Research paper

Water, Sanitation, and Hygiene (WaSH) practices and morbidity status in a rural community: findings from a cross-sectional study in Odisha, India

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Keywords

WaSH practice • Rural area • Acute illness • Chronic illness • Infection

Summary

Introduction. *Global evidence indicates an association between poor WaSH practice and inferior health outcomes. In rural areas, this practice is predominantly compromised with limited access to safe drinking water, knowledge gaps, and unhealthy socio-behavioural practices. Suboptimal WaSH practice leads to increased vulnerability of various infections, thereby posing a challenge to the primary health care system.*
Methods. *A community based cross-sectional study was conducted among 879 participants of two villages in Tigiria block, Cuttack district, Odisha, India. Information pertaining to socio-demography, WaSH practices and self-reported morbidities were captured and analysed. Bi-variate analysis was done to assess the association between WaSH practices and any acute illnesses. Differences were considered statistically significant if p-value was less than 0.05.*
Results. *Tube well was the main source of drinking water (49.3%) followed by dug well (46.6%). Only 7.1% of participants reported to purify drinking water and around 40% were still practicing open defecation. The prevalence of acute and chronic illnesses was 9.2% and 19.1% respectively. Major acute illnesses were respiratory diseases, diarrhoeal disorders, and musculoskeletal problems, while major chronic illnesses were gastrointestinal problems, musculoskeletal problems, and hypertension. After adjusting for age, gender, and education, a significant odds ratio of 3.79 [CI = (1.23-11.70)] was observed between drinking water source (surface water Vs tube well water) for acute illnesses.*
Conclusions. *Poor WaSH practices among rural people make them vulnerable to acute and chronic morbidities. Health awareness and socio behavioural changes pertaining to WaSH practices need utmost priority to ensure better health for rural people of Odisha.*

Introduction

Sustainable Development Goal 6 (SDG-6) emphasizes on access to safe water and improving sanitation and hygiene to ensure better health and wellbeing. Global evidence indicates an association between improper WaSH practices and infections like diarrhoea and pneumonia, trachoma, infestations with soil transmitted helminths, respiratory tract infection (RTI), and pulmonary tuberculosis (PTB), causing poor health outcomes [1-3]. While it is critical to have good WaSH practices for better health, there are existing gaps in relation to awareness, behavioural practices, accessibility, and availability to safe water and essential hygienic commodities. Study in India shows that 80% of mothers practice hand washing before preparing and serving food and 50% of the school children are unaware of the timing of hand-washing practice [4]. Another study from India has found that many people from rural communities use ash/soil to wash their hand(s) after faecal contact [5]. Compared to urban settings, WaSH coverage in rural areas is significantly poor [6]. A study among adolescent girls from eastern India has shown that 82% of the adolescent girls practicing open defecation [7]. It is imperative to have health education interventions to bring positive behavioural change among community people for good WaSH practices [8]. Access to safe drinking water is still a major challenge for rural people. Poor knowledge of proper WaSH practices and high risk behaviour with regard to WaSH, make them more vulnerable to acquire infectious diseases. According to a qualitative study from India, rural people believe that their communities as less healthy, less physically active and have poorer access to nutritious food [9]. Research study has also shown that in rural communities, fever, respiratory tract diseases, gastrointestinal diseases are the major acute illnesses and heart diseases, diabetes mellitus, and respiratory diseases are the common chronic diseases [10]. India, witnessing an epidemiological transition with the dual burden of disease (both communicable and non-communicable), its rural community is becoming more vulnerable because of the change in living conditions and socio-behavioural practices [11-13]. Unsafe and unhygienic practices among rural people further add to their likelihood of various diseases, thereby posing a challenge to the health system. With this backdrop, it is critical to understand the WaSH practices and prevalent

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disease morbidities among rural people for having appropriate context-specific preventive strategies.

Methods

Study settings and design

A cross-sectional community based study was carried out in two villages of Tigiria block, Cuttack district, Odisha, India over a period of six months. Odisha is one of the states in Eastern India with a vast coast separating the Bay of Bengal. Tigiria is one of the rural dominant blocks of the Cuttack district with 89.2% of its people residing in rural villages [14]. A model rural health research unit (MRHRU) has been established in this block to carry out health research. Out of 47 total villages of the study block, two villages (Baliput and Bhejia) were randomly selected for our study.

Sampling method

Assuming a prevalence of improved sanitation facilities in 23% of rural households in Odisha [15], and considering 15% relative precision, 95% confidence level and with a design effect of 1.5, a sample size of 857 was estimated using Open-Epi sample size calculator. A total of 893 eligible participants were approached and 879 study participants (aged more than 10 years) were enrolled for the study, with a drop out of 14 (1.6%) participants.

Data collection tool and method

A structured data collection tool was developed focusing on household level socio-demographic and WaSH practices and individual level disease profile (both acute and chronic). The tool was pilot tested in another village before data collection and all necessary corrections were made prior to data collection from study villages. The data were collected by qualified and trained field investigators of MRHRU. The data were entered in epi-info software ensuring double data entry and more than 10% of collected data were range checked by the supervisor to avoid any data error.

Data analysis

Data were statistically described in terms of mean ± standard deviation (SD) or Median (IQR) for continuous data and frequency (percentage) for categorical data. The bi-variate analysis was done to assess the association between WaSH practices and any acute illnesses such as diarrhoeal disorder, skin problems, and acute respiratory tract infections. Statistical analysis was performed using IBM SPSS software version 25.0 and p-value less than 0.05 was considered as statistically significant.

Ethical consideration

Ethical approval from the institutional review board of ICMR-Regional Medical Research Centre, Bhubaneswar was obtained for this study. The study participants were informed about the objectives of this study along with the risks and benefits of their participation. Participation was completely voluntary and written informed consent and assents were obtained from all the study participants. In case of minors (10-18 years), in addition to their assent, consent was also obtained from their parents.

Results

Among total 879 study participants, 465 (53%) were male and 414 (47%) were female and their mean age was 36.7 ± 17.9 years. Majority of the participants (54.6%) belonged to other backward caste or socially and economically backward caste (OBC/SEBC), followed by the scheduled tribe (19.8%) and general category (19.7%). While about one fourth (25.6%) of study participants had no formal education, 53.6% had studied secondary or more. Among the participants, 81 (9.2%) had suffered from some acute illness during the past one month, and 168 (19.1%) had some chronic illness. The descriptive statistics of socio-demographic characteristics are detailed in Table I.

WaSH practices

Among the participants, 49.3% used to drink tube well water followed by dug well water (46.6%). Only 7.1% of participants mentioned that they adopt some method to purify their drinking water. Among the participants, 39.4% were still practicing open defecation. The descriptive details about the WaSH practices are presented in Table I.

The odds ratio (non-adjusted and adjusted) of different WaSH practices for acute infection are presented in the forest plot below (Figs. 1A and 1B respectively). Washing hands before taking food by using soap/ detergent had an odds ratio of 1.70 [95% CI (1.003-2.89)] compared to hand washing using plain water and the same was 1.24 [95% CI (0.68-2.27)] upon adjustment. After adjusting, a significant odds ratio of 3.79 [95% CI (1.23-11.70)] was observed with drinking surface water compared to tube well water.

Morbidity status (Acute and Chronic illnesses)

Acute illnesses

Among the 84 participants having some acute illness in the last one month, the majority had suffered from acute respiratory illness followed by diarrhoea. The prevalence of different acute illness is presented in Figure 2. The "others" category included diseases like anemia, malaria, and Jaundice that were less prevalent.

Chronic illnesses

Among 168 participants suffering from chronic illnesses, majority had gastrointestinal (GI) related problems followed by musculoskeletal problems and hypertension. The prevalence of the ten most common

Tab. I. Frequency distribution of socio-demographic characteristics and WaSH practices (n = 879).

Characteristics	Total (n = 879)	Acute Illness n (%)	Chronic illness n (%)
Age			
10-20	208 (23.7)	22 (10.6)	14 (6.7)
21-30	174 (19.8)	11 (6.3)	7 (4.0)
31-40	157 (17.9)	16 (10.2)	25 (15.9)
41-50	134 (15.2)	11 (8.2)	35 (26.1)
51-60	114 (12.9)	14 (12.3)	50 (43.8)
Above 60	92 (10.5)	7 (7.6)	37 (40.2)
Gender			
Male	465 (52.9)	41 (8.8)	89 (19.1)
Female	414 (47.1)	40 (9.7)	79 (19.1)
Caste			
General	173 (19.7)	12 (6.9)	30 (17.3)
OBC/SEBC	480 (54.6)	52 (10.8)	104 (21.7)
Scheduled caste	52 (5.9)	04 (7.7)	06 (11.5)
Scheduled tribe	174 (19.8)	13 (7.5)	28 (16.1)
Education			
No education	225 (25.6)	18 (8.0)	66 (29.3)
Primary	183 (20.8)	16 (8.7)	36 (19.7)
Secondary	355 (40.4)	33 (9.3)	55 (15.5)
Higher	116 (13.2)	14 (12.1)	11 (9.5)
Marital status			
Never married	269 (30.6)	28 (10.4)	22 (8.2)
Currently married	585 (66.6)	53 (9.1)	138 (23.6)
Widow/widower	25 (2.8)	0	08 (32.0)
Usual source of drinking water			
Tap water	18 (2.0)	0	02 (11.1)
Tube well	433 (49.3)	36 (8.3)	80 (18.5)
Dug well	410 (46.6)	42 (10.2)	84 (20.5)
Surface water	18 (2.0)	03 (16.7)	02 (11.1)
Any treatment method to purify drinking water			
No	817 (92.9)	76 (9.3)	154 (18.8)
Yes	62 (7.1)	05 (8.1)	14 (22.6)
Where do you go for defecation			
Toilet (own)	444 (50.5)	51 (11.5)	86 (19.4)
Open space/field	435 (49.5)	30 (6.9)	82 (18.8)
Hand washing before taking food			
With water only	722 (82.1)	60 (8.3)	139 (19.2)
With soap/detergent/hand wash	157 (17.9)	21 (13.4)	29 (18.5)
Hand washing after defecation			
With water only	86 (9.8)	08 (9.3)	15 (17.4)
With soap/detergent/hand wash	531 (60.4)	55 (10.4)	110 (20.7)
Ash/Soil	262 (29.8)	18 (6.9)	43 (16.4)

chronic illnesses is presented in Figure 3. The "other" category included less prevalent conditions such as benign tumours, deafness, thyroid, and menstrual problems. Among the participants having chronic illnesses, while 131 (78.0%) had a single health illness, 25 (14.9%) had two and 12 (7.1%) had three or more health illnesses.

The bi-variate analysis between different acute illnesses and WaSH practices showed that the odds of drinking surface and dug well water was high for ARI, diarrhoeal disorder, and skin problem.

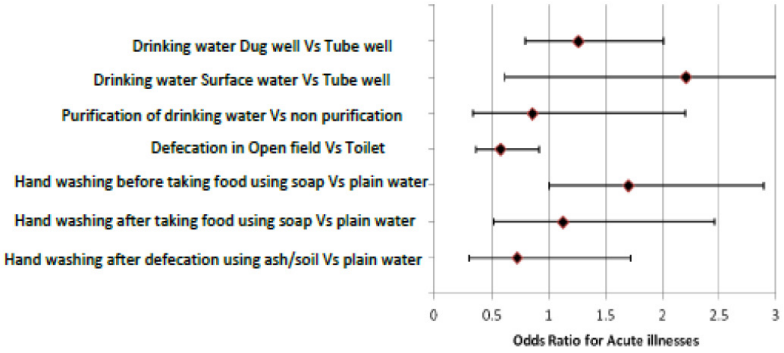
For ARI, the odds of surface water was significantly high compared to tube well water for drinking [OR = 4.4, 95% CI (1.16-16.35), p = 0.03]. The use of toilets had an OR of 2.25 [95% CI (1.18-4.30), p = 0.01] compared to open defecation. People washing their hands before taking food by using plain water had an OR = 0.27 [CI (0.15-0.50), p < 0.001] when compared to washing hands by using soap/detergent.

For diarrhoeal illness, drinking dug well water had an OR = 3.48 [95% CI (1.26-9.58), p = 0.016] compared to drinking tube well water. Similarly, using ash/soil for hand washing after defecation had an OR = 0.098 [95% CI (0.01-0.73), p = 0.02] compared to using soap/detergent.

For skin problems, hand washing after defecation using plain water had an OR = 12.62 [95% CI (1.13-140.71), p = 0.04] when compared with using soap/detergent. The detailed bi-variate analysis of different WaSH practices and having acute illnesses are depicted in Table II.

Fig. 1. A) association of WaSH practices with any acute illness among study participants (unadjusted OR); **B)** association of WaSH practices with any acute illness among study participants (adjusted OR).

A)



B)

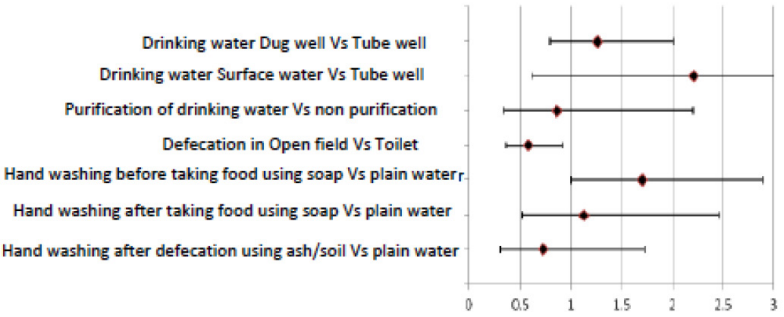


Fig. 2. Prevalence of different Acute Illnesses (N=879).

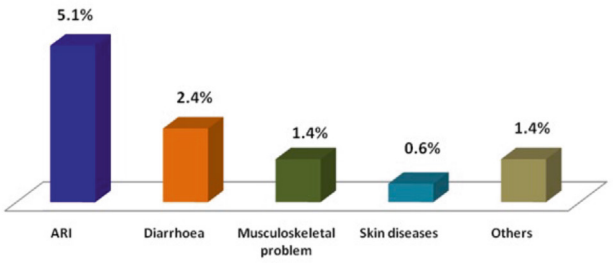
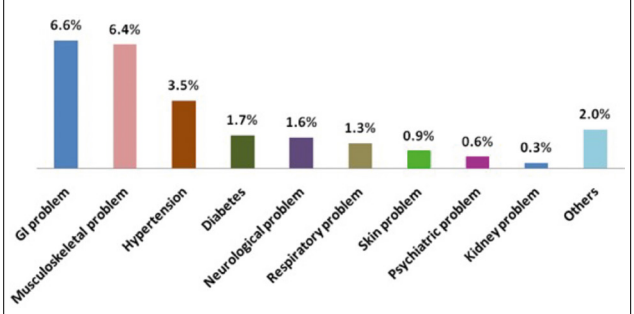


Fig. 3. Prevalence of Top 10 Chronic Illnesses (N=879).



Discussion

Clean water, toilet facilities, healthy food, and good hygiene practices are important to ensure better health. We observed the prevalence of acute infection was 8.8% among male and 9.7% among female participants respectively. According to a study among rural Indians, women face greater challenges in accessing water, sanitation, and hygiene (WaSH) resources leading to unsafe practices that increase the risk of infections [16]. Tube well was the prime source of drinking water (49.3%) followed by dug well (46.6%). A study from rural Bangladesh [17] had found 96% of people using tube well water for drinking, while another study from rural South India had shown 37% of people using tube well water for drinking [18]. National Family Health Survey-4 shows 87.5% of households in Odisha have improved access to drinking water sources in rural areas [15]. We observed a greater possibility of suffering from acute illnesses among people drinking surface and dug well water compared to those drinking tube well and tap water. The reason could be due to the greater possibility of contamination of surface and dug well water because of the high risk practices such as bathing and washing nearby the water source. In contrast to a study from India that has shown that 15.3% of people don't purify their drinking water [19], in our study only 6.6% of participants told that they purify the drinking water in their households. This implies low awareness among rural people on the importance of safe drinking water.

Tab. II. Bi-variate analysis of different acute illnesses and WaSH practices.

		ARI		Diarrhoeal disorder		Skin problem	
	N = 879	Yes (= 45)	OR	Yes (= 21)	OR	Yes (= 5)	OR
		n (%)		n (%)		n (%)	
Source of drinking water							
Tube well	433	19 (4.4)	1	05 (1.1)	1	02 (0.5)	1
Dug well	410	23 (5.6)	1.3	16 (3.9)	3.5*	03 (0.7)	1.6
Surface water	18	3 (16.7)	4.4*	0	2.1	0	4.7
Purify water for drinking							
Yes	62	03 (4.8)	1	01 (1.6)	1	01 (1.6)	1
No	817	42 (5.1)	1.1	20 (2.4)	1.5	04 (0.5)	0.3
Use toilet for defecation							
Yes	444	31 (7.0)	1	12 (2.7)	1	1 (0.2)	1
No	435	14 (3.2)	0.4*	09 (2.1)	0.8	04 (0.9)	4.1
Hand wash before taking food							
Soap/detergent/liquid hand wash	157	19 (12.1)	1	01 (0.6)	1	1 (0.6)	1
Only plain water	722	26 (3.6)	0.3*	20 (2.8)	4.4	4 (0.6)	0.9
Hand wash after defecation							
Soap/detergent/liquid hand wash	531	27 (5.1)	1	20 (3.8)	1	1 (0.2)	1
Ash/soil	262	13 (5.0)	0.9	01 (0.4)	0.1*	2 (0.8)	4.1
Only plain water only	86	05 (5.8)	1.1	0	0.1	2 (2.3)	12.6*

* Statistically significant with p-value < 0.05.

The main barriers to practice good hand hygiene have been resource limitation, lack of technical information dissemination, and not given priority [20]. The initiation of the Swacch Bharat Mission in India, has shown a great effect on improving rural sanitation and about 85.7% of people have found this program to be useful for their community [21]. According to a study on the Swacch Bharat Abhiyan, the number of acute diarrhoeal disease outbreaks have drastically come down during 2017 and 2018 after its introduction [22]. However, our study shows that around half of the participants still practice open field defecation, which is very high compared to another study that has found one-third of their rural study population practicing open defecation [19]. National Family Health Survey 4 (NFHS-4) conducted during 2016 in Odisha has found that less than one-fourth of rural households had improved sanitation facilities in the state [15]. This warrants for more awareness activities in rural communities under the Swacch Bharat Mission to bring positive change in the behaviour and practice of people. According to a study in the tribal community of Andhra Pradesh, India, open defecation was reported among 84.8% of the total population [23]. A study in rural areas of Odisha had found that most of the Government subsidized latrines were still unfinished and suggested for provisioning nearby water sources to toilets to improve its use [8].

A cluster randomized intervention trial has shown that through hand washing using soap and water, there was a 6.7% reduction of infection episodes [24]. In our study, only 17.9% of people wash their hands using soap/detergent while 82.1% of people wash their hands using plain water only, before taking food. Similarly after defecation, while 60.4% wash their hands using soap/detergent, 9.8% do it using plain water only and 29.8% wash their hands by using ash/soil. Another study had similarly found that 34% of people do not use soap/detergent to wash hands after defecation [19]. A study done from a semi-urban setting from India had found that about 43.5% of study population living with poor sanitation facilities, poor water handling practices, and having higher diarrheal incidences [25]. Other studies have also found that households not using soap/detergent to wash hands are more likely to suffer from diarrhoea [26] and pneumonia [1].

We found that practicing drinking water purification prevents 15% chances of having acute illnesses. A case study from Zambia had demonstrated that household water treatment (HWT) can improve drinking water quality and prevent diseases [27]. A study in the tribal community of Andhra Pradesh, India has found that 69% of households do nothing at home to make the water safe for drinking [23].

We observed that washing hands after defecation with ash/soil lowers the chance of suffering from acute diseases by 28% compared to using plain water only. A study from Bangladesh had shown that their study people mainly use ash and soil for hand washing after faecal contact [5]. The present study has shown that washing hands before taking food by using soap/detergent increases the chance of acute illness by about 70% compared to hand washing using plain water. This is in contrast to the conventional understanding and a trial on the effectiveness of different hand wash methods had demonstrated that hand washing using soap is better than plain water in removing the pathogens [28]. The reverse finding in our study could be due to the use of the same piece of soap by multiple members and multiple times, exposing it to get contaminated and become a source of infection. On further analysis, we found that hand washing before taking food by using soap/detergent had an odds of 3.7 times compared to plain water for ARI [OR = 3.68, CI (1.98-6.84), $p < 0.001$]. A previous study also indicates a significant increase in bacterial load on

the right hands after toilet use even after using soap for hand washing and the researchers had concluded that the paradox could be due to faulty technique of hand washing or washing for a short duration or touching contaminated surfaces after hand washing [29]. Further study on this aspect will improve our understanding on this finding. For skin related problems, the odds ratio of hand washing with plain water was 12.6 compared to hand washing with soap/detergent after defecation [OR = 12.62, CI (1.13-140.7), $p < 0.05$].

Taking the past one months' history, the prevalence of acute illnesses was found to be 9.6%. The major acute illnesses were ARI, diarrhoea, and musculoskeletal problems. The overall prevalence of chronic illnesses was found to be 19.1%. The most common chronic illnesses were GI disorders, musculoskeletal problems, and hypertension. An earlier study had shown that hypertension, cataract, and arthritis were the most prevalent co-morbid conditions [30]. Similar to our study findings, a study from middle-income countries had also observed that the burden of non-communicable disease (NCDs) has increased rapidly and is associated with higher levels of healthcare utilisation and greater financial burden for individuals [31].

Limitation of the study

The present study is from a rural setting of one block only and children aged up to 10 years were excluded. Information regarding hand washing was subjectively assessed and no information was collected about its technique and duration. The results need to be interpreted accordingly.

Conclusions

WaSH practices among the rural population are a matter of concern. Poor WaSH practices make them vulnerable to various acute and chronic morbidities. A systemic approach towards improving health awareness, socio behavioral change in WaSH practices, and adherence to appropriate techniques of hand washing including sanitization needs to be taken up on priority, for these populations through grounded interventions.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

SKP: Designing the study, obtaining ethical approval, Data collection tools, Data analysis, Manuscript writing, review and revision of the manuscript.
SK: Data analysis, Manuscript writing, review and revision, Advocacy.
MS: Data collection tool development, Data collection, Manuscript writing.
SP: Data collection, Data analysis, Manuscript writing.
DS: Data collection, Advocacy, Manuscript writing.
SP: Study planning, Ethical approval, Tool finalization, Manuscript review, Advocacy.

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