Unimproved water, sanitation, and hygiene (WASH) and common childhood illness in Myanmar: evidence from a nationally representative survey

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Research article

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Abstract

Background

Inadequate Water, Hygiene and Sanitation (WASH) is one of the major risk factors of common childhood illness - namely, diarrhea, cough, fever, and acute respiratory infection, in many Southeast Asian countries. This study aims to analyze the relationship between WASH-related indicators and common childhood illnesses; cough, fever and diarrhea among under-five children in Myanmar.

Methods

The data of 4,815 under-fives was extracted from the first Myanmar Demographic and Health Survey 2015-16. Chi-square test was used to determine association between WASH and sociodemographic variables and each common childhood illness. The bivariate logistic regression was used to obtain the unadjusted odds of cough, fever, and diarrhea for each wash indicator, i.e., Unimproved toilet, access to unsafe water, and unsafe feces disposal. Further multivariate regression was employed and adjusted odd ratios were obtained of each common childhood illness after accounting for all wash indicators.

Results

Among under-five children, 16.2% suffered from cough, 16% suffered from fever, and 10.4% from diarrhea. Unimproved toilet facility was associated with cough (Adjusted Odds Ratio (AOR) 1.15, 95% CI:0.86, 1.22), and fever (AOR 1.03, 95% CI:0.86,1.23) among children. Children from households practicing unimproved child feces disposal had 21%, 18%, and 52% higher odds of experiencing cough (95% CI:1.12, 1.31), fever (95% CI: 0.99,1.29), and diarrhea (95% CI:1.21, 1.68), respectively. A combination of unimproved water, toilet and child feces disposal facilities was associated with cough (AOR 1.34, 95% CI:1.03, 1.73), fever (AOR 1.12, 95% CI:0.86, 1.19) and diarrhea (AOR 1.18, 95% CI:0.95, 1.29).

Conclusion

Inadequate improved WASH significantly contributed to common childhood illnesses among children in Myanmar. Findings suggest that WASH interventions should be targeted to the poor and rural areas where the prevalence of both childhood illnesses and unimproved WASH facilities were reportedly high.

Background

Globally, 2.2 billion (29%) people did not have access to protected potable water, and 4.2 billion (55%) still lacked access to toilet facility or safe disposal of child excreta in 2017 [1]. Around 128,500 deaths of under-five children occurred due to unprotected drinking water, unavailability of basic sanitation, and unhygienic in the world [2]. Inadequate water, sanitation and hygiene (WASH) is one of the major risk factors of the common childhood illness; namely diarrhea, cough, fever, and acute respiratory infection (ARI) in many Southeast Asian and Sub-Saharan countries [3–5]. WASH alone contributes to 7% of overall disease burden in the least developing countries [6]. Most of diarrhea-related morbidities can be averted by ensuring access to protected water and clean environment [7]. The provision of basic sanitation and hygiene can avert 2.4 million deaths each year [8]. The “Goal 6 of Sustainable Development Goals (SDGs) calls for to ensure availability and sustainable management of water and sanitation for all, and particularly targets 6.1 and 6.2 are related to achieving the universal access to safe and affordable drinking water, and providing equitable and adequate sanitation, and hygiene, respectively” [9].

Myanmar in still going through a recovery period after the prolonged civil unrest that had dismantled the country's social, political, and economic development [10]. According to the 2018 Human Development Index, Myanmar was positioned at 148 ranks out of 189 countries [11]. Inequality in health service delivery exists in the country due to several socio-economic and geographic disparities [12]. The majority of the population (70%) in the country lives in rural areas. The rural households are deprived of necessary civic facilities due to frequent occurrence of conflicts, rampant poverty, lack of community participation, and inadequate knowledge of managing natural resources [12, 13].

Moreover, the country has long been facing with problems of unsafe potable water and inadequate sanitation; 11% people in the urban and one-third of population (34%) in rural do not have access to the protected water supply. Only three-fourth (76%) has adequate sanitation facilities [14]. Diarrhea is the fourth primary cause of childhood fatality, making up 7.7% of the total under-five deaths in Myanmar [15].

The universal access to safe potable water and improved sanitation are recognized as fundamental human rights worldwide, as endorsed by the "General Assembly of the United Nations" [16]. Like many other countries, Myanmar has committed to meet the targets of SDG-6 by 2030. For that, the country needs to ensure the equitable and universal accessibility of adequate WASH to all people. The literature suggests that household-related environmental factors constrain childhood development and diminish the prospects of school attainment and a decent livelihood in less developing countries [2, 17–22]. The Myanmar Demographic and Health survey 2015-16 is the first household survey conducted in Myanmar. It provides extensive information on the environmental factors relating to household, such as "water, sanitation and hygiene". The information can be used to assess the impact of WASH on preventable diseases among preschool children.

This study makes the first attempt to explore the prevalence of common childhood illnesses in respect to household-related environmental factors, water, sanitation and hygiene - WASH in Myanmar by using the first MDHS 2015-16. The findings may help devise multipronged health care strategies to address inadequate WASH and decrease the burden of common childhood diseases in Myanmar.

Material And Methods

Data and sample selection

This study used a sample of 4,815 under-five children from the Myanmar Demographic and Health Survey (MDHS 2015-16). MDHS used a two-stage stratified clustered sampling framework. The sampling design contained 76,990 primary sampling units (PSUs). Out of 30 sampling strata and 441 clusters, a selection of 30 households was made by using probability proportional to size rule (PPS). A total of 12,885 women aged 15 to 49 years were interviewed from 13,230 households, and data was compiled in women's file (KR), yielding a response rate of 98%. The information on socio-demographic factors, maternal and children's health, fertility, reproductive health, family planning, pregnancy, postnatal care, and immunization were collected using the Standard DHS tools. MDHS can be accessed freely from the publicly available data repository via the "DHS Program" website (https://www.dhsprogram.com/data/).

Data Processing

Ethical Review Committee of the Myanmar Ministry of Health and Sports, Department of Medical Research granted ethical approval for the implementation of MDHS [23]. The data collection held from December 7, 2015, through July 7 2016, by 19 trained field teams. The field editors used computer-assisted field editing (CAFE) procedures to enter the completed paper questionnaires soon after data collection. Completed questionnaires were entered twice to check for the inconsistencies using CSPro software.

Outcome variable

We examined three childhood illnesses; cough, fever, and diarrhea as dependent variables. MDHS enquired women aged 15-49 whether their children had diarrhea and/or fever, and/or cough in the past two weeks preceding the survey. The answers were recorded as 'Yes' or 'No'. The definition of diarrhea was read to the mothers to ensure that the mothers understood diarrhea and validate the accuracy of responses. This paper used the information on cough, fever, and diarrhea as reported by mothers to form dichotomous (0/1) outcome variables; where 1 implies the under-five child suffered by the disease, and 0 means not-experienced.

Explanatory variables

We used three WASH-related variables as explanatory variables: water, sanitation (toilet facility), and child feces disposal by households. The standard guidelines for the grouping of improved and unimproved sanitation, "as recommended by the WHO/UNICEF Joint Monitoring Program (JMP) for Water Supply and Sanitation, were used (Table 1) [24]".

Table 1 WHO classification of improved sanitation and water supply

	Unimproved	Improved
Water	Unimproved-drinking-water sources: Unprotected dug well, unprotected spring, cart with small tank/drum, surface water (river, dam, lake, pond, stream, canal, irrigation channels), and bottled water	Other improved drinking-water sources: Public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs or rainwater collection. Piped water on premises: Piped household water connection located inside the user's dwelling, plot or yard
Sanitation and child's excreta disposal facilities	Unimproved sanitation facilities: do not ensure hygienic separation of human excreta from human contact. Unimproved facilities include pit latrines without a slab or platform, hanging latrines and bucket latrines.	Improved sanitation facilities: ensure hygienic separation of human excreta from human contact. They are use of the following facilities: Flush/pour flush to: piped sewer system, septic tank, pit latrine; Ventilated improved pit (VIP) latrine, Pit latrine with slab, Composting toilet.

Source: WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation.

Households' access to different water sources was regrouped into safe drinking water or unsafe water. The responses of households interviewed about the type of toilet were combined into two responses; unimproved latrine, and improved latrine. Similarly, the practices of child feces disposal were organized into two categories, as follows, safe disposal of child feces and unsafe disposal. The binary variable (0/1) was used to represent each WASH- related indicator, 1 implies unimproved, and 0 means improved.

Other independent variables included child characteristics, such as child sex (categorical: male or female); age in months (categorical: 1-12, 13-24, 25-36, 37-48 and 49-59); child birth size (categorical: very small, average or smaller but not very small, and above average or very large); and nutritional status (binary: stunting, wasting, and underweight). The parent characteristics used in this study included mother's age in years (categorical: less than 20, 20-29, 30-39, and 40-49); mother's education (categorical: no education, primary, secondary or higher), and father's education (categorized as mother's education). The household-related variables comprised type of residence (categorical: urban or rural), and children in the households (categorical: 1-2, 3-4, and more than 4).

MDHS 2015-16 collected detailed information on durable assets and housing features. It used Principle Component Analysis (PCA) to derive the factor scores of household wealth based on the obtained data. The Household wealth in the MDHS was categorized in terms five quintiles: "poorest, poorer, middle, richer, and richest". We re-organized the wealth

index by combining first three wealth quintiles “(poorest, poorer, and middle)” into “poor” and last two quintiles “(richer and richest)” into rich.

Data Analysis

Cross-tabulation between socio-demographic characteristics and WASH-related indicators were presented as frequency distribution and in percentage. Since this study involved mostly categorical variables, we employed Pearson Chi-square test to determine the relationship between each explanatory variable and dependent variable. Three levels of significance, “$p<0.001$, $p<0.05$, $p<0.01$”, were used.

This study analyzed the prevalence of each cough, fever, and diarrhea across childhood characteristics, parent-related, and household-related factors. The univariate and bivariate statistical analyses were employed over a weighted sample. The bivariate relationships between each explanatory variable and each childhood illness were appraised at a 95% confidence interval. A p-value<0.05 indicates a statistically significant relationship. The multivariate logistic regression was used to assess the association between WASH indicators and each childhood disease; diarrhea, fever, and cough. The unadjusted odd ratios (reference category=use of adequate WASH) showed the odds of cough, fever and diarrhea for unsafe drinking water, unimproved toilet, and hazardous child feces disposal separately. The adjusted odds ratios showed the likelihood of diarrhea, cough, and fever for each WASH indicator while controlling for other indicators. Sampling weights were used while estimating the logistic model to adjust for the sampling errors and complex sampling design. The analysis was performed in Stata, version 15.

Results

Among under-five children included in the study, 52.5% were male. One-third (33%) of households had access to unprotected potable water, and 47% had an unimproved toilet. The same proportion of families opted for unsafe child feces disposal. The households with almost 40% of children aged 1–24 months reported a higher prevalence of unimproved child feces disposal. Nearly three fourth (73.3%) children in the study had a higher than average or average birth size, and birth size varied significantly across various indicators of WASH.

The rate of stunting was higher in households with unimproved toilet facility (33.6%), and unsafe feces disposal (30.7%), and 7.9% of wasted children were from the families having access to unprotected water. The prevalence of underweight was higher in households with unimproved toilet facility (20.9%), and unsafe feces disposal (19.4%). The majority of women (43.2%) were between the age-group 20–29 years, and 17% of mothers and fathers were illiterate. More than three fourth (78.9%) of respondents were from rural areas, and 71.3% belonged to the poor economic background. 14% of households had more than four children (Table 2).

Table 2
Background characteristics of under-five children according to the WASH indicators

		Unimproved water, toilet and child feces disposal facilities in households		
Variables	Total N = 4,815	Unimproved Water 32.97%	Unimproved Toilet 47.63%	Unimproved Child feces disposal 46.63%
	N/%	%	%	%
Child sex				
Male	2528/52.50	51.33	52.54	53.59
Female	2267/47.50	48.67	47.46	46.41
p-value		0.25	0.95	0.130
Child age				
1–12	1049/21.79	22.22	21.49	30.73
13–24	966/20.06	21.21	19.53	21.71
25–36	852/17.69	18.37	17.95	16.74
37–48	1100/22.85	23.04	22.72	17.62
49–59	848/17.61	15.15	18.35	13.20
p-value		0.03	0.72	0.000
Birth size				
Very small	69/1.49	2.02	1.80	2.17
Larger than average/average	3443/73.35	76.66	73.82	71.57
Greater than average/very large	1119/24.16	21.33	24.38	26.25
p-value		0.001	0.129	0.000
Stunted				
No	2927/69.48	70.99	66.33	69.26
Yes	1286/30.52	29.01	33.67	30.74
p-value		0.133	0.00	0.01
Wasting				
No	3917/93.33	92.09	92.80	93.09
Yes	280/6.67	7.91	7.20	6.91
p-value		0.02	0.174	0.46
Underweight				

**p < 0.05; ***p < 0.001, *p < 0.01

		Unimproved water, toilet and child feces disposal facilities in households		
No	3429/81.31	81.44	78.03	80.55
Yes	788/18.69	18.56	20.97	19.45
p-value		0.85	0.000	0.01
Mother education				
No education	860/17.86	19.76	24.17	21.76
Primary	2132/44.28	38.19	50.44	46.69
Secondary or higher	1823/37.86	42.05	25.39	31.55
p-value		0.000	0.000	0.000
Mother's age				
Less than 20 years	104/2.16	1.96	2.36	2.76
20–29	2081/43.22	44.0	44.75	47.88
30–39	2059/42.76	43.94	42.08	38.68
40–49	571/11.86	10.10	10.81	10.67
p-value		0.04	0.06	0.000
Father education				
No education	839/17.43	17.19	23.51	21.85
Primary	1890/39.27	34.70	44.35	41.86
Secondary or higher	2084/43.30	48.10	32.14	36.29
p-value		0.000	0.000	0.000
Type of residence				
Rural	3803/78.98	68.50	89.32	86.71
Urban	1012/21.02	31.50	10.68	13.29
p-value		0.000	0.000	0.000
Socioeconomic status				
Poor	3434/71.32	977	88.27	79.85
Rich	1381/28.68	38.32	11.73	20.15
p-value		0.00	0.000	0.000
Number of children in household				
1–2	2641/55.23	59.94	50.86	51.61
3–4	1470/30.74	29.55	32.67	32.61
> 4	671/14.03	10.51	16.47	15.38

**p < 0.05; ***p < 0.001, *p < 0.01

	Unimproved water, toilet and child feces disposal facilities in households		
p-value	0.000	0.000	0.000
**p < 0.05; ***p < 0.001, *p < 0.01			

In Myanmar, a higher percentage of preschool children (16.2%. 95% CI: 14.9, 17.5) suffered from cough, followed by fever (16.0%, 95% CI: 14.83, 17.39), and diarrhea (10.4%, 95% CI: 9.4, 11.5), in two weeks before the survey. The prevalence of childhood illnesses was high among males, and children below two years of age. Nearly one-third (31.1% 95% CI: 26.1, 36.6) of stunted children and more than one fifth (22.0%, 95% CI: 17.6, 27.1) of underweight children had diarrhea. Likewise, 29.8% (95% CI: 25.9, 34.0) of stunted children had a cough. Of three childhood illnesses, diarrhea among under-five children showed association (statistically significant) to the age of mother, mother's education, rural/urban, and household socioeconomic status. Similarly, childhood experience of cough was significantly related to the mother's age. The socioeconomic status of households showed statistically significant association with fever (Table 3).

Table 3
The prevalence of Cough, Fever, and Diarrhea among under-five children in Myanmar (weighted sample)

Variables	Cough	Fever	Diarrhea
	16.23[14.9–17.5]	16.07[14.83–17.39]	10.45[9.4–11.5]
Male	54.5[49.8–58.2]	50.2[45.8–54.5]	52.5[47.1–57.9]
Female	45.9[41.7–50.1]	49.7[45.4–54.1]	47.4[42.0-52.8]
p-value	0.12	0.64	0.41
Child age			
0–12	19.23[16.2–22.6]	22.01[18.6–25.7]	20.3[16.4–24.9]
13–24	26.2[22.6–30.2]	28.3[24.5–32.3]	38.11[32.9–43.5]
25–36	18.8[15.7–22.3]	18.5[15.3–22.2]	15.5[12.0-19.7]
37–48	20.5[17.3–24.2]	18.6[15.5–22.3]	16.3[12.8–20.6]
49–59	15.0[12.2–18.3]	12.4[9.8–15.4]	9.6[6.8–13.4]
p-value	0.000	0.000	0.000
Birth size			
Very small	2.3[1.3–3.9]	2.2[1.2–4.1]	1.9[0.8–4.2]
Larger than average/average	71.2[67.2–74.9]	68.5[64.3–72.5]	69.1[63.7–73.9]
Greater than average/very large	26.4[22.8–30.3]	29.1[25.2–33.2]	28.9[24.2–34.2]
p-value	0.02	0.00	0.001
Stunted			
No	70.1[65.90–74.0]	70.8[66.5–74.8]	68.8[63.3–73.8]
Yes	29.8[25.9–34.0]	29.1[25.1–33.4]	31.1[26.1–36.6]
p-value	0.02	0.05	0.001
Wasting			
No	92.6[90.6–94.6]	91.7[88.9–93.9]	91.0[87.1–93.7]
Yes	7.3[5.3–9.9]	8.2[6.7–11.0]	8.9[6.2–12.8]
p-value	0.50	0.35	0.25
Underweight			
No	78.9[75.0-82.4]	78.5[74.4–82.0]	77.9[72.8–82.3]
Yes	21.0[17.5–24.9]	21.4[17.9–25.5]	22.0[17.6–27.1]
p-value	0.74	0.97	0.00
Mother's education			

**p < 0.05; ***p < 0.001, *p < 0.01

Variables	Cough	Fever	Diarrhea
No education	15.9[13.1–19.1]	17.3[14.3–20.8]	18.19[14.4–22.6]
Primary	46.8[42.6–51.1]	47.7[43.4–52.0]	46.1[40.7–51.5]
Secondary or higher	37.2[33.2–41.4]	34.8[30.8–39.1]	35.6[30.6–41.0]
p-value	0.48	0.85	0.03
Mother's age			
Less than 20 years	2.4[1.4–4.7]	2.6[1.5–4.3]	1.8[0.08–3.8]
20–29	43.2[39.1–47.5]	45.5[41.3–49.9]	48.3[43.0-53.7]
30–39	44.8[40.6–49.0]	41.9[37.7–46.2]	42.1[36.9–47.5]
40–49	9.4[7.3–12.9]	9.8[7.5–12.6]	7.6[5.2–10.9]
p-value	0.04	0.82	0.02
Father's education			
No education	12.8[10.3–15.7]	15.5[12.7–18.8]	16.6[13.0-20.9]
Primary	41.7[37.5–45.9]	45.6[41.3–49.9]	41.8[36.6–47.3]
Secondary or higher	45.4[41.2–49.6]	38.8[34.7–43.1]	41.4[36.2–46.8]
p-value	0.012	0.16	0.71
Type of residence			
Rural	73.6[22.6–30.3]	76.9[19.5–27.0]	81.9[77.3–85.6]
Urban	26.3[22.6–30.3]	23.0[19.5–27.0]	18.0[14.3–22.6]
p-value	0.78	0.32	0.003
Socioeconomic status			
Poor	69.1[64.9–72.9]	73.4[69.4–77.1]	77.0[72.1–81.3]
Rich	30.8[27.0–35.0]	26.5[22.8–30.5]	22.9[18.6–27.8]
p-value	0.05	0.02	0.00
Number of children			
1–2	59.9[55.7–64.0]	61.5[57.4–65.7]	64.5[59.3–69.4]
3–4	29.6-25.9-33.7]	28.4[24.7–32.5]	25.3[21.0-30.1]
> 4	10.3[8.2–12.8]	9.8[7.7–12.3]	10.0[7.4–13.5]
p-value	0.15	0.15	0.14
**p < 0.05; ***p < 0.001, *p < 0.01			

The childhood illnesses; cough, fever, diarrhea, were higher among households with unimproved toilet facility (Fig. 1). However, the disparity was not observed in the case of the occurrence of cough, fever, and diarrhea in children by

improved or unimproved water facilities at the household (Fig. 2). The rate of childhood illness was higher among households reporting unimproved child feces disposal facilities (Fig. 3).

The multivariate analysis showed that children of households which did not have improved toilet facility were associated with cough "(Adjusted Odds Ratio [AOR] 1.15, 95% CI:0.86, 1.22) and fever (AOR 1.03, 95% CI:0.86, 1.23)" (Table 4).

Table 4
The adjusted and unadjusted odd ratios of Cough, Fever, and Diarrhea

Variables	Cough		Fever		Diarrhea	
	Unadjusted OR [95% CI]	Adjusted OR [95% CI]	Unadjusted OR [95% CI]	Adjusted OR [95% CI]	Unadjusted OR [95% CI]	Adjusted OR [95% CI]
Water facility (UIM)						
No	1	1	1	1	1	1
Yes	0.96 [0.82–1.12]	1.06[0.89–1.26]	1.10[0.94–1.24]	0.94[0.79–1.13]	0.86[0.71–1.04]	0.93[0.75–1.16]
Toilet facility (UIM)						
No	1	1	1	1	1	1
Yes	0.93[0.80–1.07]	1.15*[0.86–1.22]	1.00[0.86–1.17]	1.03*[0.86–1.13]	0.91[0.81–1.15]	0.96 [0.78–1.12]
Child feces disposal (UIM)						
No	1	1	1	1	1	1
Yes	1.08[0.94–1.25]	1.21**[1.12–1.31]	1.15**[0.91–1.65]	1.18**[0.99–1.29]	1.40***[1.76–1.58]	1.52***[1.21–1.68]
Water + Toilet + child feces disposal (UIM)						
No	1	1	1	1	1	1
Yes	1.15*[0.97–1.37]	1.34**[1.03–1.73]	1.01[0.84–1.21]	1.12**[0.86–1.19]	0.94[0.75–1.18]	1.18*[0.95–1.29]

**p < 0.01, **p < 0.05, ****p < 0.001; OR means Odd Ratios; Yes (improved facility) is the reference category; UIM means unimproved*

Children of mothers who opted for unimproved child feces disposal had 21%, 18%, and 52% higher odds of suffering from cough (AOR 1.21, 95% CI: 1.02, 1.44), fever (AOR 1.18, 95% CI: 0.99,1.89), and diarrhea (AOR 1.52, 95% CI: 1.21, 1.90), respectively, compared to children of mother who didnot. A combination of unimproved water, toilet, and child feces disposal facilities were positively associated with cough (AOR 1.34, 95% CI: 1.03, 1.73), fever (AOR 1.12, 95% CI:

0.86, 1.59) and diarrhea (AOR 1.18, 95% CI: 0.85, 1.69). However, we did not find statistically significant association in the case of unimproved water facility and any of the childhood illnesses.

Discussion

This study used the first DHS from Myanmar to assess the association between three common childhood illnesses and indicators of WASH. It also examined the prevalence of childhood illnesses across various sociodemographic characteristics of children, their parents, and households. The descriptive analysis suggested that a higher proportion of households did not have access to improved water and toilet facilities in Myanmar. The cough was the most prevalent amongst all three childhood illnesses under study, followed by fever and diarrhea. The unimproved toilet facility was significantly associated with childhood cough and fever in Myanmar.

Similarly, children from those households practicing unimproved child feces disposal were associated with higher risks (odds) of suffering from cough, fever, and diarrhea. The odds of childhood illnesses (cough, fever, and diarrhea) increased significantly if the combination of unimproved water, toilet, and child feces disposal practices were present in the same household. The unimproved WASH practices were common in rural areas and among the poor. Children of the younger and uneducated mother were more associated inadequate WASH.

According to the World Health Organization report, three-fourth or 77% has access to improved sanitation. A higher number of urban inhabitants use improved water source and sanitation facilities compared to their rural counterparts [10]. Several ministries under the government in coordination with international institutions are working to improve sanitation and drinking-water services in Myanmar. Most of the non-governmental orgainzations (NGOs) are based in cities that have abetted in building WASH infrastructures in urban neighborhoods. Nevertheless, Myanmar has made some progress in recent years to expand the coverage of improved WASH; it is still struggling to provide necessary water, sanitation, and hygiene services, especially in rural areas [25].

The one-third (2.5 billion) of the global population do not have adequate sanitation facility, and 70% of that belong to rural [24]. Rural areas have several WASH-related problems including open defecation and limited access to safe potable water. Around 9% of the population in Myanmar are still involved in the open defecation [24]. One of the potential barriers to embracing safe hygiene practices in rural areas is poverty [26]. Latrines, mostly in the rural regions of LMICs are poorly built and emit noxious odors, and chances are higher that children could be bitten by insects or rats [27]. According to the study based on behavioral intervention from rural India, nearly half of newly-constructed toilets were dysfunctional or unused [28]. Open excretion, particualrly in rural areas, in many less developing countries is socially acceptable, and even children are allowed to defecate in open [29].

Another study from India indicated that the conservative mindset and lack of awareness are barriers to transform sanitation-related knowledge into routine practice [26]. Our study reported that households with younger children have a high prevalence of all three childhood illnesses. Similarly, the unsafe child excreta disposal was higher in households with children aged 1–2 years. Infant or todlers have higher exposure to feces and dirt due to their frequent habit of putting objects, soil, and hands into their mouth [30].

Poor disposal of child feces is one of the harmful practices that directly contaminate water sources and poses a higher incidence of enteric infections for adults and young children [31]. The risks of unsafe faces disposal on child health have been studied for long, indicating the importance of safe management of child feces on child health [32]. We established that the risk of hazardous dumping of child feces was associated with diarrhea, cough, and fever among under-five children; the relationships were statisitcially significant. The result is in line with studies from several developing countries. For example, a study undertaken in Bangladesh suggested a strong connection between unimproved disposal of child feces and faltered child development [22].

Developing countries are practicing various sanitation interventions to improve the toilet facility at the household level, mainly assisting in places where open defecation is ubiquitous [33]. However, less attention was given to the disposal and management of child feces, which is critical in reducing exposure to fecal pathogens [34]. A hospital-based empirical investigation conducted in Myanmar found that hospital admission due to rotavirus diarrhea has doubled than in the 1980s. Nearly 10% of hospitalization of under-fives was due to rotavirus diarrhea; the virus was found to be more prevalent in children aged between six and sevententh months [35].

Research findings of this paper indicates a positive association between inadequate toilet facility and experiencing cough and fever among under-five children. A supporting multicountry WASH-intervention based study showed that improved sanitation facilities decreased the risks of fever by 13% and of cough by 10%; however, the reduction in childhood mortality was very low [36]. This study suggests the absence of all three WASH facilities being associated with cough, fever, and diarrhea. Similar research conducted in Nigeria reported higher odds of suffering from cough, fever, and diarrhea among households without all three types of WASH facilities [37].

This paper found a positive relationship between child poor nutritional status (stunting) and childhood illnesses. For example, the incidence of dirrhea was found higher among stunted children. The stunted children were associated with households having access to inadequate drinking water, and unsafe child feces disposal. Contrary to this, a study from Bangladesh concluded that the WASH intervention showed no effect on childhood illnesses and nutrition status between treatment and control communities. It could be due to the smaller number of observations and a shorter period between baseline and end-line intervention [21].

However, some researches have suggested that WASH interventions do not affect child nutritional status [19, 28]. Recently a study used cluster-randomized trial in rural Zimbabwe to evaluate the implications of WASH related interventions on chronic child malnutrition. The results showed no direct association between WASH-related interventions and stunting; however, it revealed significant reduction in diarrhea in rural areas where stunting was substantially higher [20]. A recent multi-country study showed an improved child nutritional status if improved child feces disposal is practiced in developing countries [30]. Another study conducted in Peru assessed the implications of WASH on the nutrition levels of children using anthropometry measurement. Authors established a positive association between improved WASH and decreased incidence in diarrhea, and improved linear growth in children [38]. Amongst countries in the Association of Southeast Asian Nations, Myanmar has one of the largest numbers of stunted and underweight children aged 0–59 months.

The nutritional outcomes in children are directly associatd with WASH and diarrhea incidence. Repeated occurrence of diarrhea in the first 24 months of life increases the likelihood of being stunted and consequently preventing children from optimal physical and cognitive development [39]. Another case-control study showed that children registered with WASH and nutrition intervention have a lower risk of getting severely stunted and underweight after two years compared to non-registered ones [19].

This paper has few limitations. It used a cross-sectional data set that can undermine the causality of WASH-related factors and childhood illnesses. Besides the WASH-related factors, several socio-demographic characteristics such as place of residence and WASH intervention factors in the study could act as confounding or reverse causal factors, which may inflate the prevalence of childhood illnesses. MDHS collects data on childhood illnesses based on the mother's recall, which is liable to recall biases and could be different from the clinical assessment of the child suffering from any ailment.

Conclusion

To sum up, this study confirms the association of common childhood illnesses with the inaccessibility of improved WASH facilities, especially among the rural and the poor. It implies that unimproved WASH is contributing to a higher burden of childhood illnesses in the Maynmar. Like many similar studies, the findings of the present study support that WASH is a fundamental component of public healthcare. The study calls for strengthening the multipronged strategies in partnership with local community and internatonal health care providers to ensure safeguarding WASH and achieve SDG 3 (target, 3.3) and SDG 6 (targets, 6.1; 6.2; 6.A; 6.B). Health education program targeting poor, illiterate, and rural is needed to create awareness on treating drinking water, hygienic practices, and safe disposal of child feces.

List Of Abbreviations

AOR; Adjusted Odds Ratio, CAFÉ; computer-assisted field editing, CI; Confidence Interval, LMICs; low- and middle-income countries, MDHS; Myanmar Demographic and Health Survey, JMP; Joint Monitoring Program, NGOs; non-governmental orgainzations, PCA; Principle Component Analysis, PPS; probability proportional size, PSUs; primary sampling units, SDGs; Sustainable Development Goals, UNICEF; United Nations Children's Fund, USAID; United States Agency for International Development, WASH; Water, Sanitation and Hygiene, WHO; World Health Organization

Declarations

Ethics approval and consent to participant

Ethical Review Committee of the Myanmar Ministry of Health and Sports, Department of Medical Research granted ethical approval to ICF international and DHS program to coordinate with the ministry of sports and Health and conduct the first Myanmar Demographic and Health Survey during 2015-16. Authors have been granted the permission from ICF and USAID to use the MDHS 2015-16 for the current research.

Consent for publication

Authors have agreed to submit this research to BMC Public Health.

Availability of data and materials

We acknowledge to the DHS program-USAID for providing access to download the Myanmar Demographic and Health Survey 2015-16 from its website to conduct this research. The following is the link of Myanmar Demographic and Health survey 2015-16 used in this manuscript. The data is publically available and can be downloaded with the due permission at the following link, https://dhsprogram.com/data/dataset/Myanmar_Standard-DHS_2016.cfm?flag=0.

Competing Interest

The authors declare that they have no known competing interests.

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Authors' Contributions

LN and UG have conceived the concept, and outlined research questions and methodology. LN analyzed the data and carried out analytical and empirical assessment of research questions. UG has written the background, results and discussion, and conclusion LN has written Material and Methods, LN has thoroughly revised the manuscript. LN and UG have critically evaluated the paper. LN and UG have agreed on the final version of the manuscript.

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Figures

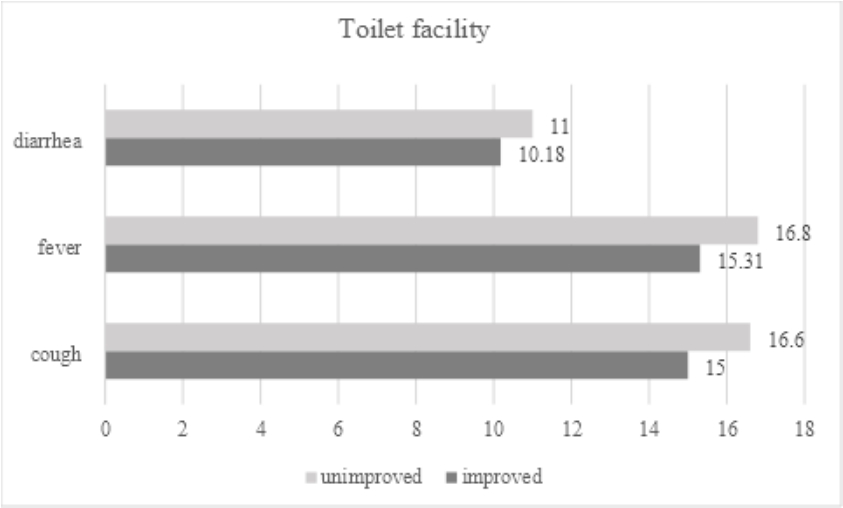

Figure 1

The prevalence of cough, fever, diarrhea by toilet facility

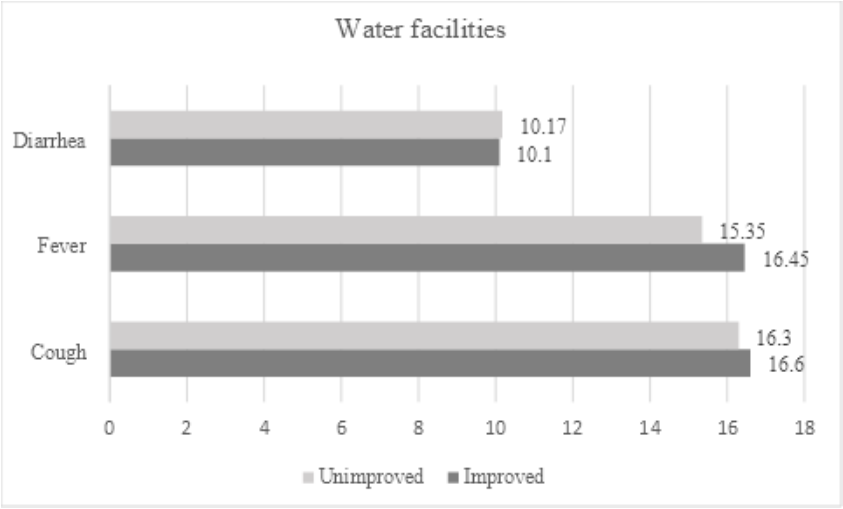

Figure 2

The prevalence of cough, fever and diarrhea by water facilities

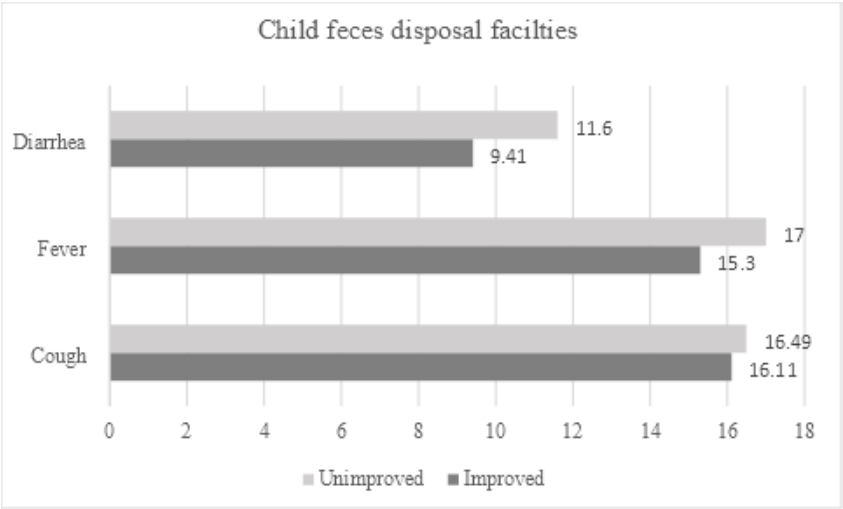

Figure 3

The prevalence of cough, fever, and diarrhea by child feces disposal facilities