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Water, Sanitation, and Malnutrition in Pakistan: Challenge for Sustainable Development

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Abstract *This paper aims to analyze the water, sanitation, and malnutrition situation in Pakistan and to evaluate the sustainable development goals situation. To find the association, this study applies a chi-square test utilizing a sample of 3,575 children of age less than five years, extracted from the data of Pakistan Demographic and Health Survey (PDHS) 2017-18. The results of chi-square show that underweight and stunting have a significant association with water and sanitation in Pakistan. Pakistan's progress in sustainable development goals is yet slow, especially targets of goal 3 and goal 6, which are far behind other countries of the region. The study concludes that there is a need to allocate more resources in programs such as water, sanitation, nutrition, and poverty reduction to uplift the socio-economic standard of the common folk.*

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Introduction

Malnutrition is a significant factor that contributes a lot to under-five child mortality in developing countries. The World Health Organization reports that 35% of deaths of children of age less than five years are because of malnutrition (Black et al., 2008). In low and middle-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). Moreover, in South Asia and Southeast Asia, 50% of global maternal deaths are also reported (Bhutta et al, 2004).

The previous empirical work that has been done on determinants of child malnutrition have consensus that economic status or wealth status etc. remains the most significant determinant of malnutrition over the time till now (Akombi et al, 2019; Mistry et al, 2019; Nie et al, 2019; Frieda Sossi, 2019; Adhikari et al, 2019; Asim & Nawaz, 2018; Hasan et al, 2017; Karki et al, 2017; Pravana et al, 2017; Dhungana, 2017; Khalid et at, 2017; Rabbani et al, 2016; Rabbi & Karmaker, 2015). But most significantly many researchers found that improved water

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and sanitation are also significant determinants of malnutrition (Mistry et al, 2019; Pratim Roy, 2019; Nguyen et al., 2019; Sinha et al, 2018; Menon et al, 2018; Tariq et at, 2018; Cunningham et al, 2017; Rabbi & Karmaker, 2015) as well.

Improved sanitation is associated with better health outcomes. The share of polluted water and inadequate sanitation-related diseases in the global burden of diseases is nearly 10% (Prüss-Üstün et al, 2007). Globally, half of the maternal-child underweight problem is due to inadequate sanitation, poor hygiene, and polluted water (World Bank 2008; Victora et al, 2008). So, malnutrition not only occurs due to lack of nutrition, but it also occurs due to social deprivation (poor water and sanitation) as well. Investing in social wellbeings like water and sanitation is not only improves the social status of individuals but also contributes to poverty reduction. Providing improved water and sanitation help in uplifting the social status or living condition of a nation. Many researchers found that improved water and sanitation are significant determinants of malnutrition (Mistry et al, 2019; Pratim Roy, 2019; Nguyen et al, 2019; Sinha et al, 2018; Menon et al, 2018; Tariq et al, 2018; Cunningham et al, 2017; Rabbi & Karmaker, 2015).

Pakistan has unified sustainable goals into its national agenda for development. A study by Brollo & Hanedar (2021) concluded that Pakistan's progress in water and sanitation is below the median of those countries whose per capita GDP is below 3,000 US Dollars, and to reduce the water and sanitation gap, Pakistan would need US 55 billion Dollars which accounts 2 percent of GDP every year till 2030. This study is on two accounts. First, this study assessed the latest SDGs situation of water and sanitation of Pakistan and also compared with SAARC countries to see the progress of Pakistan. There is very limited literature in Pakistan which discuss the water and situation progress in sustainable development goals. Secondly, the study utilized the latest data, Pakistan demographic and health survey 2017-18 and observed the association between water and sanitation indicators with child malnutrition. To our best knowledge, this is the latest study using the latest national data, which correlates water and sanitation with child nutritional status for Pakistan. Most importantly, the results of the study may be used in identifying the gaps in public policy solutions for achieving the SDGs targets.

Methods

Data

This paper utilized a sample of 3,575 children of age less than five years extracted from the latest data, PDHS 2017-18. This data provides wide information on nutrition and demographic characteristics, women and children nutritional and healthcare information, women empowerment, domestic violence, etc. this study used anthropometric measurements of eligible under-five children.

Measures

According to WHO (2009), three indices in the form of a z-score are used to measure child malnutrition. These three indices are stunting, wasting, and underweight. These indices are further coded in binary form, "1" if the child is stunting, wasting, or underweight otherwise "0". While water and sanitation variables are further categorized in two categories (improved, unimproved). Upgraded water sources and developed sanitation services are kept in the improved category, and in the same way, undeveloped water resources and unimproved sanitation services are considered in the unimproved category.

Table 1. Recoding Sanitation Variables

Improved	Unimproved
Flush toilet	Pit toilet without a slab or open toilet
Flush/dispense flush to a piped sewerage system	Any facility shared with other households
	Mobile toilet
Flush to the sewage-disposal tank	Hanging latrine
Flush to a pit toilet	Flush to somewhere else
Pit toilet latrine	Flush, I don't know where
Ventilated improved pit latrine (VIP)	No service
Pit toilet with slab	No service/bush/field/stream/river
Compositing toilet	Other unimproved

Source: Authors using PDHS data

Table 2. Recoding Drinking Water Variables

Improved	Un-Improved
Tap water	Piped to neighbor
Household tap water	Uncovered dug well
Tap water into a plot	Protected well
Public pipe water	Polluted spring
water from electric tube well	Tanker truck
Borehole	Open water
Protected well of water	River/stream/pond/lake/dam/canals
Shielded spring and rainwater	water cart having a small reservoir
Filtration plant	Bottled/sachet water
	Other polluted

Source: Authors using Pakistan DHS data

Analysis

To measure the association of water and sanitation with child malnutrition, the study applied a chi-square test using STATA statistical software.

Results and Discussion

The results of the Pakistan Demographic and Health Survey shows that stunting prevalence is 38%, under-weight 23%, and wasting 8% among under-five children in Pakistan.

The results in table 3 of chi-square show that underweight and stunting are highly significant association with water and sanitation in Pakistan, while wasting has an insignificant relationship with water and sanitation.

Table 3. Association between stunting, wasting, underweight with water and sanitation

Indicators	Underweight		Stunting		Wasting	
	Chi-square Value	P-value	Chi-square Value	P-value	Chi-Square Value	P-value
Water	3.768	0.052**	5.103	0.024**	0.145	0.703
Sanitation	7.743	0.005***	21.61	0.000***	0.061	0.805

*Significance level: ***p value < 0.01, **p value < 0.05, *p value < 0.1, p values are based on χ^2 -test*
Source: Author's estimations

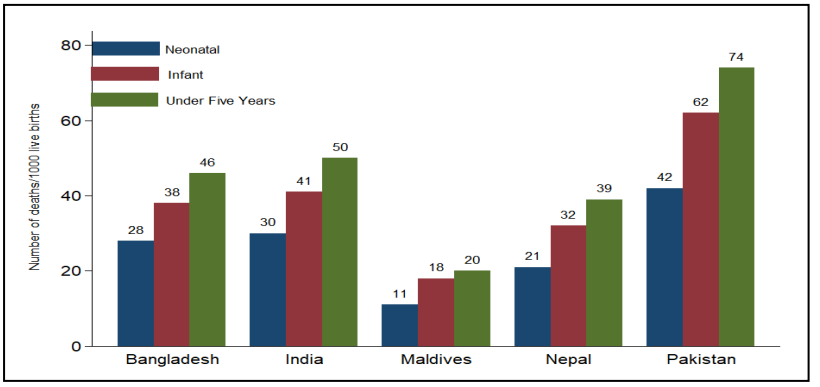
The Situation of Child Health Indicators, Water, and Sanitation

The malnutrition status of children is measured through HAZ, WAZ, and WHZ. The mortalities are in children occur due to the worse situation of these indicators. The causes of making these indicators worse are mostly socio-economic conditions, more spatially water and sanitation conditions. Below in tables and graphs is the overall discussion on children's health indicators, mortalities, and water and sanitation in Pakistan with comparison to SAARC countries in the region.

Table 4. Pakistan's Situation in Child Mortality Rates; Comparison within Region (SAARC)

Country	Neonatal deaths per 1000 live births	Infant deaths per 1000 live births	Under-five deaths per1000 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

Source: Author's estimation (SAARC DHS data)

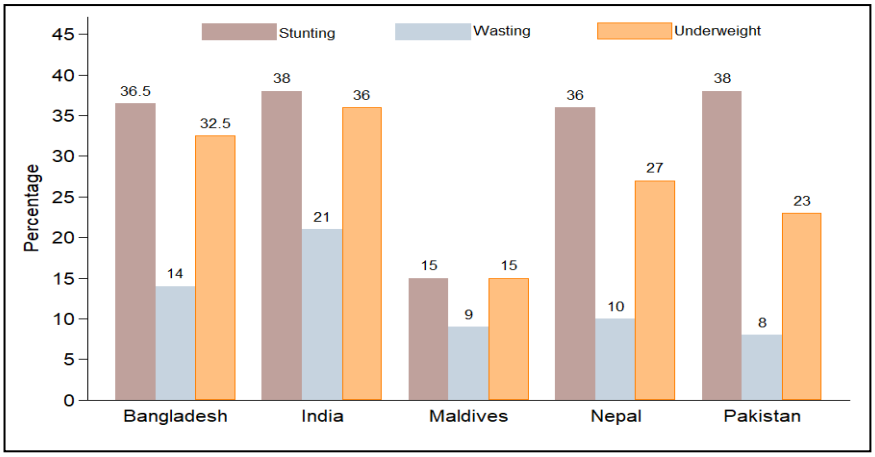
Graph 1 shows the child mortality rates for SAAC countries are given in Table 4. The graph depicts the highest neonatal, infant, and under-five mortalities in Pakistan and the lowest in the Maldives.

Table 5. Pakistan's Situation in Malnutrition Prevalence; Comparison with Region (SAARC)

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%

Country	Stunting	Wasting	Underweight
Pakistan	**38%**	8%	23%

Source: DHS SAARC



Graph 2: Child Malnutrition Prevalence

Source: Author's estimation (SAARC DHS data)

Graph 2 sketches the situation of child anthropometric rates for SAAC countries given in Table 5. The graph explains that the stunting rates are high in Pakistan, Bangladesh, India, and Nepal, while the Maldives lie at the bottom among countries. Wasting rates are slightly higher in India that are 21%, than in other countries, while Pakistan remains at the bottom in wasting among SAARC. The rates of underweight are higher in Bangladesh and India, while the Maldives stood at the bottom in underweight.

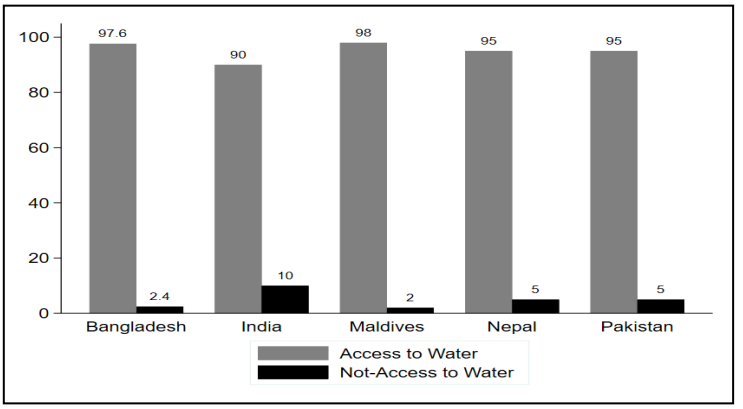
Table 6. Pakistan's Situation in Water and Sanitation; Comparison within Region (SAARC)

Country	Access to drinking water	Not-Access to drinking water	Access to Toilet facility	Not-Access to Toilet 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 6 explains the water situation in SAAC. The graph shows that almost all SAARC countries except India have 95% to above access to water while India has 90% access to water access. All SAARC countries have less than 6% not-access to

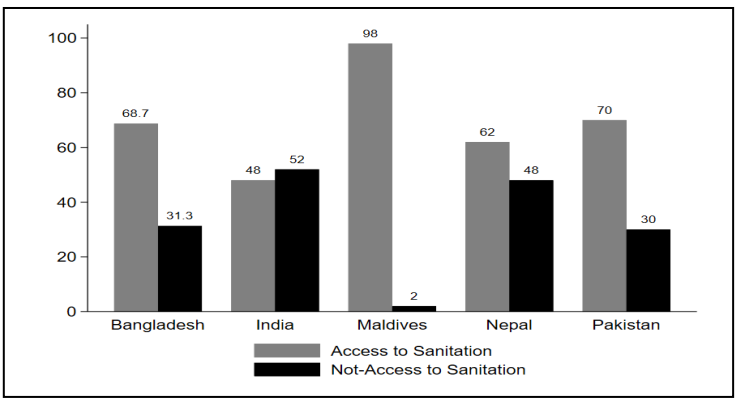
water, while India has 10% not-access to water. While this percentage shows only access to the water source, not the water quality.



Graph 3: Access to Water

Source: Author's estimation (SAARC DHS data)

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



Graph 4: Access to Sanitation Facility

Source: Author's estimation (SAARC DHS data)

Graph 4 explains the toilet facility situation in SAAC given in Table 6. According to the graph, Maldives have ideal access to a toilet facility. In this context, Pakistan and Bangladesh are slightly better. While others have a worse situation in access to toilet facility which is less than the half. While in case of not-access to the toilet facility, Maldives lies at the top while India is on the bottom.

Achievements in Sustainable Development Goals

On the eve of Millennium Development Goals in 2015, All 193 Member countries and states of the UN 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 global prosperity and peace.

Targets

SDG (Goal-1) states the end of extreme poverty, measured by the number 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 mortality rate (MMR) < 70% /1000 lives globally by 2030, while part-b of goal-3 states that by 2030, reduce the avoidable mortality ratio of infants to as low as 12 out of 1000 live births and decrease child mortality (children of age less than five years) to 25 out of 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 in (Goal 3) is not up to the mark, but it is progressing in a 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 wellbeing (Goal 3). On the other hand, progress in accessing clean water and sanitation is not in the 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 population of South Asia had availability of clean water and sanitation, which implies that almost 960 million people had no access to sanitation and 610 million people were practising open defecation (UNESCAP-2018).

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

Table 7. Pakistan Situation in Achievements of SGDs; Comparison with Region (SAARC)

Sustainable Development Goals	Afghanistan	Bangladesh	India	Maldives	Nepal	Pakistan
SDG Goal-1: Reduce poverty at least by 50% of people of all ages living in a poverty						
Population living in poverty at $1.25 per day in 2005 Purchasing Par Parity (% of the population)		43.3	23.6	1.5	23.7	12.7
Proportion 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 mortality rate measured as deaths /100,000 live births	396	176	174	68	258	178
Newborn mortality rate measured as deaths / 1,000 live births	22	28	30	11	21	42

Sustainable Development Goals	Afghanistan	Bangladesh	India	Maldives	Nepal	Pakistan
Child mortality rate measured as deaths /1,000 live births	45	38	41	18	32	62
Child (of the age less than five years) mortality rate measured as deaths /1,000 live births	55	46	50	20	39	74
SDG Goal-6: Achieve access to properly clean water and sanitation for all and eradicate defecation in an open place						
Access to improved water sources (% of population)	65	97	90	98	95	95
Access to improved sanitation (% of the population)	25	68.7	48	98	62	70

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

Improved Water and Sanitation and Child Health

Improved sanitation and water facility are highly correlated with good health. In vast literature, the water, sanitation, and health nexus has been documented (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 improved water and sanitation facilities result in decreasing child mortality ratio. Moreover, the studies on the region of South Asia and Sub-Sahara Africa also elucidate the similar association between child health and improved water and sanitation facility. Clean water for drinking and good sanitation facility directly or indirectly results in lowering mortality, morbidity, and malnutrition among children of age under five years (Anand & Roy, 2016).

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

A study by WHO calculated that 34% of diseases burden among children is associated with poor environmental conditions (Prüss-Üstün & Corvalán 2007). Polluted water, improper sanitation facilities, not washing hands, and poor hygiene are the primary factors defining poor environmental conditions in determining the health of society. Drinking water and sanitation facilities are among the few environmental risk factors that can be altered using proper technology and an adequate amount of funding (Rehfuess et al, 2009). Current studies estimated that almost one and a half million children decease every year due to contaminated water, improper hygiene, and insufficient sanitation facilities (UNICEF 2010). Unavailability of clean drinking water and improper sanitation is the major factor contributing

to diarrhea and related diseases in children (Gamper-Rabindran et al, 2007). Diarrhoea-related diseases are responsible for almost 19% of global child mortality (Boschi-Pinto et al, 2008). The death rate in children is found to be significantly reduced after providing piped water and improving sanitation (DaVanzo 1988; Gamper-Rabindran et al, 2007). Many other studies also concluded that improved water and sanitation significantly determine a reduction in mortality compared to other social, economic, and health indicators (Shi, 2000).

Less research has been done specifically on water and sanitation, mother and child malnutrition nexus. Evidence does exist that establishes a link between unclean water and improper sanitation and infectious diseases (Esrey et al, 1985). Studies also show a strong causal relationship between these infectious diseases and increased malnutrition (Bartlett, 2003). Esrey (1996) suggested that child nutritional status could be improved by providing access to clean water at a level that is optimal in combination with adequate sanitation. Wibowo & Tisdell (1993) also found that improved sanitation had a stronger effect on morbidity than clean water in a study of communities in Central Java, Indonesia.

Cost-benefit of Improving Water and Sanitation for Health

Hutton (2007) conducted a study to analyze the costs and benefits of interventions made for improving water and sanitation. This study found that in developing countries, a US$1 investment in water and sanitation returns up to US$46. The major factor was time-saving which contributes almost 80% of the economic benefits resulting from improved water and sanitation services.

Cost-benefit analyses of interventions made in water and sanitation facilities reveal that such investments result in a handsome number of returns. Hutton & Haller (2004) conducted a study for the WHO and found that the returns of investment amount 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. It also included there are direct as well as indirect benefits of decreased morbidity and mortality and reduction in the incidence of diarrheal diseases. The direct benefits include the financial savings that came from a reduction in health care expenditures, and indirect benefits are reaped as there would be fewer absentees from work or school due to sickness. Their study estimates that provision of water and sanitation services to each person in the world who is currently without would cost US$22.6 billion, or US$10.7 per person in the developing world per year. This intervention would yield, they estimate, US$262.8 billion in economic benefits. The research was conducted by considering diarrhoea and related diseases only to study the impact of water and sanitation on health. By considering the disease associated with malnourishment could also help in estimating the total health benefits of interventions in the water sanitation system (Hutton & Haller 2004).

Conclusion

The results of chi-square show that underweight and stunting are significantly associated with water and sanitation in Pakistan, while wasting has an insignificant relationship with water and sanitation. Pakistan still has not achieved SGD goal 3 and goal 6 targets and for behind from other SAARC countries in the region. The effort to

undertake this study was to identify the effective public policy solutions for combating child and maternal mortalities and morbidities, which are 1) investment in nutrition and 2) investment in social development such as water and sanitation programs. Investment in nutrition is fundamental for children's growth. While investment in water and sanitation programs means saving the health cost in terms of water and sanitation borne diseases as well as water and sanitation wise societal discrimination. There is a need to increase finance and prioritize the development budget in water and sanitation programs effectively to uplift the living standard of the population.

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