Effect of School Water, Sanitation, and Hygiene on Health Status Among Basic Level Students' in Nepal

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ABSTRACT

BACKGROUND: Access to drinking Water, Sanitation, and Hygiene (WASH) at schools are the basic determinants of a child's right to healthy and quality education. In Nepal, most of the schools had limited WASH facilities, including separate sanitation facilities for girls. The limited WASH facilities, unsafe drinking water, poor sanitation, and hygiene practices result in irresponsible behaviors that directly impede on students' health. This study examines the association between WASH services and health status of basic level students', ranging sixth to eighth grades. In Nepal, basic level education consists up to eighth standards from grade 1.

METHODS: The study applies causal-comparative research design within 2 groups; 1 having improved WASH and another without improved WASH services at the schools in Dhanusha and Chitwan districts of Nepal. Each group consists 2 schools, so altogether 4 schools were included in this study. Total 768, equal 384 respondents were selected from each improved and without improved WASH facilities. The study was conducted in between January and March 2021 at a single-phase time. The sample size was calculated using the standard statistical formula for the infinite population. The study applied quantitative research method, including 3 sorts of analysis; univariate, bivariate, and the multivariate. The univariate was applied to analyze the frequency and percentages of the respondents. Bivariate analysis was made applying chi^2 test in order to show the association between 2 variables, whereas the multivariate logistic regression was performed through multilevel modeling to show the effects of school WASH facilities on students' health status.

RESULTS: Out of 768 students', 384 (50%) were from improved and 384 (50%) were from unimproved WASH facilities at schools. More than two third (64%) of respondents from the unimproved and higher than two fifth (41%) from the improved schools got sickness ($P<.001$). Further, three fifth (59%) of respondents aged 15 to 19 and higher than half (51%) of respondents ages of 10 to 14 years got sickness ($P<.05$). Most (57%) of the female respondents had sickness compared to males (47%), ($P<.05$). More than two-thirds (67%) of respondents from Dalit and nearly two-thirds (62%) of respondents from Brahmin/Chhetri-Terai more often found being sick in unimproved schools compared to other castes (55%), Janajati (43%), and Brahmin/Chhetri-Hill (39%) ($P<.001$). The school WASH services has significant effect (cOR = 0.388, CI; 290-0.519, $P<.001$) on students health status, even adjusting other socio-covariates (aOR = .442, CI; 0.302-0.646, $P<.001$). The female respondents were more likely to fall sick (aOR = 678, CI; 0.502-0.915, $P<.01$) compared to the male respondents keeping all other variables constant in the model.

CONCLUSION: The study recommends to extend WASH awareness program to school families, particularly to the students as there is an evident need to increase preventive as well as the therapeutic efficacy of the potential infections.

KEYWORDS: Water, Sanitation and Hygiene, health status, school children, Nepal

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Background

Every child has the right to quality education. The right includes access to drinking Water, Sanitation, and Hygiene (WASH) services while at school. Safe and adequate water supply and sanitation in schools are pre requisites for the right to basic education for school children.[1] The provision of adequate WASH services in schools has been closely linked to the achievement of Sustainable Development Goals (SDGs), and in particular Goal 6 on clean water and sanitation by 2030.[2]

Several types of research works found that unsafe drinking water, poor access to appropriate sanitation facilities, and inadequate handwashing contribute significantly to child illness and death.[3,4] Globally, 11% of child deaths were ensued due to diarrheal disease and 1.9 billion school days were missed by the students each year, which is taken as the consequence of inadequate WASH services in the schools.[5] So, improvements of WASH infrastructure and appropriate health-seeking behavior are essential for preventive and therapeutic efficacy, which eventually eliminate many diseases emerged from the WASH deficiency.

An inadequate WASH service at school invites serious problems to the students and school families as well. Consumption of contaminated water invites several adverse effects on physical and cognitive performance and bodily

functions.[6] The lack of sanitation leads to the transmission of pathogens through feces and, to a lesser extent, urine. The author further underlined that a basic understanding of these pathways by which pathogens from feces are ingested through transmission by figures, flies, fluids, fields (soil), and food.[7] Poor personal hygiene causes fungal skin infections such as ringworm and scabies and is associated with respiratory infections.[8]

The acronym WASH indicates solutions for addressing the emergence and spread of diseases, which includes all-around water use, sanitation, and hygiene.[9] Saying simply, some behaviors need to apply to prevent potential infections. For instance, treating water before drinking, washing hands with soap and running water, and appropriately disposing of human excreta have resulted in diarrheal risk reductions. These behaviors significantly can reduce the chances of getting ill and death, which occurred by inadequate WASH services.

In Nepal, 80% of government schools are equipped with water, and sanitation facilities, 15% of them lack separate toilets and Menstruation Hygiene Management (MHM) facilities for girls.[10] Schools are equipped without separate toilets and MHM facilities.[11] The handwashing facilities have not also been found constructed with running water and there is no provision of soap. 10% to 20% absenteeism occurs at school time may be, due to the lack of WASH facilities, access to the facilities and privacy in these facilities. Finally, this situation affects students' health status. In this study, health status was measured whether respondents had caught by WASH related diseases like diarrhea, cholera, shigellosis, salmonellosis, typhoid, and dysentery. The respondents were asked whether they had experienced WASH related diseases as mentioned above in the 6 months before the interview. It was because Cholera, schigellosis, diarrhea, and scimonellosis are caused by consumption of contaminated water that effects physical and cognitive performance and bodily functions.[12] Simultaneously, poor sanitation transmits of pathogens through feces and, to a lesser extent, urine which is the core source of typhoid diseases.[12] The poor personal hygiene causes dysentery; amebic and bacillary and fungal skin infections; ringworm and scabies.[8] In this context, the research intends to measure the association and effects of having improved and without improved school WASH facilities on the health status of the basic level students.

Methods

Research design

This study applied causal-comparative research design. It was conducted in between January and February, 2021 at 4 basic schools of Nepal. Out of the total 4, equal number of schools, that is, 2 schools were consisted with improved and other 2 from the unimproved school groups relating to the WASH facilities. The researcher closely consulted with the Education Development Coordination Unit (EDCU) having concerned with whether they considered improved or unimproved WASH facilities, for the selection of schools in the study area. Schools and students were randomly selected based on JMP guidelines.[13] The students were selected from all the selected 4 schools. The data were collected directly from the students in a 1 time.

Sample and sampling techniques

The sample size was calculated using the standard statistical formula presented by Yamane, 1967[14] $S = \frac{z^2 \times p \times (1-p)}{e^2}$ for the infinite population. The procedure which was used to compute the sample size is presented in appendix section (see Appendix A). Based on the given calculation, the exact sample size is 384. However, to make a more representative sample and minimize sampling errors, the study's sample size was multiplied by $2 \times 384 = 768$. Further, the sample size was intentionally made double to obtain optimum results from the more significant number of respondents. Within the total range of samples, equal 384 were selected from each improved and unimproved school WASH services. In a sense, this is a school-based study consisted grades 6, 7, and 8 in the basic level, where students were proportionally selected through stratified sampling method.

Data collection and analysis

The data were collected through the application of survey tools which included face-to-face survey with students. The research tools were reviewed by the experts and a panel of experts prior to the field work. The exports were professors, having 20+ years' experience as academic and professional researcher. Later, based on the experts' comments the unclear and obscure questions were revised and complex items were reworded. No incentives such as money or any goods were offered to the respondents agreed to be a part of this study.[15] All the collected interviews were carefully re-checked, coded, and analysis was done through the application of Statistical Package of Social Science (SPSS) version 25. The descriptive statistics and Chi-square test with considering its 95% confidence level, 1.96 z values, 5% margin of error were used to determine the significant difference between the prevalence of illness and the demographic variables. Overall, 3 sorts of statistical analysis; univariate; frequency and percentages, Bivariate; Chi-Square test, and Multivariate; binary logistic regression, all of such were used to show the effect of covariates on students' health status. All the variables used in univariate and bivariate analysis were used in the multivariate analysis to show the net effect between variables. After adjusting of all other co-variables like sex, age, ethnicity, and religion through multilevel modeling, multivariate analysis was made among the variables.

Ethical considerations

Ethical approval was obtained from the Nepal Health Research Council (NHRC), Nepal, and 85412020 PhD. Initially, written consent was obtained from the school authorities like school administration to conduct the study in the school. Researcher further took written consent from each students above 16 years old. Considering under 16 years age students, the consent of the school headteacher was obtained as he is the legal guardian, while students are at the school. The parental consent was not obtained due, since it was very complex to visit all the parents of the respondents during the study. To protect and respect the right of the respondents to self-determination to participate or withdraw from the research process, researcher used an informed consent letter with research purposes so that respondents got alternative to decide as to whether they participate in the research or not. It is a central principle in research ethics that refers to a voluntary consent to participate in a study.

Results

This section depicts the health status of the respondents by background variables. The background variables show a significant association between the socio-demographic variables of the respondents: school WASH situations ($P = <.001$), sex ($P = <.05$), caste ($P = <.001$) with health status, though, age grade, and religion of the respondents did not have. Moreover, school WASH facilities have significant effect on health status (cOR = 0.388; CI; 290-0.519, $P = <.001$), as it was remained significant (aOR = 0.442, CI; 0.302-0.646, $P = <.001$) even after enclosure of all socio-demographic covariates. In addition, sex of the respondents has significant effect (aOR = 678, CI; 0.502-0.915, $P = <.01$) on health. The findings of the study are expected to be supportive in different aspects. For instance, better planning for an awareness program in a school can be implemented to correct unhygienic practices within the school which ultimately transfer to the home and communities. Similarly, students can play a role model as a changing agent or good transmitter of health and hygiene behavior via the awareness program.

Distribution of demographic characteristics

Total 768 students participated in the study, with equal proportions in schools with improved WASH facilities and without improved. Table 1 shows that the majority (82%) were aged 10 to 14 (47%) represented from improved school WASH facilities. More were female (53%) respondents, and (28%) were from unimproved school WASH facilities. Respondents were fairly equally representing grades 6 to 8. There were higher respondents from Brahmin/Chhetri-Hill (29%) and Brahmin/Chhetri-Terai (27%) than Dalit (19%), Janajati (16%), and other castes (9%). The improved school had a quarter of Brahmin/Chhetri Hill and less (2%) of other caste respondents. The majority (20%) Brahmin/Chhetri Terai and a few (4%) Brahmin/Chhetri Hill respondents were found in unimproved school WASH facilities. The majority (82%) were Hindu, fairly equally representing the improved and unimproved school WASH facilities (Table 1). In this study, Non-Hindu respondents represent Buddhist, Christian, and Muslim religious groups.

Health status of the students by background variable

The data related to the health status (Table 2) shows that more than 2 in 3 (64%) of respondents from the unimproved schools felt sick which was the higher proportion compared to improved (41%), ($P < .001$). Nearly 3 in 5 (59%) of respondents aged 15 to 19 got ill, and slightly higher than half (51%) of respondents reported that they have had illness between 10 and 14 years ($P = .082$). More female respondents had sickness compared to males (57% vs 47%) ($P < .05$). More than half (54%) of those in grade 7 reported being ill, 53% in grade 8, and half of grade 6 ($P = .665$) reported that they had illness. More than two-thirds (67%) of Dalits and nearly two-thirds (62%) of Brahmin/Chhetri-Terai related respondents reported having been ill, which was higher proportions than other castes (55%), Janajati (43%), and Brahmin/Chhetri-Hill (39%) ($P < .001$). More than half (53%) of Hindu respondents and less than half (48%) of non-Hindu respondents reported having been sick ($P = .227$). However, the analysis shows insufficient evidence to claim the significant difference between the religion of the students and their health status.

Adjusted odds ratios (aOR) from multivariate logistic regression assessing the by students' feeling of being sick predicting the school WASH situation and other selected socio-demographic covariates

This table presents the results of the multivariate logistic regressions. The results (Table 3) show that only some covariates could predict sickness among students'. The first model considers only school WASH situation at school, which has a positive and statistically significant effect on students' health status. The result also depicts that students' who were from unimproved WASH facilities at school were more likely to feel sick (cOR = 0.388, CI; 290-0.519, $P < .001$) than those who have improved WASH facilities at school. Equally, in the second model, students' health status remained its significance even after enclosure of all socio-demographic covariates. The (aOR = 0.442, CI; 0.302-0.646, $P < .001$) was increased after inclusion of sociodemographic covariates. As shown in model 2, it can be further explained that female students were more likely getting sick (aOR = 678, CI; 0.502-0.915, $P < .01$) compared to male students keeping all other variables constant in the model.

Table 1. Background characteristics of the students.

VARIABLES	SCHOOL WASH FACILITIES				TOTAL	
	IMPROVED		UNIMPROVED		N = 768	100%
	N	%	N	%		
Age group						
10-14	360	46.9	273	35.5	633	82.4
15-19	24	3.1	111	14.5	135	17.6
Sex						
Male	190	24.7	170	22.1	360	46.9
Female	194	25.3	214	27.9	214	53.1
Grade/Class						
Grade 6	183	23.8	49	6.4	232	30.2
Grade 7	117	15.2	135	17.6	252	32.8
Grade 8	84	10.9	200	26.0	284	37.0
Caste/ethnicity						
Brahmin/Chhetri-Hill	190	24.7	34	4.4	224	29.2
Brahmin/Chhetri-Terai	54	7.0	152	19.8	206	26.8
Janajati	73	9.5	52	6.8	125	16.3
Dalit	49	6.4	95	12.4	144	18.8
Other caste	18	2.3	51	6.6	69	9.0
Religion						
Non-Hindu	73	9.5	65	8.5	138	18.0
Hindu	311	40.5	319	41.5	630	82.0
Total	384	50.0	384	50.0	768	100

Discussion

The present study has assessed the effects of WASH services; improved and unimproved at school in students' health status in Nepal. The occurrence of disease was found at 64% in the unimproved and 41% in the improved WASH facilities at schools ($P < .001$). The findings of the current study are at variance with the report of the study by Johnson et al[16] in West Africa that schools and communities always consume surface water without applying any disinfection measures but they do not get infected. The same study further revealed that Open Defecation (OD) is practiced by the majority of the schools which is caused due to the lack of latrines in the school. The findings of this study are in line with Freeman et al,[17] which concluded that the prevention, control, and eventual elimination of many Neglected Tropical Diseases (NTDs) depends on the heavily available of improved WASH in endemic countries.

This study further found that although having lower rates of sickness in the younger groups consisting of younger adolescents aged 10 to 14 years compared to the older adolescents aged 15 to 19 years; there is no statistically significant difference between age groups and prevalence of sickness. In contrast with the present findings,[17] in Combodia found higher rates of infection. Helminths and protozoa were more prevalent in the younger age group consisting of children aged 7 to 8 years old compared to the older children aged 8 to 10 years.[17] In a similar vein,[18] stated negative health outcomes as more common in children of lower grade levels. So, from the study and the insights of review, it can be concluded that the basic school children are important vectors for spreading infectious diseases in intralevel, interlevel, and communities level, particularly in developing countries like Nepal, where Government schools are extremely overcrowded.

The results of the study project that gender and sickness were found statistically significant association where the female sickness was higher (57%) compared to male (47%). In support of present findings[19] at Odisha, India determined the urogenital symptoms were more likely to have to those women used

Table 2. Background characteristics of students by illness status.

		SICK						χ^2	*P*-VALUE
		NO		YES		TOTAL			
		N	%	N	%	N	%		
School WASH situation***	Unimproved	138	35.9	246	64.1	384	100.0	41.3	.000
	Improved	227	59.1	157	40.9	384	100.0		
Age group	10-14	310	49.0	323	51.0	633	100.0	3.02	.082
	15-19	55	40.7	80	59.3	135	100.0		
Sex of students*	Male	189	52.5	171	47.5	360	100.0	6.7	.010
	Female	176	43.1	232	56.9	408	100.0		
Class/grade of students	Grade 6	116	50.0	116	50.0	232	100.0	0.82	.665
	Grade 7	117	46.4	135	53.6	252	100.0		
	Grade 8	132	46.5	152	53.5	284	100.0		
Caste/ethnicity***	Brahmin/Chhetri-Hill	136	60.7	88	39.3	224	100.0	38.7	.000
	Brahmin/Chhetri-Terai	79	38.3	127	61.7	206	100.0		
	Janajati	71	56.8	54	43.2	125	100.0		
	Dalit	48	33.3	96	66.7	144	100.0		
	Other caste	31	44.9	38	55.1	69	100.0		
Religion	Non-Hindu	72	52.2	66	47.8	138	100.0	1.5	.227
	Hindu	293	46.5	337	53.5	630	100.0		
Total		365	47.5	403	52.5	768	100.0		

***Significant at chi-square $P < .001$. *$P < .05$.

reusable absorbent pads with poor sanitation than using disposal pads and maintain proper sanitation, which has no relation to men. The same study on different headings concluded that people with WASH education have better preparedness to prevent disease and to use health services effectively. Though, the prevalence of some infections like seasonal influenza has high potential to rapid transmission, WASH could be effective enough to Governmental school students and staffs, especially among high-density populations.

The study concluded that grade and religion have no strong evidence to claim the significant association to the students' sickness ($P = .665$ and $P = .481$), respectively. The students from the same school WASH facilities may have different health status. The health status, in turn, may depend on their home WASH environment, ways of it's handling, food consuming behavior, family background, their attitudes toward health behavior. In contrast to the present finding,[20] reviewed more significantly associated with the children in higher grade levels, where grades ranging from pre kindergarten to the eighth grade. However, the caste of the students and illness was found significant ($P < .001$), where Terai/Medhashai Dalit had a higher (73%) proportion and Hill Brahmin had a lower (35%) prevalence rate of infection. Being consistent with the present findings,[21] concluded that facilitating improved WASH in schools ensures an environment that decreases the risk of NTD transmission among school-aged children, who represent a key risk group. This also depicts that before facilitating improved school-WASH, key risk groups have a higher potential of NTD infections compared to non-key risk groups.

The study presents that the students who were from the improved WASH facilities at school had a positive and statistically significant effect on their health status (cOR = 0.388, CI; 290-0.519, $P < .001$) than those who were from unimproved WASH facilities at school. Equally, health status has significant effect even after enclosure of all socio-demographic covariates to those students who were from improved school WASH facilities (aOR = 0.442, CI; 0.302-0.646, $P < .001$). At the same time, female students were more likely to get sick (aOR = 678, CI; 0.502-0.915, $P < .01$) compared to male students keeping all other variables constant in the model. The burden of disease from inadequate WASH on health outcomes by Prüss-Ustün et al[22] showed that inadequate WASH remains an important determinant of global disease burden, especially among young children. In the same vein but differently,[23] said that improved WASH is often unreliable of poor water quality and unsafely managed sanitation does not protect the community.

Table 3. Adjusted odds ratios (aOR) from multivariate logistic regression assessing the feeling of being sick by students' predicting the school WASH situation and other selected socio-demographic covariates.

SELECTED PREDICTORS	MODEL I			MODEL II		
	COR	95% CI		AOR	95% CI	
School WASH situation						
Unimproved	1.00			1.00		
Improved	0.388***	0.290	0.519	0.442***	0.302	0.646
Age group of the students						
10-14				1.00		
15-19				0.934	0.610	1.430
Sex of the students						
Male				1.00		
Female				0.678**	0.502	0.915
Class/grade of students						
Grade 6				1.00		
Grade 7				1.385	0.909	2.110
Grade 8				1.113	0.767	1.613
Caste/ethnicity of the students						
Brahmin/Chhetri-Hill				1.00		
Brahmin/Chhetri-Terai				0.838	0.429	1.638
Janajati				1.344	0.708	2.551
Dalit				0.769	0.416	1.422
Other castes				1.789	0.933	3.428
Religion of the students						
Non-Hindu				1.00		
Hindu				0.999	0.597	1.672
Constant	1.783***			1.695		
Cox & Snell R Square	0.53			0.083		
2 Log likelihood	1021.053			996.606		

***$P < .001$. **$P < .01$.

Our study also indicates that improved school WASH facilities have positive impact on health status. This finding is consistent with other studies as they concluded that the health status can be improved by improving drinking water and sanitation status beyond improved water sources and sanitation facilities. These facilities may include piped water sources, household water treatment, and sewered sanitation, and from considering personal hygiene as a separate risk factor.[24] A systematic review[25] presented the findings in line with the present study that of the total, 78% of publications reported disease-related WASH; diarrheal, respiratory illness, and soil-transmitted helminthiases among students at WASH interventions schools, which impaired health status directly.

By and large, one of the limitations of the study is that the study was confined in only 4 basic schools. It was conducted on a small scale for a single-phase. It has included only WASH-related diseases: diarrhea, cholera, shigellosis, salmonellosis, typhoid, and dysentery 6 months before the study. As the respondents were asked whether they were sick 6 months before the interview, there might be the chances of recall bias information. Yet, it provided valuable insights for future interventions. Finally, this study can be seen as a starting point by scholars, especially in Nepal, to design more comprehensive school WASH research.

Conclusion

This study has brought that students' prevalence of sickness was significantly higher in unimproved compared to improved WASH services at school. Simultaneously, sickness was significantly found higher in female than male students. The marginalized/risk caste had a higher proportion of infection compared to non-risk castes. It was also noted that there was no statistically significant association between the age groups, school grades, and religious identity to the health status of students. Students who were from improved school WASH facilities had a positive and statically significant effect on health status; it remains significant even after the adjusting of all socio-demographic covariates. The school WASH services, thus, needed to be improved with proper WASH programs within the school for strengthening the preventive measures at school.

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Author Contributions

MKS conceived and led the research. MKS carried out data collection, interpretation, and drafted the paper. RA made a substantial contribution by designing and analyzing statistical aspects. Both Authors approved the final version of the paper for publication.

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Appendix A

The procedure employed to compute the sample size from the infinite population is presented below:

$$S=\frac{\mathbf{z}^2\times\mathbf{p}\times(1-\mathbf{p})}{\mathbf{e}^2}$$

Where,

S = sample size for infinite population,

Z = the standard normal deviation, set at 1.96 which corresponds to 95% confidence level,

P = population proportion (assumed to be 50% (0.5))

e = margin of error/acceptance range of error

Now, the Z score is determined based on the confidence level (the probability that the parameter depends on a specified range of values). We consider a 95% confidence level; then, the z value is 1.96. M, Margin of error/acceptance level of error is a small amount allowed for in case of miscalculation or chance of circumstances. Generally, we take the Margin of error as 5%. So, e = 0.05.

Formula,

$$S=\frac{\mathbf{z}^2\times\mathbf{p}\times(1-\mathbf{p})}{\mathbf{e}^2}\ S=\frac{1.96^2\times0.5\times(1-0.5)}{(0.005)^2}S$$
$$=\frac{3.8416\times0.25}{0.0025}S=384.16=\ 384$$