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Revisiting the Impact of Clean Water and Improved Sanitation on Child Mortality: Implications for Sustainable Development Goals

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Abstract: Using Demographic and Health Surveys, this study examined the impact of clean water and improved sanitation on child morality in five South Asian countries. South Asia is the region with the second most public health crises due to the utilization of unsafe water and sanitation, only second to Sub-Saharan Africa. Logistic regression models suggest that access to improved water and sanitation is significantly associated with a lower probability of child mortality, especially during the post-neonatal period. Although increased parental educational attainment and household wealth reduce the risk of child mortality, the combined household wealth and place of residence variable revealed the higher risk of mortality for children living in urban areas than rural areas. These findings emphasize the importance of the access to clean water and improved sanitation to reduce the number of children dying due to water-related diseases. Additionally, they suggest the need for additional research on the contribution of clean water and improved sanitation to achieve the global goals of child mortality reduction, especially the United Nations Sustainable Development Goals.

Keywords: water and sanitation; child mortality; Sustainable Development Goals; South Asia

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1. Introduction

In 2020, about one in four people worldwide lacked safe drinking water, and almost one in two lacked improved sanitation [1]. International organizations have recognized the potential to prevent and/or minimize diseases caused by unsafe drinking water and poor sanitation. Subsequently, these organizations have provided greater access to improved water and sanitation facilities. For example, the United Nations (UN) set two agendas for global development over a fifteen-year timeframe—the Millennium Development Goals 2000–2015 (MDGs) and the Sustainable Development Goals 2015–2030 (SDGs). A decade earlier, in 1990, a joint monitoring program between the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) for Water Supply and Hygiene (JMP) was established to report on and estimate the progress of safe drinking water, sanitation, and hygiene (WASH). Due to international and national investment in improving water quality and providing safely managed sanitation facilities, 84 countries have now achieved more than 99% access to basic safe drinking water services, and 62 have now achieved more than 99% access to basic sanitation services [1].

The SDGs, along with the above efforts, have set the following targets [2]:

- Goal 6 (SDG.6)—Clean Water and Sanitation;
- By 2030, universal and equitable access to safe and affordable drinking water for all;
- By 2030, access to adequate and equitable sanitation and hygiene for all and the end of open defecation, with special attention to the needs of women, girls, and the vulnerable.

However, at the current rate of improved access to safe water and sanitation, the goal of SDG.6 [1] might not be achieved by 2030 [3]. Scholars studying the quality of

water and sanitation and how they affect public health have focused on less developed countries and regions, of which Sub-Saharan Africa and South Asia are two key areas. In this study, five South Asian countries with low-to-middle per capita incomes [4] were considered—Afghanistan, Bangladesh, Nepal, Pakistan, and the Maldives. Recorded as the second worst region for unimproved water and sanitation services (Sub-Saharan Africa is first), South Asian countries have struggled to improve water and sanitation, partly due to their vulnerability to natural and man-made disasters, despite significant progress in recent years [5]. Four of the five countries categorized as South Asia's poorest are Afghanistan, Bangladesh, Nepal, and Pakistan, which, despite some progress in improving the quality of water and sanitation, still face crises with maintenance and further investment. Although access to these services has improved for the Maldives, water degradation due to high salinity and polluted water has risen to alarming levels. For the water sector in the Maldives, the risk is even greater due to the geographical vulnerability to climate-related disasters and hazards such as drought, flooding, heavy precipitation, and a rise in sea level. Additionally, the urban dwellers in many South Asian countries have limited or no access to safely managed sanitation and adequate drinking water, which is reported to be almost 40% of the urban population living in slums. Overall, for our five selected countries, the range for limited or no access to safe drinking water and improved sanitation is 40% to over 70% [6,7].

Limited or no access to clean water and sanitation has important health implications, particularly for children. For example, water- and sanitation-related diarrheal diseases remain a "leading killer", especially for children under 5 years old. Despite the availability of basic treatment, one in nine children under five dies due to diarrhea, which amounts to more than one thousand global child deaths every day [8,9]. As the Centers for Disease Control and Prevention (CDC) have reported, about 88% of diarrheal diseases are attributable to unsafe water sources and inadequate sanitation services [8]. Given the significant burden of child mortality rates from water-related diseases, reductions in mortality rates for children under 5 by improving the quality of water and sanitation services are believed to be potentially large. This paper presents the association between the quality of water and sanitation services and child mortality rates in five South Asian nations that have among the lowest rates of quality water and sanitation—Afghanistan, Bangladesh, Maldives, Nepal, and Pakistan [1]. The study aimed to raise awareness on the impact of water and sanitation on young children—a group in particular need of protection from unimproved water- and sanitation-related diseases.

The Effort of Scholars to Emphasize the Importance of Using Safe Water and Sanitation to Reduce Mortality

The impact of water and sanitation on mortality has been studied both indirectly as a proxy factor and directly as the main cause of mortality. First, the serious impact of unimproved water and sanitation on children has been recognized and discussed in the public health literature in close relation to water-borne diseases [10–14]. Specifically, the literature has treated water, sanitation, and hygiene as risk factors for diarrhea and malaria. The quality of water and sanitation has generally been a fundamental pre-condition that impacts not only child mortality, but also public health. Indeed, the use of unimproved water and sanitation sources tends to undermine public health programs and constrains attempts to decrease mortality rates [15–17].

Second, the literature has closely examined the direct association between mortality rates and the use of unimproved water and sanitation sources. The likelihood of deaths among households with unimproved water sources and sanitation services is generally greater than those with improved water and sanitation systems [18–20]. Children are particularly vulnerable, with mortality risks relating to unsafe water and sanitation among post-neonatal and 12–59-month-olds being significantly higher than for neonates [19,21]. On the other hand, the literature seldom makes clear the risk differences between age

groups, because the focus often shifts to other factors such as socioeconomic status, health expenditure, and toilet facility types [22,23].

Aware of the mixed outcomes and arguments from the research as well as the constant need to warn about the harms of unimproved water and sanitation, this study revisits the association between water and sanitation quality and child mortality. Using select South Asian countries, this study had four main aims: to examine the effects of water and sanitation on the risk of mortality for:

- Children under 5-year-old, overall;
- Neonates (children from birth to one month old);
- Post-neonates (children 2–11 months old);
- Children 12–59 months old.

2. Materials and Methods

2.1. Data

This study used data from the Demographic and Health Surveys (DHS), a nationally representative household survey that, since 1985, has focused on the population, health, and nutrition of more than seventy low- to middle-income countries. The data obtained for this study were from the Standard DHS Surveys, which are generally conducted every 5 years. Our data for this study came from the most recent surveys from Afghanistan, Bangladesh, Nepal, Pakistan, and the Maldives, ranging from 2015 to 2018.

2.2. Outcome Variables

In this study, four main outcome variables were tested: the probability of at least one child in a household dying, the probability of neonatal mortality, the probability of post-neonatal mortality, and the probability of mortality occurring between 12 and 59 months old (yes = 1, no = 0). The first variable, which was the key outcome of the first model, measuring the probability of at least one child dying, was calculated by subtracting the number of living children from the total number of children ever born in the household. The outcome variables of neonatal, post-neonatal, and children aged 12–59 months were calculated from the reported time when the child died (counting in months) and recoded in binary rules.

2.3. Explanatory Variables

The primary independent variable was the coverage of improved sources of drinking water and the coverage of the improved sanitation facility. To categorize the quality of water source and sanitation facilities, we applied the standard categorization of water and sanitation developed by the WHO and UNICEF for the JMP program [24]. Specifically, the water source categories were piped (=2), improved (=1), and unimproved (=0), and for sanitation facilities they were unimproved (=0) and improved (=1), as shown in Table 1.

Table 1. Water and sanitation facility categories (JMP ladder).

	Source of Drinking Water	Sanitation Facility
Piped (=2)	Piped into dwelling Piped to yard/plot Public tap/standpipe Piped to neighbor	
Improved (=1)	Tube well or borehole Protected well Protected spring Rainwater Tanker truck Cart with small tank Bottled water	Flush—to piped sewer system Flush—to septic tank Flush—to pit latrine Flush—do not know where Pit latrine—ventilated improved pit (VIP) Pit latrine—with slab Composting toilet

Table 1. *Cont.*

	Source of Drinking Water	Sanitation Facility
Unimproved (=0)	Unprotected well Unprotected spring Surface water (river/dam/lake/pond/ stream/canal/irrigation/channel) Others	Flush—to somewhere else Pit latrine—without slab/open pit Bucket toilet Hanging toilet/latrine Others Open defecation (no facility/bush/field)

2.4. Control Variables

Based on previous studies examining the association between water and sanitation and child mortality, the model's control variables were parental education attainment level, mother's marital status, household size, place of residence combined with household wealth, and country [19,25–28].

For educational attainment, the variable was measured in years—specifically, the highest years of education. Mother's educational years and father's educational years were measured separately. The variable for marital status was measured in binary rules (married = 1, unmarried = 0). Household size was measured by the number of people living in the same household. A household wealth index in the DHS Surveys was constructed using principal component analysis (PCA) [29]. Weights were assigned to different facilities and assets of the respondents in the household. In the DHS dataset, the household wealth index was categorized into five quintiles: poorest, poorer, middle, richer, and richest. Given a large number of urban dwellers, especially urban slums experiencing limited and unsafe water and sanitation systems in the South Asian region, the wealth percentile and place of residence (rural area versus urban area) were combined to capture the nuance of how household conditions affect water and sanitation usage. Specifically, two variables were combined into one categorical variable indicating six different living conditions, which were rural poor, rural middle, rural rich, urban poor, urban middle, and urban rich households. Although the wealth percentile was originally categorized into five quintiles, which would result in creating ten categories for the combined variable, we believe that one with six categories is sufficient to reveal a more nuanced story of the impact of household wealth in relation to the place of residence on child mortality.

2.5. Statistical Analysis Strategies

The statistical analysis started with the tabulation of the control variables to obtain the socioeconomic and demographic characteristics of the data. To examine the association between water and sanitation and child mortality, the analysis process was divided into two main stages, with multiple logistic regression models used for both stages. For the first stage, our analysis focused on general household child mortality as the primary outcome variable. The explanatory variables were added sequentially to the model controlling for socioeconomic and demographic characteristics. Specifically, the drinking water source variable was independently estimated with all the control variables. The explanatory variable of sanitation facilities was also independently tested within the model. In the next step, both main explanatory variables were included in the regression model with the control variables.

For the second stage, three regression models were estimated for the probability of neonatal mortality, post-neonatal mortality, and 12–59-month mortality. These models were examined in the same sequence as the regression model in the first stage when the explanatory variables were sequentially added with the completed set of control variables. The odds ratios and 95% confidence intervals obtained from these models were used to further interpret and discuss the impact of water quality and sanitation on child mortality generally, as well as for each age group specifically.

3. Results

3.1. Descriptive Data

The total number of observations in the sample was 102,584 households, with the percentage of missing data approximately accounting for 3.5%. Table 2 shows the sample characteristics of testing variables including the outcome, explanatory, and control variables. Among the sample observations, 18.03% of households had at least one child who had died by the day of survey collection. When taking a more detailed look at each age group for child mortality, the highest percentage of deaths (8.9%) occurred during the neonatal period, followed by children in the post-neonatal period, and children 1–4 years old. Despite the large coverage of improved drinking water sources, nearly 20% of households in the five countries used an unimproved water source. However, the situation was worse for sanitation; only slightly more than half of the households had access to improved facilities, leaving the percentage of households with unimproved sanitation facilities at nearly 48%. Among the five countries, 36.16% of urban dwellers were categorized as having a low income, which might affect the use of improved water and sanitation. By default, Afghanistan was chosen as the reference category because it accounted for the largest number of observations in the sample.

Table 2. Descriptive data.

	Category (Min, Max)	**Full Sample (N = 102,854)**	
		%	(SD)
Child dying in a household	(0, 1)	18.03	(0.38)
Neonatal death	(0, 1)	8.90	(0.28)
Post-neonatal death	(0, 1)	7.32	(0.26)
12–59-month-old death	(0, 1)	4.14	(0.20)
Drinking water source	Unimproved (ref. category)	19.82	(0.56)
	Improved	67.75	(0.56)
	Piped	12.43	(0.56)
Improved sanitation facilities	(0, 1)	52.26	(0.50)
Control Variables			
Mother's educational years [1]	(0, 18)	3.34	(4.53)
Father's educational years [1]	(0, 18)	5.06	(5.03)
Married	(0, 1)	0.93	(0.26)
Combined residence and wealth	Rural poor (ref. category)	5.93	(1.29)
	Rural middle	4.47	(1.29)
	Rural rich	22.70	(1.29)
	Urban poor	36.16	(1.29)
	Urban middle	16.68	(1.29)
	Urban rich	14.07	(1.29)
Household size [1]	(1, 48)	8.09	(4.60)
Country	Afghanistan (ref. category)	51.38	(1.48)
	Bangladesh	17.55	(1.48)
	Maldives	6.71	(1.48)
	Nepal	11.22	(1.48)
	Pakistan	13.14	(1.48)

Abbreviation: SD = standard deviation. [1] Mean reported.

3.2. Reduction in Child Mortality in Household

Table 3 (Model 1) shows the estimated results for the probability of a child of any age dying in a household with different types of water and sanitation. Specifically, for households using improved drinking water, such as a protected well, piped, and bottled

water, the probability of one child dying was reduced by 18.1% (CI: 0.78–0.85), after statistically adjusting for the effects of parental education, marital status, household wealth, place of residence, and household size. The reduction in the odds of dying was surprisingly smaller for households with piped drinking water, because it reduced the odds of children dying only by 9.3% (CI: 0.85–0.97). Additionally, the effect of improved sanitation facilities was not as significant as the effect of safe drinking water. Households with improved sanitation facilities were associated with a 5.4% (CI: 0.91–0.99) reduction in the probability of at least one child dying in the household as compared with households with unimproved sanitation facilities. Model 1 also presents a statistically significant effect of parental educational attainment and combined wealth and residence on child mortality probabilities. Odds ratios reported for parental educational attainment were statistically significant, revealing the considerable reduction in child mortality as the educational level increased. Specifically, the odds of children dying reduced by 10.6% (CI: 0.89–0.9) for each one-year increase in the mother's education, whereas the odds associated with the father's education were 3% (CI: 0.96–0.97). For the effect of combined household wealth and place of residence, compared with rural poor households, the improvement in household wealth in rural areas significantly reduced the probability of a child dying in a household. Particularly, rich households were associated with a 24.3% (CI: 0.7–0.82) reduction in the probability of at least one child dying. Compared with the figure for rich households in urban areas, which was 21.2% (CI: 0.73–0.85), this statistic reveals, surprisingly, a higher risk of mortality among children living in urban areas than those living in rural areas.

Table 3. Regression results of separately modeled child mortality.

	Model 1. Overall Mortality	**Model 2. Neonatal**	**Model 3. Post-Neonatal**	**Model 4. 12–59 Months Old**
Drinking water				
Improved water	0.819 ***	0.862 ***	0.759 ***	0.957
Piped	0.907 **	0.884 **	0.891 *	0.944
Toilet Facilities	0.946 **	0.905 ***	1.015	0.926
Control Variables				
Mother's educational years	0.894 ***	0.913 ***	0.898 ***	0.857 ***
Father's educational years	0.97 ***	0.98 ***	0.968 ***	0.960 ***
Married	0.822 ***	1.125	0.996	0.666 ***
Combined residence and wealth				
Rural middle	0.909	0.977	0.82 *	0.934
Rural rich	0.758 ***	0.825 ***	0.713 ***	0.749 ***
Urban poor	0.948	0.977	0.936	1.03
Urban middle	0.839 ***	0.936	0.809 ***	0.837 *
Urban rich	0.788 ***	0.843 **	0.811 ***	0.696 ***
Household size	0.993 ***	0.993 **	0.993 *	0.988 ***
Country				
Bangladesh	1.207 ***	1.483 ***	0.612 ***	0.833 **
Maldives	0.609 ***	0.68 ***	0.336 ***	0.546 ***
Nepal	0.984	1.159 **	0.611 ***	0.809 **
Pakistan	1.195 ***	1.474 ***	0.809 ***	0.777 ***
Pseudo-R^2	0.048	0.0268	0.0533	0.0543
Log likelihood	−47,432.449	−31,013.988	−26,531.829	−17,376.07
LR Chi^2	4796.64	1708.06	2986.27	1995.12
p	<0.001	<0.001	<0.001	<0.001

Note. Results are presented as odds ratios. Sample (N = 102,854). Reference categories: unimproved water source, unimproved sanitation facilities, unmarried, rural poor, Afghanistan. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

3.3. The Dual Impact of Water and Sanitation on the Mortality of Each Age Group

Having estimated an empirical association between water and sanitation facilities and child mortality in general, here we provide an in-depth estimation of the mortality probabilities for each under-5-year-old age group including the neonatal (birth to 1 month), post-neonatal (2–11 months), and 12–59-month periods.

3.3.1. The Effect of Water and Sanitation on Children during the Neonatal Period

Table 3 (Model 2) shows that the effect of water and sanitation on children during the neonatal period is statistically significant. During this sensitive time, when children's vulnerability is usually at its highest, the improved drinking water source contributed to a 13.8% (CI: 0.82–0.91) reduction in the odds of a neonatal child dying in a household compared with households using an unimproved drinking water source. The same pattern was reported for households using improved sanitation facilities. Compared with households using unimproved sanitation facilities such as bucket toilets, hanging latrines, and open defecation, households with access to improved sanitation facilities decreased the odds of children dying by 9.5% (CI: 0.86–0.96).

3.3.2. The Effect of Water and Sanitation on Children during the Post-Neonatal Period

For children in the post-neonatal period, the quality of the water source also had a significant effect. A piped water source was reported to decrease the odds of a child dying by 11% (CI: 0.72–0.80), after adjusting for the effects of parental educational attainment, marital status, household wealth, place of residence, and household size. Access to improved drinking water sources contributed to a reduction of 24% (CI: 0.81–0.98) in the probability of a post-neonatal child dying in a household compared with households with unimproved drinking water.

3.3.3. The Effect of Water and Sanitation on Children Aged 12–59 Months

The nested model examined the association solely between the compounded effects of water and sanitation on children aged from 12 to 59 months without controlling for other socioeconomic factors (as shown in Appendix A). As the results show, access to an improved water source and sanitation facilities was significantly associated with a reduced risk of a child dying in a household. Specifically, for households with an improved water source, the probability of child mortality was 26.7% lower than for households with unimproved drinking water. With the installation of a piped water system, the reduction was even greater. Children aged from 12 to 59 months who live in households with piped drinking water were 40.5% less likely to be at risk of water-related deaths than children in households with an unimproved water source. For sanitation facilities, the improvement contributed to a 49% reduction in the mortality risk among children in households with improved sanitation facilities as compared with children in households with unimproved sanitation facilities. During the 12–59-month period, the utilization of improved water and sanitation was also reported to contribute to the reduction in the probability of a child dying (Table 3), after statistically controlling for the effects of parental educational attainment, marital status, combined household wealth, place of residence, and household size. However, the effects of clean water and safe sanitation on child mortality were not statistically significant, whereas the effects of other control variables on the reduction in child mortality were more significant (see Model 4: Table 3).

For the three examined age groups, the effects of water source and sanitation facilities were reported to reduce the probability of a child dying in a household. Comparing between these groups, the effects of water and sanitation were greater on children during the post-neonatal period and the 12–59-month period (when not controlling other socioeconomic variables) than for children during the neonatal period. Additionally, the impact of parental educational attainment, as well as the impact of combined household wealth and place of residence on child mortality probabilities, were consistently significant. For parental educational attainment, an increase in the mother's education years contributed more

to the reduction in child mortality probabilities than the gain in the father's education years. However, the educational attainment of both mother and father compounded to significantly reduce childhood mortality. The combined effect of place of residence and household wealth had a significant impact on child mortality. Interestingly, the results show that, despite living in rich households, urban residents under 5 years old were more likely to have a higher risk of dying than their peers in rich rural areas. This pattern was consistent throughout the four models tested in Table 3.

4. Discussion

In this study, we examined the direct impact of water and sanitation facilities on the probability of a child dying in a household, with a focus on specified age groups of children under 5 years old. The results show that the gain from improved drinking water sources and sanitation facilities was significant for different age groups of children under 5 [18,22,30–32]. For neonatal children, the reduction in the odds of mortality reached 13.8%; for post-neonatal children, it was even higher: 24%. This result supports previous findings which have stressed the greater impact of water and sanitation on post-neonatal child mortality than on neonatal children [19]. As explained in the literature, greater exposure to diarrhea-related pathogens among post-neonatal children is associated with less protective effects from breastfeeding, an increased use of water for feeding and food preparation, and learning to crawl [18,19,33,34]. However, for children aged 12–59 months old, the quality of water and sanitation facilities had no significant effect on mortality probability, after controlling for basic demographic characteristics. Surprisingly, this pattern differs from past findings that focused on child mortality rates as the primary outcome variables in association with the quality of water sources and sanitation facilities [19,21,35]. This result can possibly be explained due to stronger immune systems and widespread vaccination and public health programs for children aged 12–59 months compared with neonatal and post-neonatal children [19,36]. The model tested in this study also included demographic features as a set of control variables, which might have a stronger and more direct association with the probability of a child dying in a household, such as parental educational attainment and combined household wealth and place of residence.

Aligning the results with existing UN Sustainable Development Goals, this study's findings highlight that household living conditions presented in SDG.6 (clean water and sanitation) and SDG.11 (sustainable cities and communities) are related to reductions in the risk of a child dying. Furthermore, findings highlight the significant influence of educational attainment presented in SDG.4 on ensuring a quality education for all in relation to reducing child mortality. Specifically, children whose parents have higher education levels have a reduced risk of mortality than those whose parents completed lower levels of education. This finding implies that improved water and sanitation for families is likely associated with an increase in parental education level [26,37]. Target 4.7 of SDG.4 has a universal aim that "all learners acquire the knowledge and skills needed to promote sustainable development" through education and life skill training, in which sustainable lifestyles are a constitutive factor [2]. Thus, access to safe water sources and sanitation facilities plays a pivotal role in improving and maintaining sustainable lifestyles and minimizing the mortality risk from water-borne diseases. Additionally, according to the newest report by the UN about SDGs, gender parity in education has not progressed in most countries, and the gap between female and male educational attainment has widened [38]. Gender inequalities in education must fall to achieve more equitable educational opportunities for women and girls, especially mothers. The education of women and girls, as this study shows, is essential for improving water and sanitation quality as well as for reducing child mortality [22,26,27,39,40]. This is not to disregard the importance of fathers' educational attainment or its impact on reducing child mortality. Indeed, the result reveals the significant contribution of fathers' educational attainment in reducing child mortality, which is consistent with past findings [19,22,26,37]. Therefore, investment in education

on clean water, sanitation, health, and well-being should be explicitly highlighted in the SDG framework.

Another implication of this study is to emphasize the necessity of improving urban living conditions, particularly concerning the quality of water and sanitation in South Asia. Target 11.1 of SDG.11 (sustainable cities and communities) aims for a universal future which ensures "access for all to adequate, safe and affordable housing and basic services and upgrade slums" by 2030 [2]. Slum-dwellers are most prevalent in the South and Central Asia Region, accounting for roughly 50% of slum residents globally [38]. Although overall better living quality, including the quality of water and sanitation, in urban areas is likely to be associated with a reduction in child mortality [28,41,42], positive urbanization is not what South Asian urban residents currently experience. The consequences of rapid urbanization have left a large number of residents living in shanty houses and poor home environs, placing them at risk of water-borne diseases [43,44]. More specifically, because household wealth also plays such a pivotal role in creating decent living conditions, the findings reveal that the impacts of using unsafe water and sanitation in rural and urban areas are not significantly different. The decreased and insignificant disparity of child mortality between urban and rural areas was revealed [27,40]; thus, the underlying reason for this exposed in this study highlights the negative reality of poor water and sanitation quality in South Asian urban households, especially the poor, who are less likely to be able to afford safe water and sanitation systems. Consequently, urgent action is needed to reduce the urban population living in slums and inadequate housing, with a focus on improving water and sanitation systems. Governments should develop the capital market, boosting the national economy to ensure decent income which will considerably contribute to household wealth and improve living conditions for poor to middle urban dwellers [28]. This, we believe, should be indicated more explicitly in the SDG.6 and SDG.11 targets.

The UN 2015–2030 Sustainable Development Goals aim for "universal and equitable access to safe drinking water for all" and for "access to adequate and equitable sanitation and hygiene for all and [an] end [to] open defecation." For children's health and well-being, the agenda aims to reduce preventable deaths to approximately 12 neonatal deaths per 1000 live births and 25 per 1000 live births for children under five years old [2]. However, some scholars doubt whether these goals can be met in the next 8 years, specifically, the reduction in child mortality rates [3,38]. However, this study reveals the significant and remarkable contribution improved water sources and sanitation facilities can make to reduce infant mortality. By clarifying the mixed effects of water and sanitation from past findings, this study reminds scholars—and stresses the importance—of comprehensively studying improved water and sanitation from an interdisciplinary perspective. Additionally, it reminds policymakers to improve and maintain the quality of water source and sanitation facilities, as promised in the UN SDGs.

The study's limitations—such as that child mortality can have diverse causes that require careful investigation, including medical, environmental, and household conditions—can be addressed by future researchers. We recommend further studies to construct a more comprehensive conceptual model for investigating the inter-related associations between the risk of children dying, the effects of water and sanitation, and the demographic features of the selected sample.

5. Conclusions

This study revisited the direct association between the quality of drinking water and sanitation and the risk of child mortality. Using data from the DHS of five South Asian countries—Afghanistan, Bangladesh, Maldives, Nepal, and Pakistan—our analysis indicates that access to improved water and sanitation plays a significant role in reducing preventable child deaths, especially among post-neonatal children. In addition to the direct effect of water and sanitation, the risk of child mortality is affected by other demographic characteristics, chiefly, parental educational attainment, household wealth, and place of residence. Moreover, this study has affirmed the importance of easy access to improved

water and sanitation for reducing child mortality rates. The benefits extend far beyond improving child survival and well-being, likely contributing to better living environs for other age groups and communities, especially in less developed countries and regions. Although the global effort to increase the coverage of improved water and sanitation has improved countless lives, much work remains to be carried out. Addressing the need for safe water and sanitation for millions remains urgent. Prompted by the guidance proposed by the UN, UNICEF, WHO, and other affiliated organizations, governments, policymakers, social and environmental activists, and citizens can hasten the day when all children have access to clean water and safe sanitation.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Regression results for child mortality probability (12–59 months old) in association with water source and toilet facilities (without control variables).

	Nested Model		
	Odds Ratio	**Lower (95% CI)**	**Upper (95% CI)**
Drinking water			
Improved	0.733 ***	0.682	0.784
Piped	0.595 ***	0.521	0.672
Improved sanitation facilities	0.51 ***	0.480	0.550

Note. Sample (N = 109,661). *** $p < 0.001$.

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