss-Üstün and Corvalán 2007). Polluted water, improper sanitation facility, not washing hands and poor hygiene are the primary factors, defining poor environmental condition, in determining health of society. Drinking water and sanitation facilities are among few environmental risk factors that can be altered using proper technology and adequate amount of funding (Rehfuess, 2009). Current studies estimated that almost 1.5 million children die every year due to polluted water, improper hygiene, and insufficient sanitation facilities (UNICEF 2010). Unavailability of clean drinking water and improper sanitation are the major factor contributing to diarrhea and related diseases in children (Gamper-Rabindran et al. 2007). Diarrheal related diseases are responsible of almost 19% ofglobal child mortality (Boschi-Pinto, 2008). Child death rate is found to be significantly reduced after providing piped water and improving sanitation

(Gamper-Rabindran et al. 2007, DaVanzo 1988). Many other studies also concluded that improved water and sanitation is more detrimental in reducing mortality compared to other social, economic and health indicators (Shi 2000).

There are fewer studies have been conducted to analyze the relationship between maternal and child malnourishment and water, sanitation facility. However, there are certain evidence that found significantly strong relationship between unclean water and improper sanitation and infectious diseases (Esrey, 1985). Literature also suggests that there is a causality between contagious diseases and increased malnutrition (Bartlett 2003). Esrey (1996) investigated the relationship between sanitation, water and malnourishment among child and found that the improvement in sanitation is negatively related with the occurrence of child malnourishment.

Since water and sanitation are closely related with each other so usually their combine effect on health is elucidated. Limited number of researchers tried to studies have tried segregate the impact of clean water from the effects of improved sanitation. Esrey (1985) performed an analysis to distinctly evaluate the impact of water quality and water availability and sanitation facility and concluded that water quality is not as much of detrimental in diarrheal disease as the availability of water and sanitation facility. In alternative research, Esrey (1996) found that the health status of community improved by increasing access to water up to certain limit along with an optimal improvement in sanitation facility. (Wibowo and Tisdell (1993) also elucidated that the availability of water along with sanitation is more detrimental than clean water. He found these results while doing research Central Java, Indonesia.

2.3. Cost-benefit analysis of water and sanitation interventions

Hutton, G (2007) studied the cost-benefit analysis of improving water supply and sanitation services. This study found that in developing countries, an investment of US one dollar on water and sanitation returns up to US$46. The major factor was time saving that contributes almost 80% of the economic benefits results by improved water and sanitation services.

Cost-benefit analysis of investment on water and sanitation improvement exhibits higher and positive returns on investments. Hutton and Haller (2004) conducted a study for the WHO, reported that the returns of an investment of US$1 on water and sanitation facility are ranging from US$5 to US$28 in many developing countries. The most prominent reason for such benefits is the time saving associated with good sanitation and water facility, reduction of mortality and morbidity rate. There accrue direct benefits of these investments by health expenditure mitigation and indirect benefits by increasing productivity through reduction in absentees from work. The report provides that the expenditures on providing the water and sanitation facility in developing countries would be around US$22.6 that is equivalent to US$10.7 per head annually. And the returns of this investment would be US$262.8 billion per year showing very good payoff for this investment. (Hutton and Haller 2004).

2.4. Significance of the study and Conclusion of Literature review

The malnutrition is defined as a state that is caused by consuming an imbalanced diet that lacks few nutrients. W.H.O defines the health as: physical, mental, and social wellbeing is called health. In the light of WHO definition of health, **physical wellbeing** means a person is physically ill by having disease or injury admitted in hospital for cure of disease, putting doctor effort, giving medicine as well as investing on hospital for restoring the physical illness means that you are restoring the physical wellbeing, same as for child in SAM case (giving RUTF). **Mental wellbeing** is that releasing mental stress of nation by providing food, cloth, and shelter slogan (social security net or employment or income generating activities), means uplifting in economic deprivation which is main cause of mental stress of people in developing nation. While uplifting social status or living condition of a nation is basically **social wellbeing**, it means providing improved water and sanitation, batter roads, quality transports etc. all these three components collectively describe the health in view of WHO. The previous empirical work that has done on determinants of maternal and child malnutrition, in which most of the findings have consensus that economic status or wealth status etc. remains most significant determinant of malnutrition over the time till now (Blessing J. Akombi et al, 2019). But most significantly in recent decades, many researchers found that improved water and sanitation are also significant determinants of malnutrition (Mistry et al, 2019) as well.

In the light of above literature, rare studies have found on association of water and sanitation with child malnutrition in Pakistan, even in South Asia too, which talks about water and sanitation as an important determinant of child malnutrition in Pakistan. Considering this research gap in case of Pakistan, the current research covers this objective for Pakistan.

Good sanitation facility ensures good health of society. The share of diseases related to poor water and sanitation is about 10% of the global disease burden (Prüss-Üstün et al, 2008). Almost 50% of the children remain underweight because of unavailability of clean water, proper sanitation, and adequate hygiene (World Bank 2008; Victora et al 2008). So, now malnutrition not only occurs due to lack of nutrition, but it also occurs in case of social deprivation (poor water and sanitation). It means poor water and sanitation and economics are 50% cause of malnutrition and the rest of 50% is poor diet. Investing in social wellbeing (in the light of health definition of WHO) like water and sanitation is not only improves social status of individuals but it also contributes to poverty reduction, improved water, and sanitation as well as it reduces the chances in occurrence of diseases, and it improves the health of individuals (saving life from water borne diseases and poor sanitation diseases). With social wellbeing, nutrition also plays a substantial role in developing the individual's health or child health as well as it contributes to reducing poverty. which ultimately produces healthy workers in an economy that leads to better productivity and economic growth.

In the entire discussion the main point that came into discussion is that water and sanitation are social development dimension of health, which are considered as 50% cause behind child and maternal malnutrition by different researchers, and by providing the improved water and sanitation means ensuring social wellbeing part of health as it has defined by WHO. This current study has covered this gap

Chapter 3

THERATICAL AND

CONCEPTUAL FRMEWORK

3.1 Theoretical Framework

The effectuation of malnutrition is difficult to understand. Malnutrition among children is due to combination of several social, economic, psychological, and environmental and health factors. The conceptual framework that we use to examine the malnutrition status of children is based on utility maximization model of households. The modeling of child nutritional determinants, we assume that each individual lives in a unit's called household, these households maximize a Utility function as follows,

$$U = u\,(H^i, F^i, Z^i, L^i) \ldots\ldots\ldots (1)$$

Model shows that household's utility depends on nutritional health (H^i) of individual, consumption of food, nonfood expenditures (F^i, Z^i) and leisure (L^i) of individuals. All these factors are defined in several dimensions (Garcia & Alderman 1989). Maximization model of utility has been used which have several constraints such as income or budget constraints and health-nutrition production function. Several implicit and explicit characteristics are combined to produce health and nutrition of children. Health-nutrition production function depends on consumption of food (F^i), the time devoted for the child care (T^i), individual child's and maternal characteristics (C^i) i.e. age, gender and genetic endowments etc., parental and household characteristics (M^i) i.e. mother education, head of household, income of household, Community level characteristics (E^i) i.e. place and region of residence and environmental factors sanitation and sewerage facilities, and (u^i)is a random term (Arif et.al 2012).

However, the health-nutrition production function for child is formalized as follows,

$$N^i = n\,(F^i, T^i, C^i, M^i, E^i, u^i) \ldots\ldots (2)$$

(N^i) is taken as standard measurement of anthropometry for child, height for age standardized score (HAZ), weight for age standardized score (WAZ) and weight for height standardized score (WHZ). These three are used as standard measure of nutritional status of children recommended by WHO.

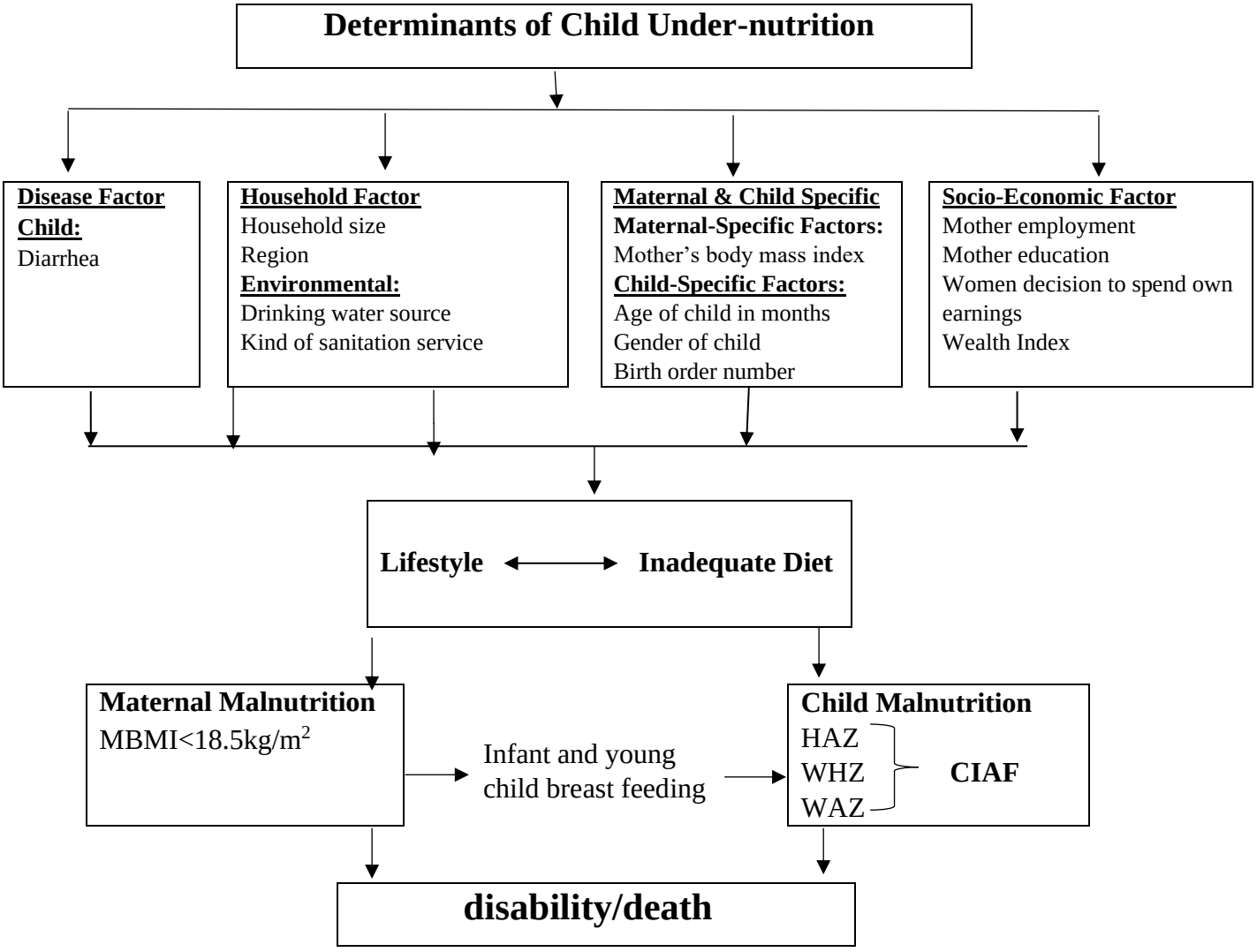
Equation 1 explains the utility function which shows that household utility of nutrition depends on different factors such as consumption of food and nonfood and leisure and good health etc. In this equation one our dependent variable is to get utility (U).

While in equation 2 our dependent variable is child's nutrition status (N^i). The idea is how to increase or improve child's nutritional status. So, child nutritional status depends on many socioeconomic factors which are socioeconomic, environmental, individuals etc. which are explained in the final equation of this study.

3.2 Conceptual Framework

Disease does not occur itself there are some factors that become the cause of disease. These factors can be socioeconomic factors, environmental, lifestyle, behavioral, individual, clinical/genes, insufficient access to food, inadequate maternal and childcare etc. When some of these factors are missing, it effects lifestyle dietary patterns directly, and results that individual suffers with disease. Inadequate diet and disease push the individual into maternal and child malnutrition. When malnourished mother breast feed her child, the child suffers from malnutrition because nutritional status of mother's effects the nutrition of infant, and a child with low weight at the time of birth has higher tendency to be ill, delayed physical and mental growth, and greater risk to have anemia in adulthood (World Bank 1994). The outcomes of malnutrition not only affect the single child but also transfer from one generation to another particularly female malnutrition e.g., malnourished girl to malnourished mother that born malnourished child (Khan and Raza, 2014). Further the result of malnutrition of both mother and child is disability or death. Below the Figure-5 elucidates the theoretical framework of the study.

Figure-5: Conceptual framework for determinants of child under-nutrition

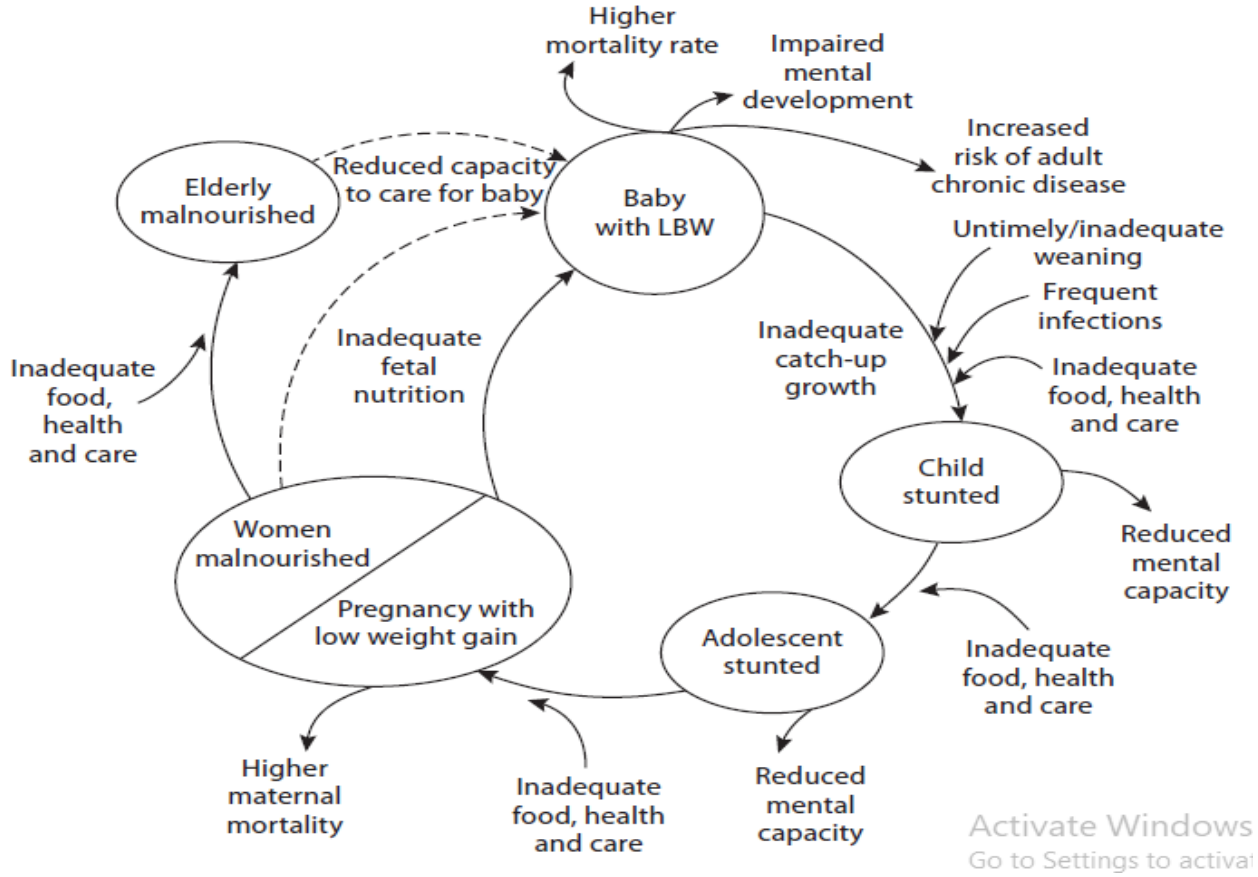


Source: Author's Illustration

3.3 Malnutrition Cycle (from Maternal to Child)

Malnourishment is defined as the condition that is caused by consuming an imbalanced diet missing few of the nutritious ingredients. Maternal nourishment mentions to the dietary requirements of a female during pregnancy and postpartum periods and sometimes also to the time before conception that is usually adolescent age (The Man off Group, 2011). Malnutrition occurs first 2 years of child age starts from pregnancy period. First 2 years are vital which shape the entire life of child. It is a multifaceted issue, nutritional status of mothers has a large effect on infant and an underweight child at the time of birth is more vulnerable to illness, delayed physical and intellectual growth, inclined to become an anemic adult (World Bank 1994). It is considered that if malnutrition occurs during the first two years of child age or pregnancy, there will be a permanent problem of mental and physical development. Therefore, much more importance is given to mothers' body mass index (BMI) and her nutrition during pregnancy so that she can bear a healthy child. The outcomes of malnutrition not only affect the single child but also they are transferred in generation to generation particularly female malnutrition e.g., malnourished girl to malnourished mother that give birth to malnourished child (Khan and Raza, 2014). Nutrition through various factors in Figure 6 is showing the impact of low birth weight (LBW), on child including higher risk of diseases in adulthood (ACC/SCN, 2000).

Figure-5: Malnutrition Cycle



Source: *ACC/SCN, 2000*

3.4 Developing the theoretical equation and conceptual framework from previous theories and conceptual framework

Most of the research on the assessment of child malnutrition pursue the utility-maximizing model by postulating the production function of households Becker (1965) and Strauss and Thomas (1995). This model assumes that each child lives in a unit called a household.

$N^i = n [H, Z, W, C, \varepsilon]$

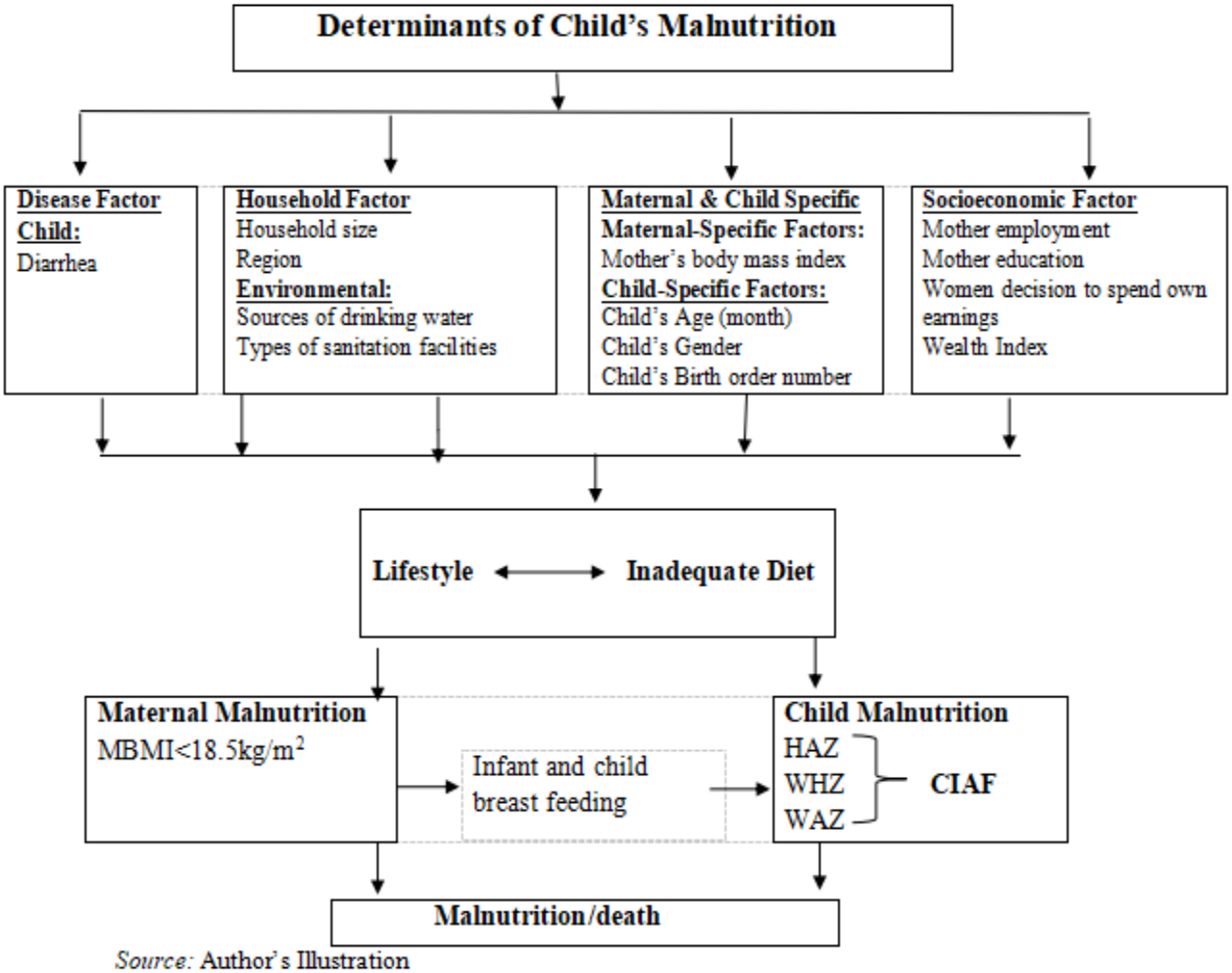
N^i is taken as the standard measurement of anthropometry for a child. *C* shows consumption, *W* represents the vector of specific children and maternal factors; *H* represents the vector of specific household and environmental factors; *Z* represents the vector of health factors, while the error term of children-specific is ε.

This study developed its theoretical reduced specified form of the nutrition production function for this study which is:

CIAFi = f (household factors and environmental factors, disease factors, child and maternal specific factors, socioeconomic factors, individual factors, εCIAF).

Previous studies followed the conceptual framework of Victora et al. (1997). The distribution of variables in this framework is in three group types: socio-economic reasons, intermediate factors containing maternal and environmental issues, and proximal or individual aspects. In short, pre-school children's nutritional status may be affected by these factors (Victora et al., 1997). Based on this framework the conceptual model of this study is as follows:

Diagram-1: Conceptual framework for determinants of child malnutrition



Source: Author's Illustration

If we merge and follow the theoretical framework of Becker (1965) and Strauss and Thomas (1995) and conceptual framework of Victora et al. (1997). The major sections of the variables in our study are followed by those sections which are used in these theoretical and conceptual models.

Chapter 4

DATA AND METHODOLOGY

4.1. Data

This paper examines the effect of water and sanitation quality on child nutrition status in Pakistan. Pakistan Demographic and Health Surveys (PDHS) data of 2017-18 has been used in this study. This section provides complete information on data, dependent and independent variables, method of analysis, and econometric models. The survey year, sample sizes, response rate, and subsample sizes are shown in Table-5.

Table 5. DHS data

State	Year of the survey	No. of Households	Response rate	No. of children under five	No. Mothers of age 15 to 49
Pakistan	2017-18	12,815	96 percent	4,499	12,364

Source: PDHS

4.2. Dependent Variable

4.2.1. Dependent Variable-Child malnutrition

This study comprises on three objectives. First two objectives deal with child malnutrition. Malnutrition is measured through anthropometry. WHO (2006) recommended the standard measurement of anthropometry such as HAZ, WAZ and WHZ. These indicators are developed by calculating the difference of SD from median value of National Center for Health Statistics/WHO with international reference population. W.H.O suggested abovementioned indicators to measure stunted growth, wasting and condition of underweight among children. The growth charts developed by NCHS/WHO use standardized values calculated from raw data. These three used for standard measurement for child malnutrition below age 5. These three indices are expressed as below:

a. *Stunning if HAZ < -2 SD*
b. *Wasting if WHZ < -2 SD and*
c. *Underweight if WAZ < -2 SD*

But these three indicators not necessarily give a detailed individual assessment as they may coincide. A child who is stunted could also experience stunting or he could be underweight as well or the two failures can coexist with stunting (Bose & Mandal 2010). However, CIAF is a cumulative indicator to measure under nutrition and incorporate all undernourished children either they are stunted, wasted, or underweight as a single variable. It identifies seven groups of children (Anjum et al. 2012).

i. *If low height for age, then stunted only*
ii. *If low weight for height, then wasted only*
iii. *If low weight for age, then underweight only*
iv. *Wasted and stunted*
v. *Underweight and stunted*

vi. Underweight and wasted
vii. Wasted, stunted and underweight.
viii. No failure

But Svedberg (2000) who originally proposed this model introduce six groups of anthropometric failure since he did not add the group in which only underweight children exist, so later Nandy et al. added this additional group in its model. In addition to that Bose and Mundal also added another group named no failure in the model that they develop (Bose & Mandal 2010).
For estimating the prevalence of malnutrition in children, a CIAF index has been generated as a dependent variable. It is used as an indicator of nutritional value According to W.H.O standards (2006). The total measure of child malnutrition prevalence is calculated by combinations of all except group A. It is binary variable use "1" if a child is malnourished otherwise use "0" if a child is not malnourished.

4.3. Independent Variables

In this study we are concerned in evaluating the combined impact of drinking water and sanitation quality on maternal health and child malnutrition, the main explanatory variables in this study are *source of drinking water* and *type of toilet/latrine facility*. To compare the different variables, the responses of water and sanitation are improved sanitation, unimproved sanitation, improved water, and unimproved water. These breakdowns are shown in Tables 6 and 7.

Table 6. Recoding Sanitation Variables

Improved	Unimproved
Flush latrine	Pit latrine without slab or open ditch
Flush/pour flush to piped sewer system	Any facility shared with other households
Flush to septic tank	Bucket toilet
Flush to pit latrine	Hanging toilet/hanging latrine
Pit toilet latrine	Flush to somewhere else
Ventilated improve pit latrine (VIP)	Flush, don't know where
Pit latrine with slab	No facility
Compositing toilet	No facility/bush/field/stream/river
	Other unimproved

Table 7. Recoding Drinking Water Variables

Optimal	Un-Improved
Piped water	Piped to neighbor
Piped into dwelling	Unprotected dug well
Piped water into yard/plot	Protected well
Public tap/stand pipe	Unprotected spring
Tube well water	Tanker truck
Borehole	Surface water
Protected well	River/stream/pond/lake/dam/canals
Protected spring	Cart with small tank
Rain water	Bottled/sachet water
Filtration plant	Other unimproved

To control our study other independent variables that are child specific characteristics, maternal characteristics, and household-level characteristics and disease characteristics will be controlled.

4.3.1. Child and Maternal-specific characteristics

Age and gender of child is taken as a variable to control the effect of personal characteristics on child malnourishment. The child age variable has been further categorized into six groups identified in the duration of months like (i) 0-6, (ii) 7-12, (iii) 13-24, (iv) 25-36, (v) 37-48, and (vi) 49-60. Children of the age 0 to 6 months are assumed be less malnourished if they are on mother feed compared to other age groups. Because when children grow and start moving, they have more chances to be in contact with the external polluted environment because of poor sanitation. After becoming mature enough to learn about cleaning practices there are chances of malnourishment decline (Bartlett 2003).

Birth order number: It is assumed that parents are least conscious to the dietary requirement of an older children, when a new baby is born who in real need more attention and care. Sommerfelt et al (1994)) found that at low birth order there are less chances of being stunted. While higher birth order usually greater than five is directly related with malnourishment of a child (Jeyaseelan, 1997).

Higher *maternal education* is assumed to reduce child malnourishment because highly educated mother weights on the quality of children and plan their families implying negative relation between mother education and fertility. It is also found that educated mother is more conscious about healthy diet and nutrition of her own self and her child and has more concern about health of her child (Shin 2007). So, in the study mother education is used as a control variable. In the DHS data, *mother's education* is measured as 0 = no education; 1= Five years of schooling or less; 2 = 10 years of schooling; and 3 = more than 10 years of schooling.

Mother employment and *decision to spend own earnings* is another important source for the enhancement of positive health outcomes. Maternal employment is assumed to reduce child malnourishment because mother employment is considered positive correlate of malnutrition and well-being, in form of increase resources to fulfil the food needs. An employed women not only contributes to the increased income of household but also her employment status may help her to improve her own as well as her children nutrition status. This may happen because an economically empowered women has higher status and authority in a household compared to housewife. Employment may also reinforce a woman's choices to devote her income on health and nutrition. Although working ladies who do not control their earnings and not have any right in household decision making are underprivileged, and they don't have the right to do for their own well-being. In Africa employed women with the freedom to use and control their income have more food security compared to one having no autonomy in spending their income (Kennedy and Haddad, 1991).

Mother Body Mass Index (MBMI) is another important indicator that is used as predictor of malnourishment in mothers. It helps to measure the nutritional status of mother with two anthropometric indices, height, and body mass index. A BMI below 18.5 kg/m^2 indicate thinness and under nutrition. Lower BMI particularly during pre-antenatal is related to poor birth outcomes that causes lower birth weight and malnourished children.

4.3.2. Household-level characteristics

The *household size* is one of the major determinants of wellbeing and better health status. It has repercussions for the economy and family. Size of the household also affect the distribution of goods and services. With the increase in household size, no of people consuming food increases but it does not imply a proportional rise in household income and food. More with larger family size not necessarily the sanitation facility changes, thus more people have to share same sanitation. This suggests that household size can be associated with child malnutrition and water and sanitation facility too. So, household size is also used as a control variable in the study. In underdeveloped countries economic pressure, force the families to live together. The regional location of the household is expected to be associated with the availability of water and sanitation facility because different regions have differences in the infrastructure development and water and sanitation facility provision, thus have different status of child malnourishment (UNICEF 2010). *Region (Punjab, Sindh, KPK, Balochistan, FATA, AJK, and ICT)* is also used as a control variable in this analysis. Households are categorized based on no. of individual in a HH. The classification is as follow:(i) 1-4 people, (ii) 5-8 people, (iii) 8-10 people, or (iv) more than 11 people. A rise in no. of children less than five years of age in HH is also associated with child malnourishment and quality of HH water and sanitation facility. *Household wealth index* is assumed to be among the most significantly related variables in the study with both child malnourishment and quality of sanitation and water. As level of wealth index rises, child malnourishment is assumed to decline and quality of sanitation and drinking water to improve. The wealth index is also measure in five categories defined on number scale as follow 1 stands for poorest, 2 for poorer, 3 for middle, 4 for richer, and 5 for the wealthiest.

4.3.3. Disease Factors

Disease such as fever, cough and Diarrhea are three major manifestations of malnutrition and mortality. Presence of diarrhea indicates the higher probability of child being malnourished. In PDHS, questions related to all three diseases are asked from mothers that children under age 5 are suffered in diarrhea, fever, or cough from last two weeks before survey or not.

Table 8. operational definitions of variables used in logistic model for child malnutrition

Name of variable	Operational Definitions
Variable (Dependent):	
Composite Index of Anthropometric Failure (CIAF)	1= Child is malnourished, 0=Otherwise
Independent Variables:	
Child-specific characteristics	
Child's gender	1=male, 2=female
Age of child in Months	1=0-6 months, 2=7-12 months, 3=13-18 months, 4=19-24 months, 5=25-36 months-5, 6=37-38 months, 7=49-60
Maternal Characteristics	
Mother's Employment Status	1 if employed, 0 if not employed in last 12 months
Mother's Education Level	Illiterate=0, 5 years of schooling=1, 8 years of schooling=2, More than 8 years of schooling=3
Body Mass Index of Mother	0 if BMI<18.5kg/m^2, 1 if BMI>=18.5kg/m^2
Decision to Spend Women own earning	1 if yes, 0 if no
Household characteristics	
Residence Place	1=urban, 2=rural

Region	1=Punjab, 2=Sindh, 3=KPK, 4=Balochistan, 5=ICT 6=AJK, 7=FATA
Children' numbers under 5 years in a Household	1= Less than equal to 1, 2=2-3, 3=4-5, 4= greater than 5
Household Size	1= Less than 5, 2=6-10, 3=11-15, 4= greater than 15
Source of Drinking Water	0=Un-Improved, 1=Unimproved
Type of Sanitation Facility	0=Un-Improved, 1=Unimproved
Wealth Index	1=poorest,2=poorer,3=middle,4=richer,5=richest
Child Disease factors	
Had diarrhea recently	1 if yes, 0 if no

4.5. Method of Analysis

The objective of the study is to evaluate the impact of water and sanitation facility on child malnutrition. The dependent variable CIAF is in binary form and coded as 0 and 1 weather the child is under nourished or not. The subpopulation selected for this analysis, for whom height and weight measurements is obtained. Because the outcomes of interest are binary, a non-linear model has been used.

Logit model is an appropriate method for analyzing equations with binary variables. The binary logistic regression estimates the chances of success for dependent variable. The binary logistic regression is adopted for analysis when dependent variable has a binary responsum (i.e., 0 or 1). Regressand may be categorical, quantitative, or mixed. Assume, the probability of an event to occur,

Y, [P (Y=1)] which depends on many explanatory variables X1, X2, X3, …., Xk

Functional form for logistic regression is as follow:

$$P = P\left[Y = \frac{1}{x1, x2, x3, \ldots\ldots, xk}\right] = \frac{e^z}{1 + e^z} = \frac{\exp(z)}{1 + \exp\,(z)}$$

Where Z, is a linear function of a set of explanatory variables, X1, X2, X3, …. Xk , given by

Z = bo + boX1 + b2X2 + ……. + bkXk,

b0, b1, b2, ……. bk are the coefficients in regression.

By taking the natural log, logit of P is derived which is, log [(p/1–p)] = Z

The quantity [(p/1–p)] is called the odds and hence log [(p/1–p)], the log odds.

The coefficients b0, b1, b2…...bk are same as the regression coefficients and are called logit regression coefficients.

4.6. Econometric Models

This study examines the effect of water quality and sanitation facility on child undernutrition in Pakistan.

In econometric equation study can expressed as:

Yi=f (X1, X2, X3, X4 …)

Where Yi denotes child malnutrition, Y is equal to 1, if the child is malnourished and Y is equal to 0, if child is not malnourished. X1, X2, X3, X4 and so on; are the different variables are associated with child malnutrition directly or inversely.

Following econometric model will be estimated in this research:

Model- (interaction of water and sanitation facility and child malnourishment)

$CIAF_{ij} = \beta_0 + \beta_1 wealth_{ij} + \beta_2 water_{ij} + \beta_3 sanitation_{ij} + \beta_4 Region_{ij} + \beta_5 Residence_{ij} + \beta_6 Hsize_{ij} + \beta_7 HDR_{ij} + \beta_8 GOC_{ij} + \beta_9 CAM_{ij} + \beta_{10} BirthON_{ij} + \beta_{11} MES_{ij} + \beta_{12} MEL_{ij} + \beta_{13} MBMI_{ij} + \beta_{14} DSWOE_{ij} + \beta_{15} water_{ij} \# \beta_3 sanitation_{ij} + \varepsilon_{ij}$----------**(I)**

1= if child is malnourished, while 0=if the child is not malnourished

Mode2- (impact of water and sanitation facility on male child malnourishment)

$CIAF_{ij\ male} = \beta_0 + \beta_1 wealth_{ij} + \beta_2 water_{ij} + \beta_3 sanitation_{ij} + \beta_4 Region_{ij} + \beta_5 Residence_{ij} + \beta_6 Hsize_{ij} + \beta_7 HDR_{ij} + \beta_8 GOC_{ij} + \beta_9 CAM_{ij} + \beta_{10} BirthON_{ij} + \beta_{11} MES_{ij} + \beta_{12} MEL_{ij} + \beta_{13} MBMI_{ij} + \beta_{14} DSWOE_{ij} + + \varepsilon_{ij}$----------**(I)**

1= if child is malnourished, while 0=if the child is not malnourished

Mode3- (impact of water and sanitation facility on female child malnourishment)

$CIAF_{ij\ female} = \beta_0 + \beta_1 wealth_{ij} + \beta_2 water_{ij} + \beta_3 sanitation_{ij} + \beta_4 Region_{ij} + \beta_5 Residence_{ij} + \beta_6 Hsize_{ij} + \beta_7 HDR_{ij} + \beta_8 GOC_{ij} + \beta_9 CAM_{ij} + \beta_{10} BirthON_{ij} + \beta_{11} MES_{ij} + \beta_{12} MEL_{ij} + \beta_{13} MBMI_{ij} + \beta_{14} DSWOE_{ij} + + \varepsilon_{ij}$----------**(I)**

1= if child is malnourished, while 0=if the child is not malnourished

Chapter 5

RESULTS AND DISCUSSION

This research examined the effect of water and sanitation quality on child undernutrition. By analyzing the PDHS data for the selected variables, the percentage of existence of CIAF in a child according to different characteristics is given in Table 9.

Table 9 exhibits that the occurrence of undernutrition is higher in male children (50.50%). Prevalence rates is higher in 25-36 months' age group (45.49%) and in birth order 4 or 5 (24.05%). Malnutrition rates is higher in pre-school children who belongs to Sindh and Balochistan, 24.65% and 24.85% respectively. Rates is high (88.38%) among those children whose mothers couldn't decide to spend their own earnings and it is even higher in those (84.77%) whose mothers are not employed. The prevalence of undernutrition among children is higher (73.15) whose mother are illiterate or have very low education. Prevalence rates is higher in children whose belongs to household size group 6-10 (51.10%) and 11-15 (26.05%) members. The children who belong to poorest and poorer wealth status houses, their prevalence rates are higher 37.88% and 29.26% respectively. Undernutrition prevalence rates is high (73.55%) among children who have improved source of water in their houses. The prevalence rates are high (63.73%) among children who have improved sanitation facility in their houses.

Table 9. Descriptive analysis describing the association between different socioeconomic characteristic over CIAF (child malnutrition).

Variables	Categories	Frequencies	Percentages
Gender of Child	Male	252	50.50
	Female	247	49.50
Age of Child (in months)	0 to 6	69	13.83
	7 to 12	60	12.02
	13 to 18	62	12.42
	19 to 24	81	16.23
	25 to 36	227	45.49
Birth Order Number	Birth order 1	99	19.84
	2 or 3	167	33.47
	4 or 5	120	24.05
	6 or 7	69	13.83
	Above 7	44	8.82
Decision to Spend Women Earning	Not-Involved	441	88.38
	Involved	58	11.62
Region	Punjab	49	9.82
	Sindh	123	24.65
	KPK	77	15.43
	Balochistan	124	24.85
	Gilgit Baltistan	23	4.61
	ICT (Capital)	14	2.81
	AJK	26	5.21
	FATA	63	12.63

Mother Body Mass Index		64	12.93
	≥ 18.5kg/m2	431	87.07
Mother's Education Level	Illiterate	365	73.15
	Primary	48	9.62
	Middle	59	11.82
	High	27	5.41
Mother's Working Status	Unemployed	423	84.77
	Employed	76	15.23
Household Size	Less than 5 members	41	8.22
	6-10	225	51.10
	11-15	130	26.05
	Greater than 15	73	14.63
Wealth Index	Poorest	189	37.88
	Poorer	146	29.26
	Middle	74	14.83
	Richer	52	10.42
	Richest	38	7.62
Drinking Water Source	Un-Improved	132	26.45
	Improved	367	73.55
Had Diarrhea Recently	No	368	73.75
	Yes	131	26.25
Type of Sanitation Facility	Un-Improved	181	36.27
	Improved	318	63.73

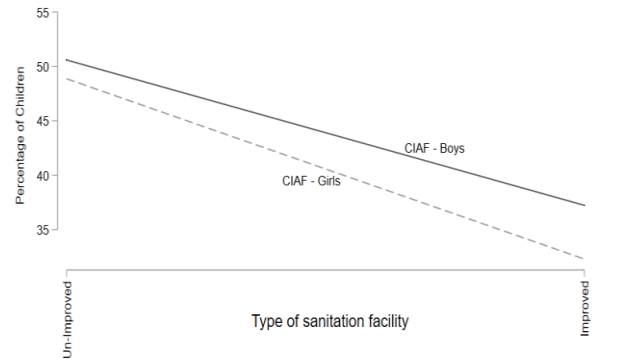
Source: Authors 'estimation

5.1. Association of anthropometric Indicators (Malnutrition) with water source and Sanitation facility

Figure 7A shows that stunting and underweight rates decrease as household have improved sanitation facility but wasting rates remains constant over change in sanitation facility.
Figure 7B depicts that overall malnutrition rates in case of both girls and boys decrease as household have improved sanitation facility.

Figure 7 Prevalence Rates of Stunting, Wasting, Underweight, and CIAF for Sanitation Facility (Overall)

A: Total Sample for HAZ, WAZ, WHZ with Sanitation

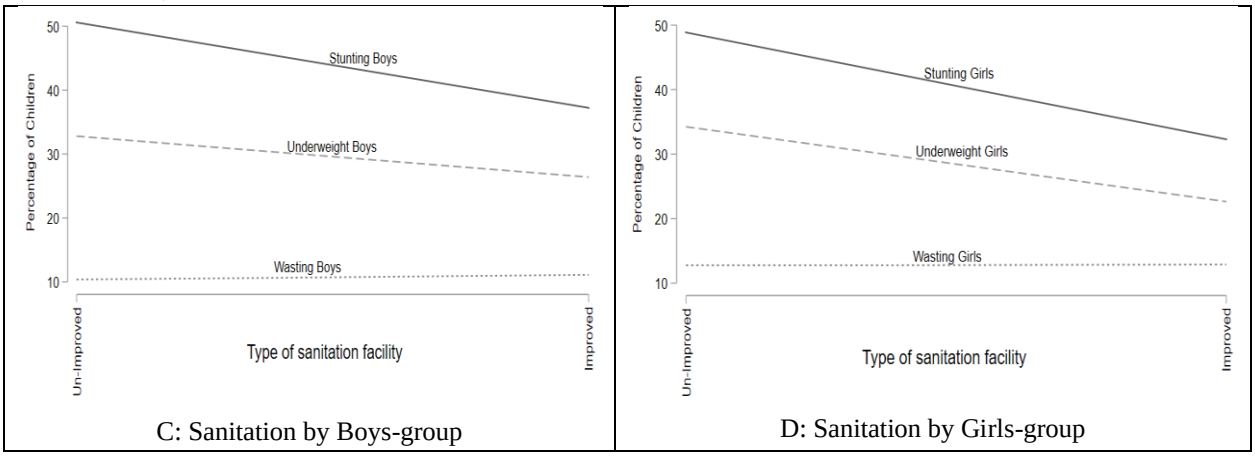


B: Total sample for CIAF with Sanitation

Source: Authors' estimations

Figure 8C and figure 8D highlights the stunting wasting and underweight prevalence rates by children' gender. Results in both figures show that stunting and underweight rates decrease as household have improved sanitation facility but wasting rates remains constant over change in sanitation facility in both figures.

Figure 8 Prevalence Rates of Stunting, Wasting, Underweight for Sanitation Facility (Disaggregated by Child Gender)



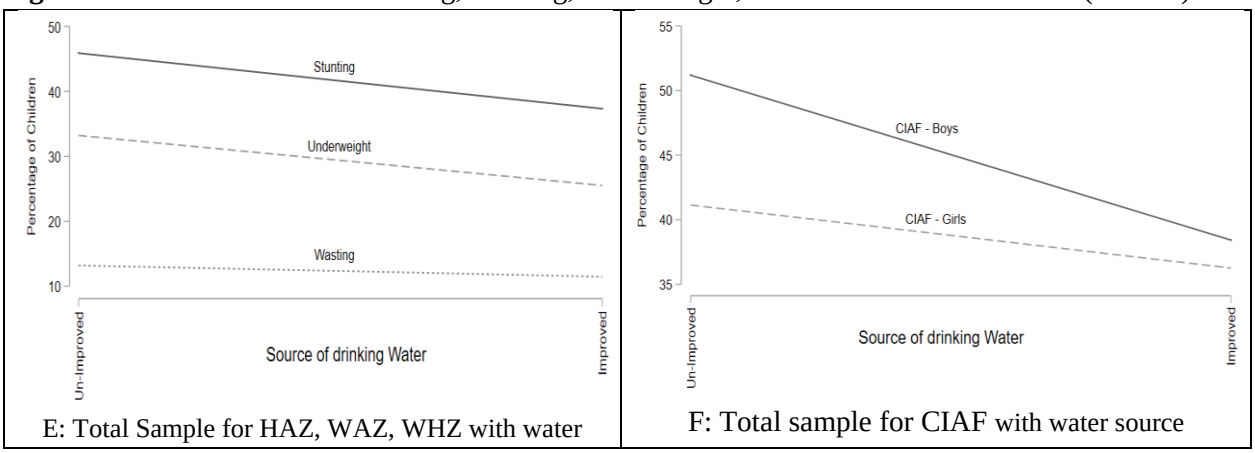
C: Sanitation by Boys-group

D: Sanitation by Girls-group

Source: Authors' estimations

Figure 9E shows that stunting and underweight rates decrease as household have improved source of water but wasting rates remain constant over change in source of water.
Figure 9F depicts that overall malnutrition rates in case of both girls and boys decrease as household have improved water source.

Figure 9 Prevalence Rates of Stunting, Wasting, Underweight, and CIAF for Water Source (Overall)



E: Total Sample for HAZ, WAZ, WHZ with water

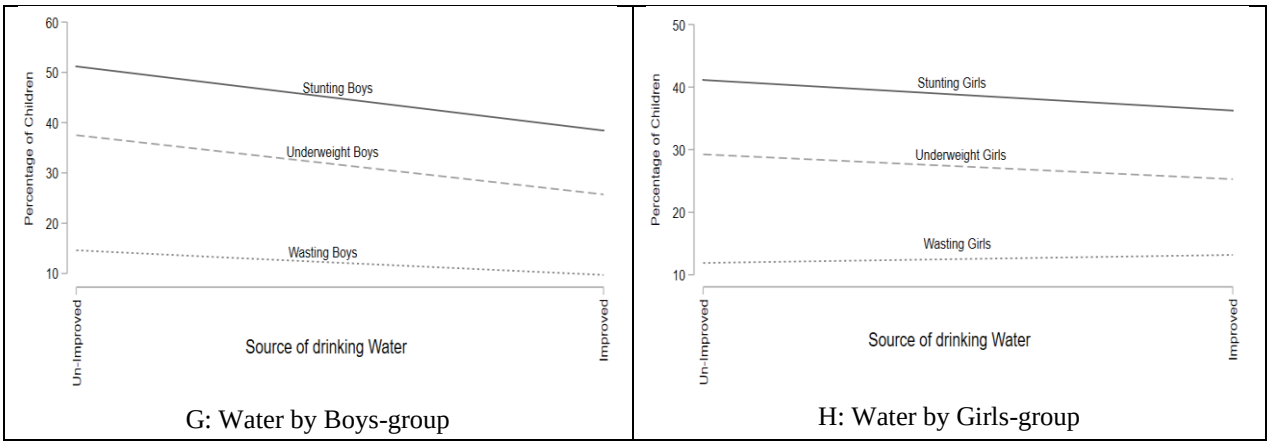
F: Total sample for CIAF with water source

Source: Authors' estimations

Figure 10G and figure 10H highlights the stunting wasting and underweight prevalence rates by children' gender. Results in both figures show that stunting and underweight rates decrease as

household have improved sanitation facility. While rates of wasting also decrease in boys as household have improved water source, but wasting rates do not change (remain constant) in girls.

Figure 10 Prevalence Rates of Stunting, Wasting, Underweight for Water Source (Disaggregated by Child Gender)



G: Water by Boys-group H: Water by Girls-group

Source: Authors' estimations

Table 10. Results of binary logistic regression analysis for CIAF (child malnutrition) and its correlates.

Variables	Categories	Coef.	Odds Ratio	Std. Err.	95% CI
Gender of Child	Male (R)				
	Female	-.098	.9065	.1268	[.689, 1.19]
Age of Child (in months)	0 to 6 (R)				
	7 to 12	.176	1.192	.295	[.733, 1.94]
	13 to 18	.156	1.169	.286	[.724, 1.89]
	19 to 24	.922	2.514***	.634	[1.54, 4.12]
	25 to 36	1.05	2.863***	.580	[1.93, 4.26]
Birth Order Number	Measure as continuous	-.02	.9798	.171	[.696, 1.38]
Decision to Spend Women Earning	Not-Involved (R)				
	Involved	.265	1.304	.483	[.631, 2.69]
Region	Punjab (R)				
	Sindh	1.035	2.816***	.705	[1.72, 4.60]
	KPK	.564	1.758***	.453	[1.06, 2.91]
	Balochistan	1.103	3.012***	.798	[1.79, 5.06]
	Gilgit Baltistan	-.138	.871	.304	[.439, 1.72]
	ICT (Capital)	.0636	1.066	.424	[.489, 2.32]
	AJK	.1358	1.145	.38	[.598, 2.19]
	FATA	.1518	1.164	.337	[.660, 2.05]
Mother's Education Level	Illiterate (R)				
	Primary	-.421	.656**	.15	[.415, 1.04]
	Middle	-.326	.72	.167	[.459, 1.14]
	High	-.907	.40***	.118	[.227, .72]

Mother's Working Status	unemployed (R)				
	Employed	-.021	.9791	.326	[.509, 1.88]
Mother Body Mass Index					
	≥ 18.5kg/m2	-.333	.717	.167	[.454, 1.13]
Household Size	< 5 members (R)				
	6-10	.154	1.167	.308	[.695, 1.96]
	11-15	.280	1.323	.379	[.754, 2.32]
	Greater than 15	.156	1.169	.361	[.638, 2.14]
Wealth Index	Poorest (R)				
	Poorer	-.118	.889	.178	[.599, 1.32]
	Middle	-.293	.746	.186	[.458, 1.22]
	Richer	-.545	.579**	.159	[.338, .995]
	Richest	-.91	.403***	.125	[.219, .738]
Had Diarrhea Recently	No (R)				
	Yes	.389	1.475***	.244	[1.07, 2.04]
Drinking water source	Un-Improved (R)				
	Improved	-.335	.715**	73.55	[.505, 1.01]
kind of Sanitation Facility	Un-Improved (R)				
	Improved	-.372	.689***	.098	[.521, .912]
Water # Sanitation (interaction)	Un-Improved Water # Un-Improved Sanitation (R)				
	Un-Impr-water # Impr-sani	-.068	.934	.238	[0.57, 1.54]
	Impr-water # Un-Impr-sani	.203	1.23	.276	[0.79, 1.90]
	Impr-water # Impr-sanitaion	-.308	.735**	.137	[0.51, 1.06]
	Overall significance of the model				
No. of observations = 1,004		Prob>= 0.0000			
LR χ^2 (29) = 172.22		Pseudo R^2 = 0.1238			
*: References: Odd ratios; P-values; Confidence Intervals					
(R): shows the reference category					
Significance level: *** if Prob < 0.01 ** if Prob < 0.05, * if Prob < 0.1					

Source: Authors 'estimation

Table 10 depicts the binary logistic regression results. Age of children from 19-24 months is related with higher odds of malnutrition (CIAF) among preschool children (Odd ratio =2.52, 95% Confidence Interval: 1.54-4.12), and chances of becoming malnourished among under five children are also higher for 25-36 months' child age group (Odd ratio =2.86, 95% Confidence Interval: 1.93-4.26). The region Sindh is associated with higher odds of undernutrition (CIAF) among preschool children (Odd ratio =2.82, 95% Confidence Interval: 1.72-4.60), chances of becoming malnourished among under five children are also higher in KPK (OR=1.76, 95% Confidence Interval: 1.06-2.91) and higher in Balochistan region (Odd ratio =3.02, 95% Confidence Interval: 1.79-5.06). Mothers who have primary and higher education, the odd ratios of undernutrition among their children are lower in comparison with other educational categories, as follows, primary (Odd ratio =0.66, 95% Confidence Interval: 0.42-1.04), high (Odd ratio =0.40, 95% Confidence Interval: 0.23-0.72). The odds of undernutrition are likely to higher among preschool children who had diarrhea recently (Odd ratio =1.48, 95% Confidence Interval: 1.07-

2.04). Across the wealth quantiles, the odds of undernutrition are lover in the richer households (Odd ratio =0.58, 95% Confidence Interval: 0.34-0.99), and lower in richest households (Odd ratio OR=0.40, 95% Confidence Interval: 0.22-0.74).

The households who have improved water source, had 71.5% (95% Confidence Intervals: 0.51-1.01) lower probability to have the incidence of undernutrition among their children under age five. Same as, the households who have improved toilet or sanitation facility, have 68.9% (95% Confidence Intervals: 0.52-0.91) lower chances to experience the occurrence of undernutrition among them under five children.

The results of interaction term of water and sanitation, only improved water and improved sanitation category is significantly contributing to the undernutrition of children. It shows that households who have improved water and improved sanitation facility, have 13.7% (Odd ratio =0.137, 95% Confidence Interval: 0.51, 1.06) lower chances to experience the occurrence of malnutrition among them under five children.

Table 11. Results of binary logistic regression analysis for CIAF (**Male Child**) and its correlates.

Variables	**Categories**	**Coef.**	**Odds Ratio**	**Std. Err.**	**95% CI**
Age of Child (in months)	0 to 6 (R)				
	7 to 12	.140	1.150	.422	[.56, 2.36]
	13 to 18	-.216	.805	.289	[.39, 1.63]
	19 to 24	.744	2.105**	.797	[1.00, 4.4]
	25 to 36	.660	1.935**	.588	[1.00, 4.4]
Birth Order Number	Measure as continuous	.005	1.005	.255	[1.07, 3.5]
Decision to Spend Women Earning	Not-Involved (R)				
	Involved	.291	1.338	.783	[.43, 4.21]
Region	Punjab (R)				
	Sindh	1.06	2.89***	1.04	[1.4, 5.85]
	KPK	.508	1.66	.625	[.79, 3.47]
	Balochistan	1.11	3.035***	1.14	[1.5, 6.33]
	Gilgit Baltistan	-.22	.802	.421	[.29, 2.24]
	ICT (Capital)	.468	1.596	.858	[.56, 4.58]
	AJK	.246	1.279	.701	[.44, 3.75]
	FATA	.231	1.259	.539	[.54, 2.91]
Mother's Education Level	Illiterate (R)				
	Primary	-.714	.489**	.167	[.25, .955]
	Middle	.0275	1.028	.343	[.53, 1.98]
	High	-1.06	.348***	.148	[.15, .803]
Mother's Working Status	Unemployed (R)				
	Employed	-.176	.838	.452	[.29, 2.41]
Mother Body Mass Index					
	≥18.5kg/m2	.06	1.062	.347	[.56, 2.02]
Household Size	< 5 members (R)				
	6-10	.555	1.743	.686	[.81, 3.77]

	11-15	.504	1.656	.692	[.73, 3.75]
	Greater than 15	.331	1.392	.632	[.57, 3.39]
Wealth Index	Poorest (R)				
	Poorer	-.080	.923	.272	[.52, 1.65]
	Middle	-.499	.6069	.225	[.29, 1.26]
	Richer	-.739	.478**	.185	[.22, 1.02]
	Richest	-1.12	.327***	.152	[.13, .807]
Had Diarrhea Recently	No (R)				
	Yes	.439	1.551*	.379	[.96, 2.50]
Drinking water source	Un-Improved (R)				
	Improved	-.476	.621**	.161	[.37, 1.03]
Kind of Sanitation Facility	Un-Improved (R)				
	Improved	.214	1.238	.314	[.75, 2.03]

Overall significance of the model

No. of observations = 494 Prob>χ^2 = 0.0000

LR Chi^2 (28) = 90.92 Pseudo R^2 = 0.1328

*: References: Odd ratios; P-values; Confidence Intervals

(R): shows the reference category

Significance level: *** if Prob < 0.01 ** if Prob < 0.05, * if Prob < 0.1

Source: Authors 'estimation

Table 12. Results of binary logistic regression analysis for CIAF (**Female Child**) and its correlates.

Variables	Categories	Coef.	Odds Ratio	Std. Err.	95% CI
Age of Child (in months)	0 to 6 (R)				
	7 to 12	.119	1.126	.399	[.56, 2.25]
	13 to 18	.355	1.427	.502	[.72, 2.84]
	19 to 24	.945	2.57***	.911	[1.28, 5.2]
	25 to 36	1.35	3.87***	1.107	[2.2, 6.78]
Birth Order Number	Measure as continuous	.008	1.008	.253	[0.62, 1.6]
Decision to Spend Women Earning	Not-Involved (R)				
	Involved	.216	1.241	.634	[.46, 3.38]
Region	Punjab (R)				
	Sindh	1.15	3.15***	1.15	[1.5, 6.45]
	KPK	.727	2.07**	.772	[.99, 4.29]
	Balochistan	1.23	3.44***	1.36	[1.6, 7.47]
	Gilgit Baltistan	-.03	.975	.478	[.37, 2.55]
	ICT (Capital)	-.54	.581	.376	[.16, 2.07]
	AJK	.152	1.164	.514	[.49, 2.77]
	FATA	.204	1.226	.499	[.55, 2.72]
Mother's Education Level	Illiterate (R)				
	Primary	-.126	.881	.299	[.45, 1.71]

	Middle	-.638	.528**	.183	[.27, 1.04]
	High	-.671	.511	.215	[.23, 1.17]
Mother's Working Status	Unemployed (R)				
	Employed	.11	1.117	.503	[.46, 2.70]
Mother Body Mass Index					
	≥ 18.5kg/m2	-.691	.501**	.181	[.25, 1.02]
Household Size	< 5 members (R)				
	6-10	-.122	.8851	.331	[.43, 1.84]
	11-15	.115	1.122	.463	[.50, 2.52]
	Greater than 15	-.042	.959	.421	[.41, 2.26]
Wealth Index	Poorest (R)				
	Poorer	-.181	.834	.239	[.48, 1.46]
	Middle	-.078	.925	.326	[.46, 1.85]
	Richer	-.429	.651	.269	[.29, 1.47]
	Richest	-.736	.478*	.209	[.20, 1.13]
Had Diarrhea Recently	No (R)				
	Yes	.391	1.478	.352	[.93, 2.36]
Source of Drinking Water	Un-Improved (R)				
	Improved	-.223	.800	.202	[.49, 1.31]
Type of Sanitation Facility	Un-Improved (R)				
	Improved	-.446	.641**	.128	[.43, .95]

Overall significance of the model

No. of observations = 510 Prob >χ^2 = 0.0000

LR Chi^2 (28) = 102.85 Pseudo R^2 = 0.1456

*: References: Odd ratios; P-values; Confidence Intervals

(R): shows the reference category

Significance level: *** if Prob < 0.01 ** if Prob< 0.05, * if Prob < 0.1

Source: Authors 'estimation

Table 11 and table 12 shows the binary logistic regression results for gender-disaggregated analysis. In male model: age of child, region, mother's education, had diarrhea recently, and wealth status has significant association with male child malnutrition. The results of source of drinking water in male model shows that households who have improved water sources had 62.1% (95% Confidence Intervals: 0.37-1.03) lower probability to experience the undernutrition among their male children. Sanitation variable is insignificant in male model. Similarly in female model: age of child, region, mother's education, wealth index, and mother's body mass index shown significant association with female child malnutrition. The results of type of sanitation facility in female model illustrates that households who have improved sanitation facility had 64.1% (95% Confidence Intervals: 0.43-0.95) lower chances of undernutrition prevalence among their female children. Water variable was insignificant in female child model.

DISCUSSION

Pakistan is presently facing greater incidence of various forms of undernutrition among preschool children. In Pakistan, the incidence of prolonged undernutrition or stunting is 38%, after that almost 23% of children are underweight and 8% are wasted. Mother education plays a significant role in determining the nutritional status of under five children in Pakistan. The results of the study depict that those mothers who had five years and ten years of schooling, have 65.5% [primary (CI: 0.42-1.04] and 40% [high (CI: 0.23-0.72)] lower chances of malnutrition prevalence among their children. Early childbirth affects the health of neonatal and mother's health. Because of awareness, educated mothers keep appropriate birth intervals and fewer children and can give better healthcare and nutritional consideration. Mother education has a direct or indirect effect on nutritional status of the child. The direct effect saturates through the capability of the literate mothers to be well equipped with the knowledge about child nutrition requirement, feeding practices and healthcare requirements of child (Aguayo, 2018). The indirect effect functions by delaying in marriage decision, and first birth that subsequently decreases the demand of children and help in empowering women (Cunningham, 2017).

The children of age group 19-24 months and 25-36 months have higher probability of being malnourished as compared to other age groups. It portrays that with the increase of age the prevalence in malnutrition also increases. The results are consistent with previous literature (Shahid, 2020).

Diarrhea, respiratory infections, and malnutrition are three major causes of death during infancy (Irena, 2011). Diarrhea becomes more dangerous if the child belongs to a deprived family. The child loses many minerals, and in this situation, the child needs a better diet to overcome the weakness. However, poor families mostly treat their children discriminately. The findings of the study depict those children having diarrhea recently increases the probability of malnutrition in children. The findings are in harmony with (Shahid, 2020).

In PDHS-2017/18 data on household income or consumption is not available. For that, the household wealth index is used as proxy to indicate economic status of household. In current study, the relationship between economic status of household proxies by wealth status with undernutrition found to be highly significant. The occurrence of severe undernutrition prevalence seems to decline across households with different economic status. Malnutrition prevalence is the lowest among richer and richest households. Similar pattern observed (Lubna Naz, 2020). The study reveals that families with better economic status, have more resources for taking good care of their children, can provide a balanced nutritious diet, and if needed, can afford proper medication as well. The good socioeconomic status of the household helps to reduce the gender disparity in nutritional outcomes. Malnutrition is not only a symptom of ill health but also a cause of poverty (Khan, 2019). The studies correlate with the analysis that in comparison to poor households, children are lower probability of being malnourished as they have more resources to purchase food items (Adhikari., 2019).

The results for region show that children belong to Sindh, KPK and Balochistan have higher chances of becoming malnourished. Malnutrition rate and disparity in nutrition under five years' children is falling in the regions of developing countries i.e., 26% in 2000 and 23% in 2010 (World

Bank data 2012). Variation in nutrition exists on regional basis in Pakistan, higher malnutrition exists in adults or younger female (Chatterjee and Lambert 2006).

Proper sanitation facility, along with good hygiene and clean water, are essential for good health and socioeconomic development (Singh M. 2008). In South Asia, about 663 million people do not have access to clean drinking water in 2015 (UNICEF, 2016). More than 2.3 billion population is deprived of basic sanitation facilities, around 892 million people do open defecation and around 4.5 billion people do not have adequate sanitation services (WHO, 2017). In last few years, studies on determinants of child and maternal malnutrition found water, hygiene, and sanitation as a prominent determinant more specifically much prominent in South Asia (Harding, K. L,2018). The diseases caused by polluted water and poor sanitation are predominantly associated with poverty and infancy. Almost 10% of global disease burden is related with the diseases caused by improper water and sanitation conditions (Prüss-Üstün, 2008). Almost 50% of people living in cities of Africa, Asia, and Latin America become victim of diseases caused by inadequate sanitation, hygiene, and water facility (WHO, 1999). Better sanitation facility can mitigate ratio of diarrheal diseases by 32% to 37% (Waddington & Snilstveit ,2009).

The results of the study show that the household who have clean water and adequate sanitation facilities, chances of malnutrition prevalence among their children decreases. This analysis concludes that a child with a facility of flush toilet at home or water-based sanitation into a piped sewer system, septic tank, has a reduced probability of being malnourished than a child living in a household with unimproved sanitation even controlling other variables. Improved drinking water quality is also associated with a decline in the probability of a child malnourishment. Inadequate sanitation, poor hygiene, and polluted water account for 50% underweight among mother and children globally (World Bank 2008). Insufficient sanitation, water and washing facilities adversely affect attendance and performance of children at school, particularly for girls (Cumming, 2016). The provision of sanitation facilities into school implies that there is little chance for girls to be absent from school particularly during menses (Mahon & Fernandes, 2010). Availability of sanitation facility at household also reduces the risk for a woman to be raped or being harassed compared to the situation of open defecation. Lack of access to sanitation facilities also reduce the self-esteem. In the absence of household toilets risk of sexual assault also increases (Hutton, 2015). A study for Sub-Saharan Africa and South Asia revealed a substantial impact of improved facility of sanitation and clean water on children health. They also explain that such an improvement significantly reduces the odd ratio of child mortality, morbidity, and malnutrition (Anand & Roy, 2016). Harding, K. L. et al (2018) studied the examined determinants of wasting among children under the age of five in South Asia and they found that birth order, gender, mother education, mother stature, water source quality, and household poverty was also related with wasting in different countries. Research done on (WASH), environmental enteropathy, nutrition, and childhood development revealed that WASH may have an impact on childhood development, mainly through inflation, stunting, and anemia (Ngure et al, 2014). A study by Benova (2014) studied that the lack of water and sanitation facility on maternal death ratio and found that polluted water and poor sanitation was related with increased maternal mortality. Esrey (1996) proposed that the only way for improving the nutritional status of children is optimal access to water resources along with improved sanitation facility.

Chapter 6

CONCLUSIONS AND POLICY IMPLICATIONS

This study contributes to the literature by proposing socioeconomic benefits of improving the water and sanitation system. Moreover, it also augments in the existing literature on child malnutrition and water/sanitation nexus focusing exclusively on Pakistan, using recent data from Pakistan Demographic and Health Survey (PDHS) 2017-18, and elucidating the association between the child malnutrition and quality of water and sanitation facility. This study specifically accesses the association of malnutrition with social and economic factors in general and environmental factors in specific such as sanitation facilities and drinking water sources for Pakistan. Moreover, this research examines the determinants of male and female child malnutrition in Pakistan while, in specific, the role of the sanitation facility and drinking water source in gender analysis.

The results of the study depict that the likelihood of malnutrition increases when child had diarrhea recently and child belongs to deprived region such as KPK, Sind and Balochistan. While the likelihood of child malnutrition decreases with an increase in education of mothers, increase in household wealth status, and the household having improved water source and sanitation facility. The only water-improved sanitation category of the interaction term is significant in the model which depicts that households having both improved water and improved sanitation facilities have a very less chances of malnutrition among their children. In gender analysis, the logistic regression results depict that the child belongs to deprived regions, mother education, and wealth status of household are significant common determinants of malnutrition in children. Child diarrhea and drinking water source are separate prominent predictors of malnutrition in male children while sanitation facility is the main determinant of malnutrition in female children.

The analysis of this study suggests that improved water and sanitation quality much more likely to decrease malnutrition among children. The results of the study provide useful implications for policy makers to emphasize on improving water and sanitation system to not only reap direct benefits of decreased avoidable health expenditures but indirect benefits of rising productivity. Specific policy implications are given below:

- This requires the re-allocation of resources from other developmental projects to increased public investments on improving water and sanitation system and related technologies. To achieve research and development objectives, education to every child both male and female should be given at their doorstep without any regional or provincial difference. More specifically both formal and nutritional education to mothers is very important in development of their children especially in hygienic care point of view.
- For better nutritional outcomes and batter living standard of a family, income security of a household in need of time, either cash transfer or creating short-term employments or introducing social security nets for downtrodden class so that they can meet the nutritional requirements as well to improve their social status.
- Availability of pure water and adequate sanitation services are necessary of wellbeing and healthy life. The improvements in water and sanitation system are fundamental for improving children nutrition status. Therefore, significant concern should be given by policy makers.
- By giving equal opportunities of access of development projects like water, sanitation, education, employment etc. to all irrespective of genders will help in meeting the other

sustainable development goal such as SDG 3 (good health and wellbeing) and SDG 4 (gender equity).

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APPENDIX

Binary Logistic Regression Results odds ratios (interaction terms water and sanitation)

```
logistic CIAF i.GOC i.CAM 1.BirthON 1.MES i.MEL i.MBMI 1.DSWOE i.Region i.Hsize i.wealth i.water
i.sanitation i.HDR, r
```

```
Logistic regression                             Number of obs     =      1,004
                                                LR chi2(29)       =     172.22
                                                Prob > chi2       =     0.0000
Log likelihood = -609.71125                     Pseudo R2         =     0.1238
```

CIAF	Odds Ratio	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
GOC						
Female	.906461	.1268213	-0.70	0.483	.6890632	1.192447
CAM						
7-12	1.191984	.2953883	0.71	0.479	.7333852	1.937352
13-18	1.169132	.2858362	0.64	0.523	.7240303	1.887862
19-24	2.514382	.6335765	3.66	0.000	1.534421	4.120196
25-36	2.863254	.5801929	5.19	0.000	1.924764	4.259341
BirthON						
Continuous	.9798171	.1710624	-0.12	0.907	.6958844	1.379599
MES						
Employed	.9790691	.3259652	-0.06	0.949	.5098232	1.880213
MEL						
Primary	.6563884	.1533907	-1.80	0.072	.4151877	1.037713
middle	.7221238	.1670996	-1.41	0.159	.4588212	1.136527
High	.4036919	.1183317	-3.09	0.002	.2272703	.7170633
MBMI						
greater than or equal to 18.5k	.7167315	.1673168	-1.43	0.154	.4535743	1.132569
DSWOE						
Woman involved	1.304132	.4828498	0.72	0.473	.6312009	2.694484
Region						
Sindh	2.816234	.7053661	4.13	0.000	1.723745	4.601128
KPK	1.758139	.4525904	2.19	0.028	1.061529	2.911887
Balochistan	3.012196	.7981623	4.16	0.000	1.791986	5.063281
GB	.8710296	.3037494	-0.40	0.692	.439742	1.725313
Islamabad-capital	1.065717	.4235866	0.16	0.873	.4890099	2.322554
AJK	1.145452	.3799863	0.41	0.682	.5978656	2.194573
FATA	1.163975	.3366875	0.52	0.600	.6602797	2.051915
Hsize						
6-10	1.166791	.3088578	0.58	0.560	.6945028	1.960253
11-15	1.323592	.3795968	0.98	0.328	.7544592	2.322056
Greater than 15	1.16878	.3606118	0.51	0.613	.6384185	2.139734
wealth						
poorer	.8883949	.1784445	-0.59	0.556	.5992835	1.316982
middle	.7460128	.1858109	-1.18	0.239	.4578634	1.215505
richer	.5798729	.1596604	-1.98	0.048	.3380381	.994718
richest	.4025249	.1247464	-2.94	0.003	.219279	.7389048
water						

Improved	.7150689	.1268838	-1.89	0.059	.5050197	1.012482
sanitation						
Improved	.689311	.0983962	-2.61	0.009	.5210865	.911844
HDR						
Yes	1.475439	.2446979	2.35	0.019	1.065986	2.042166
_cons	.7083419	.3057663	-0.80	0.424	.3039549	1.650733

Binary Logistic Regression Results Odd Ratios (Male Child)

```
logistic CIAF i.CAM 1.BirthON 1.MES i.MEL i.MBMI 1.DSWOE i.Region i.Hsize i.wealth i.water
i.sanitation i.HDR if GOC==1, r (Male)
```

```
Logistic regression                             Number of obs     =        494
                                                LR chi2(28)       =      90.92
                                                Prob > chi2       =     0.0000
Log likelihood = -296.91715                     Pseudo R2         =     0.1328
```

CIAF	Odds Ratio	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
CAM						
7-12	1.150437	.421669	0.38	0.702	.5608831	2.359681
13-18	.8051569	.2894661	-0.60	0.547	.3979795	1.628922
19-24	2.1047	.7966936	1.97	0.049	1.002269	4.419734
25-36	1.935261	.5878999	2.17	0.030	1.066986	3.510107
BirthON						
Continuous	1.000535	.2550842	0.00	0.998	.6070443	1.64909
MES						
Employed	.8382978	.4520839	-0.33	0.744	.2913101	2.412354
MEL						
Primary	.4896859	.1668396	-2.10	0.036	.2511348	.954835
middle	1.027884	.3428282	0.08	0.934	.534619	1.976258
High	.3477044	.1485235	-2.47	0.013	.1505274	.803165
MBMI						
greater than or equal to 18.5kg/m2	1.062001	.3470676	0.18	0.854	.5596902	2.015125
DSWOE						
Woman involved	1.338424	.7825274	0.50	0.618	.4255271	4.209786
Region						
Sindh	2.893668	1.038681	2.96	0.003	1.431892	5.847729
KPK	1.663494	.6246561	1.36	0.175	.7968706	3.472599
Balochistan	3.034522	1.137612	2.96	0.003	1.455403	6.32699
GB	.8021964	.4210975	-0.42	0.675	.2867206	2.244412
Islamabad-capital	1.596053	.8583906	0.87	0.385	.5562286	4.579745
AJK	1.279016	.7009671	0.45	0.653	.4368911	3.744368
FATA	1.259508	.5390726	0.54	0.590	.5443581	2.914187
Hsize						
6-10	1.742502	.6860257	1.41	0.158	.8054786	3.769577
11-15	1.655655	.692421	1.21	0.228	.7294303	3.757991
Greater than 15	1.392281	.6316917	0.73	0.466	.5721742	3.38786

wealth						
poorer	.9230268	.2722087	-0.27	0.786	.5178304	1.645285
middle	.6068965	.2252706	-1.35	0.178	.2931985	1.256225
richer	.4775172	.1852803	-1.91	0.057	.2232114	1.021555
richest	.3272718	.1506412	-2.43	0.015	.1327718	.8066987
water						
Improved	.6210415	.1610324	-1.84	0.066	.3736019	1.032362
sanitation						
Improved	1.237939	.3138727	0.84	0.400	.7531502	2.034776
HDR						
Yes	1.550536	.3786694	1.80	0.073	.9607334	2.502425
_cons	.4741497	.3028965	-1.17	0.243	.1355659	1.658366

Binary Logistic Regression Results Odd Ratios (Female Child)

```
logistic CIAF i.CAM 1.BirthON 1.MES i.MEL i.MBMI 1.DSWOE i.Region i.Hsize i.wealth i.water
i.sanitation i.HDR if GOC==2, r (Female)
```

```
Logistic regression                             Number of obs     =        510
                                                LR chi2(28)       =     102.85
                                                Prob > chi2       =     0.0000
Log likelihood = -301.68759                     Pseudo R2         =     0.1456
```

CIAF	Odds Ratio	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
CAM						
7-12	1.125819	.3989661	0.33	0.738	.5621094	2.254842
13-18	1.426517	.5018624	1.01	0.313	.7158403	2.842745
19-24	2.571423	.9114691	2.66	0.008	1.283677	5.150997
25-36	3.875281	1.106898	4.74	0.000	2.213982	6.783163
BirthON						
Continuous	1.008082	.2532677	0.03	0.974	.6160878	1.649489
MES						
Employed	1.117351	.5034554	0.25	0.805	.4620144	2.702238
MEL						
Primary	.8812844	.298789	-0.37	0.709	.4534467	1.712797
middle	.5282262	.1831486	-1.84	0.066	.2677244	1.042202
High	.5110864	.2150262	-1.60	0.111	.2240648	1.165776
MBMI						
greater than or equal to 18.5kg/m2	.5012864	.1809713	-1.91	0.056	.2470532	1.017141
DSWOE						
Woman involved	1.240713	.6338817	0.42	0.673	.455818	3.377156
Region						
Sindh	3.148768	1.150862	3.14	0.002	1.538261	6.445422
KPK	2.069415	.771578	1.95	0.051	.9965026	4.297508
Balochistan	3.436671	1.361106	3.12	0.002	1.581307	7.468949
GB	.9751304	.4782063	-0.05	0.959	.3729335	2.549729

Islamabad-capital	.5809717	.3760819	-0.84	0.402	.1633595	2.066167
AJK	1.163598	.5141084	0.34	0.732	.4894625	2.766217
FATA	1.226377	.4992154	0.50	0.616	.5522419	2.723445
Hsize						
6-10	.8850692	.3313931	-0.33	0.744	.4248788	1.843696
11-15	1.122258	.4625679	0.28	0.780	.5003195	2.517315
Greater than 15	.9591174	.4204989	-0.10	0.924	.4061492	2.264946
wealth						
poorer	.8341077	.239591	-0.63	0.528	.47503	1.464614
middle	.9251648	.3263017	-0.22	0.825	.4634512	1.846861
richer	.651437	.2693462	-1.04	0.300	.289688	1.464921
richest	.4788323	.2094477	-1.68	0.092	.2031685	1.128523
water						
Improved	.8002834	.2021584	-0.88	0.378	.4877789	1.313
sanitation						
Improved	.6404622	.1281467	-2.23	0.026	.4326942	.9479948
HDR						
Yes	1.478761	.352236	1.64	0.101	.927138	2.358584
_cons	.8332622	.4966891	-0.31	0.760	.2590594	2.68018