



Manuscript ID: ZUMJ-2411-3704

DOI: 10.21608/zumj.2024.339646.3704

ORIGINAL ARTICLE

Water, Sanitation and Hygiene (WASH) Practices among Rural and Urban School Students in Iringa, Tanzania

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Submit Date: 28-11-2024

Revise Date: 14-12-2024

Accept Date: 20-12-2024

ABSTRACT

Background: Access to adequate Water, Sanitation, and Hygiene (WASH) facilities in rural schools remains challenging, resulting in poor sanitation and hygiene practices and increased risk of waterborne diseases among students. Despite having better resources, urban schools face challenges like limited resources and high student populations that strain WASH facilities. The study evaluates WASH practices among primary and secondary students in urban and rural Iringa, Tanzania, focusing on comparing reported practices and identifying factors associated with WASH practices.

Methods: This study used a cross-sectional design among 1,536 students from 64 primary and secondary schools in rural and urban Iringa, Tanzania. Data were collected through structured questionnaires and analyzed using Statistical Package for Social Sciences (SPSS) version 26, focusing on descriptive and comparative statistics to assess WASH practices and identify significant relationships between variables.

Results: The study found that 53.5% of rural students had adequate WASH practices, compared to 85.9% in urban areas. A Mann-Whitney U test showed a significant difference in practice scores ($Z = -3.545$, $P < 0.001$), with urban schools having a median score of 78.57% versus 57.14% in rural schools. Although binary logistic regression did not reveal a significant relationship between the two groups, it indicated that public schools (AOR = 2.129), students in the Kilolo district (AOR = 15.979), and boarding students (AOR = 2.874) were more likely to inadequate WASH practices.

Conclusions: This study revealed rural-urban disparities among students regarding WASH practices, highlighting the urgent need for targeted interventions in rural schools.

Keywords: Sanitation; Hygiene; WASH; Practices; Students

INTRODUCTION

In rural schools, access to Water, Sanitation, and Hygiene (WASH) facilities remains a significant challenge. A study conducted in Pakistan reported that while 70% of rural schools had access to improved water sources, less than 25% had adequate sanitation facilities [1]. This disparity is echoed in findings from Ethiopia, where students in rural areas were found to be 18.84 times less likely to practice proper handwashing compared to their urban counterparts [2]. The lack of resources in rural

settings often translates into poor hygiene practices, which can lead to increased incidences of waterborne diseases among students [3]. Furthermore, a systematic review indicated that rural schools often lack the necessary infrastructure to support effective hygiene education, which is critical for instilling good practices among students [4].

Conversely, while generally better equipped, urban schools still face challenges related to WASH practices. For instance, a study in urban India found that most students who did not practice proper

handwashing cited a lack of soap as a primary reason [5]. This highlights that even in urban settings, the availability of resources does not always translate into effective hygiene practices. Moreover, urban schools often experience larger class sizes, which can strain WASH facilities and reduce the effectiveness of hygiene education programs [6].

Educational interventions have been shown to improve WASH practices in both rural and urban settings. A handwashing education program in rural Bangladesh resulted in 97.4% of students reporting handwashing with soap after using the toilet, while a school-based WASH intervention increased hygiene knowledge scores from 15.17 to 34.13 post-intervention [7, 8]. Moreover, research indicates that the presence of supportive school staff, such as janitors and teachers, is crucial for maintaining WASH facilities and promoting hygiene practices [9]. In rural areas, where resources are often limited, the absence of such support can hinder the effectiveness of WASH interventions [10].

In rural Tanzanian schools, research reported inadequate WASH facilities, including non-functional handwashing stations and dirty latrines, hinder effective hygiene practices [11]. A similar trend was observed in a study that highlighted the inadequacy of WASH facilities in rural schools, where only 39.8% of respondents reported that handwashing facilities were sufficient [12]. Rural schools struggle with limited resources and hygiene practices, increasing their risk of waterborne diseases, while urban schools in Tanzania, despite better facilities, face significant WASH challenges, including a notable lack of soap hindering effective handwashing among students [13]. This suggests that even in urban settings, the presence of facilities does not guarantee effective hygiene practices.

This study aims to evaluate WASH practices among primary and secondary school students in rural and urban areas of Iringa, Tanzania. The objectives are to compare WASH practices among students in two settings and identify influential factors leading to targeted education programs, especially for rural schools with notable gaps.

METHODS

Area of study: This research was conducted in the districts of Iringa, Kilolo, and Mufindi, which together form the Iringa region of Tanzania. Located in the Southern Highlands, the Iringa Region lies south of the Equator, between latitudes 6° 55' and 9°

00' south and longitudes 33° 45' and 36° 55' East. It is bordered by Singida and Dodoma to the north, Morogoro to the east, Mbeya to the west, and Njombe to the south [14]. Iringa municipality was selected to represent urban schools, while Kilolo and Mufindi districts symbolize rural settings. Iringa district has 151 primary and 42 secondary schools, with 50 primary and 30 secondary schools in the municipality. Kilolo district has 133 primary and 44 secondary schools, and Mufindi district has 162 primary and 48 secondary schools [15-18].

Study design: This research carried out from July 4 to July 25, 2024, employed a cross-sectional analytical approach to assess WASH practices among students in rural and urban primary and secondary schools in the Iringa region of Tanzania.

Study population: This research involved students from rural and urban schools in the Iringa area, including a mix of public and private schools, as well as day and boarding schools. For primary school students, the emphasis was placed on standard 5 to 7, while those in the lower grades (standard 1 to 4) were excluded from the study. For secondary education, the research included both O-level students (form 1 to 4) and A-level students (form 5 to 6).

Sample size and sampling techniques: A balanced selection of rural and urban schools was conducted to ensure proportional representation among private and public schools, primary and secondary schools, and boarding versus day schools. The study encompassed 64 schools, employing a stratified random sampling method to achieve adequate representation: 32 schools were selected from rural areas (16 from Kilolo and 16 from Mufindi), and 32 were drawn from Iringa Municipality to ensure urban representation. Students were selected using a simple random sampling method from the classrooms. The Cochran formula was employed to determine the sample size of students for the rural districts of Kilolo and Mufindi, which was then replicated for the urban area for equal structured representation.

Cochran formula: $N = \frac{Z^2 P(1-P)}{d^2}$

d^2

Where;

N = Minimum sample size

Z = Constant, standard normal deviation (1.96 for 95% Confidence level)

P = Estimated proportion of the population (50% or 0.5) to maximize sample size in the absence of precise prevalence data
d = Acceptable margin of error (5% or 0.05)

$$\text{For Kilolo district: } N = \frac{1.96^2 \times 0.5 \times (1 - 0.5)}{0.05^2} = 384 \text{ students}$$

The total number of students in rural schools reached 768, which was complemented by the same sample size of 768 students from urban schools, resulting in a cumulative total of 1,536 students.

Data collection: Data were collected using structured questionnaires designed to assess Water, Sanitation, and Hygiene (WASH) practices among students. The questionnaires included both recommended and non-recommended practices. Participants received 14 questions, each with four options, and were required to select one option that they normally practice. Among these options, one was identified as a recommended practice, while the other three were non-recommended. The frequency of reported recommended practices was then used to calculate a WASH practice adequacy score expressed as a percentage for each student.

Data analysis: Data analysis was conducted using version 26 of the Statistical Package for Social Sciences (SPSS). Both descriptive and comparative data were analyzed to summarize and interpret the results. Frequencies and percentages related to WASH practices were computed. Significant relationships between variables were examined using the P-value obtained from cross-tabulation, while predictors linked to these practices were analyzed through binary logistic regression. The levels of practice were categorized into two groups: Adequate practices (60% to 100%), and Inadequate practices (<60%).

ETHICAL CONSIDERATIONS

Ruaha Catholic University (RUCU) granted ethical approval for this research, which is referenced as RU/PC/RP/2024/14. Permission to conduct the study was obtained from the regional education officer's office, the relevant district education officers, and the heads and administrators of the schools involved. All data collected were handled with the utmost confidentiality, ensuring that no personal information was disclosed.

RESULTS

Socio-demographic characteristics of rural-urban students in schools

The demographic profile of 1,536 students highlights key characteristics, with the majority, 543 (35.4%) students aged 10-12 years, followed by 13-15 years 533 (34.7%) students. Gender representation shows 689 (44.9%) males and 847 (55.1%) females, indicating a slightly higher representation of females. In terms of education level, 772 (50.3%) students were in primary school, followed by 690 (44.9%) in O-level secondary school (form 1-4). The student population is evenly split between urban and rural areas, each with 768 (50%). About 1,017 (66.2%) students were assessed in public schools and 519 (33.8%) in private schools. Concerning living situations, 1,074 (69.9%) students were day students, and 462 (30.1%) boarding students, as described in **Table 1**.

WASH practices among students in schools

Water, hygiene, and sanitation practices among school students show varying levels of compliance. Practices with good compliance include using clean water for drinking with 1,237 (80.5%) students, maintaining the cleanliness of personal hygiene items by 1196 (77.9%) students, and washing hands with soap and water before eating by 1177 (76.6%) students. Conversely, the practices with the lowest compliance rates are using hand sanitizer when soap and water are unavailable by 596 (38.8%) students, trimming nails regularly to prevent dirt accumulation by 770 (50.2%) students, and cleaning and disinfecting surfaces regularly by 869 (56.6%) students as described in **Table 2**.

Description of WASH practice levels among students in rural and urban schools

The findings presented in the **Figure** indicate a disparity in the levels of WASH practice among students from rural and urban areas, categorized as either adequate or inadequate. In rural regions, 53.5% of students exhibit adequate practices, while nearly half (46.5%) are classified as inadequate. In contrast, urban students show a much higher rate of adequate practices at 85.9%, with only 14.1% falling into the inadequate category. Overall, 69.7% of students across both settings are deemed adequate.

Mann-Whitney U test comparison of practice scores between urban and rural schools

A Mann-Whitney U test demonstrated a statistically significant difference in practice scores between urban and rural schools ($U = 177,956.00$, $Z = -13.545$, $P < 0.001$). Urban schools exhibited a higher median practice score of 78.57% (IQR: 78.57–92.86, mean rank: 920.79) in comparison to rural schools, which reported a median practice score of 57.14% (IQR: 57.14–78.57, mean rank: 616.21), as illustrated in **Table 3**.

Bivariate analysis of factors associated with the level of WASH practices among students in schools

Significant relationships were observed in the bivariate analysis of factors associated with WASH practices among 1,536 students. The educational level was significantly associated with WASH practices, with a p-value of 0.006. School location (rural and urban), type of school (public and private), and school districts showed noteworthy associations with WASH practices, all having p-values < 0.001 . In contrast, the analysis found no statistically significant associations between age and gender with WASH practices, as detailed in **Table 4**.

Binary logistic regression odds ratios for factors associated with the levels of WASH practices among students in schools

The results revealed that students in public schools demonstrated a markedly higher odds ratio (AOR = 2.129, $p < 0.001$, 95% CI: 1.448 - 3.13) for inadequate WASH practices compared to their private school counterparts when adequate practice was used as a reference category. Additionally, students from the Kilolo district exhibited a very high odds ratio (AOR = 15.979, $p < 0.001$, 95% CI: 11.022 - 23.165), indicating a strong likelihood of practicing inadequate WASH practice. Furthermore, boarding students had significantly higher odds of inadequate practice than day students (AOR = 2.874, $p < 0.001$; 95% CI: 1.892 - 4.365). These results underscore the importance of school type, district, and living situation in promoting effective WASH practices among students. However, no significant associations were found between age, gender, level of study, or school location with WASH practices, indicating that these factors do not play a role in determining students' WASH practices, as described in **Table 5**.

Table 1: Socio-demographic characteristics of students in schools (N = 1536)

Variables	Frequency (n)	Percent (%)
Age		
Under 10 years	70	4.6
10-12 years	543	35.4
13-15 years	533	34.7
16-18 years	338	22
Over 18 years	52	3.4
Gender		
Male	689	44.9
Female	847	55.1
Level of study		
Primary school (Standard 5-7)	772	50.3
Secondary school (Form 1-4)	690	44.9
High school (Form 5-6)	74	4.8
School Location		
Urban	768	50
Rural	768	50
Type of school		
Public	1017	66.2
Private	519	33.8

School district		
Iringa	768	50
Variables	Frequency (n)	Percent (%)
Kilolo	384	25
Mufindi	384	25
Living situation		
Boarding student	462	30.1
Day student	1074	69.9

Table 2: WASH practices among students in schools (N = 1536)

Practices assessed	Practice responses	
	Recommended	Non-Recommended
	n (%)	n (%)
Wash hands with soap and water before eating	1177 (76.6)	359 (23.4)
Use soap and water to wash hands after using the toilet	1177 (76.6)	359 (23.4)
Use a tissue or elbow to cover mouth when sneezing or coughing	1102 (71.7)	434 (28.3)
Dispose of waste in designated bins or containers	995 (64.8)	541 (35.2)
Clean and disinfect surfaces regularly (e.g., desks, tables)	869 (56.6)	667 (43.4)
Keeping personal hygiene items clean.(e.g., toothbrush, comb)	1196 (77.9)	340 (22.1)
Keeping shared spaces clean (e.g., classrooms, hallways).	1146 (74.6)	390 (25.4)
Use clean water for drinking purposes	1237 (80.5)	299 (19.5)
Maintain cleanliness of toilets or latrines in the school	1119 (72.9)	417 (27.1)
Wash fruits and vegetables before consuming	1125 (73.3)	411 (26.7)
Trim nails regularly to avoid dirt accumulation	770 (50.2)	766 (49.8)
Avoid sharing personal hygiene items (e.g., towels, razors)	991 (64.5)	545 (35.5)
Use hand sanitizer when soap and water are not available	596 (38.8)	940 (61.2)
Participate in school-wide hygiene promotion activities	1181 (76.9)	355 (23.1)

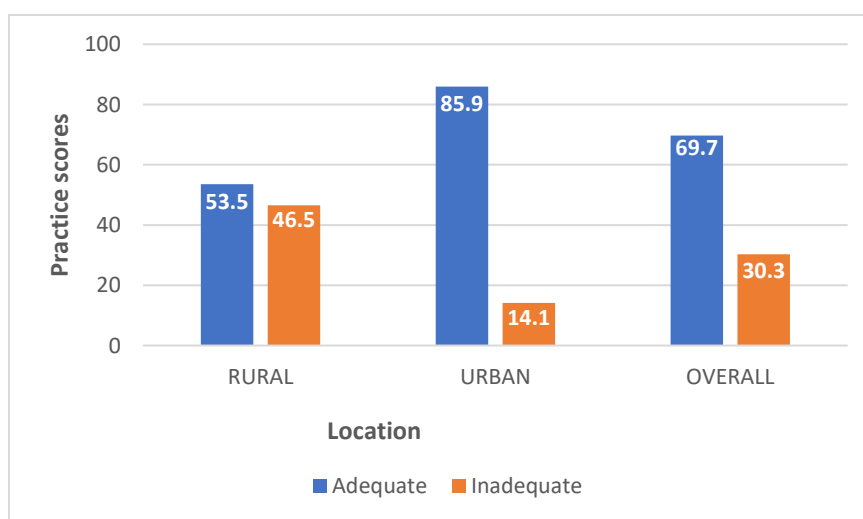


Figure (1): Description of WASH practice levels among rural and urban students in schools

Table 3: Mann-Whitney U test comparing practice score between urban and rural schools

School Location	Median (%)	IQR (%)	Mean Rank	Mann-Whitney U	Z-value	P-value
Urban	78.57	78.57 - 92.86	920.79	177,956.00	-13.545	< 0.001*
Rural	57.14	57.14 - 78.57	616.21			

* P<0.05 is statistically significant, IQR = Interquartile Range

Table 4: Bivariate analysis of factors associated with the level of WASH practice among students in schools (N = 1536)

Predictor variables	Level of practices		Chi-square	P-value
	Adequate	Inadequate		
	n (%)	n (%)		
Age				
Under 10 years	48 (3.1)	22 (1.4)		
10-12 years	363 (23.6)	180 (11.7)		
13-15 years	368 (24.0)	165 (10.7)	7.300	0.121
16-18 years	252 (16.4)	86 (5.6)		
Over 18 years	40 (2.6)	12 (0.8)		
Gender				
Male	465 (30.3)	224 (14.6)	2.963	0.085
Female	606 (39.5)	241 (15.7)		
Level of study				
Primary school (Standard 5-7)	512 (33.3)	260 (16.9)		
Secondary school (Form 1-4)	500 (32.6)	190 (12.4)	10.198	0.006*
High school (Form 5-6)	59 (3.8)	15 (1.0)		
School Location				
Urban	660 (43.0)	108 (7.0)	191.226	< 0.001*
Rural	411 (26.8)	357 (23.2)		
Type of school				
Public	679 (44.2)	338 (22.0)	12.506	< 0.001*
Private	392 (25.5)	127 (8.3)		
School district				
Iringa	660 (43.0)	108 (7.0)		
Kilolo	98 (6.4)	286 (18.6)	476.365	< 0.001*
Mufindi	313 (20.4)	71 (4.6)		
Living situation				
Boarding student	319 (20.8)	143 (9.3)	0.144	0.704
Day student	752 (49.0)	322 (21.0)		

* P<0.05 is statistically significant

Table 5: Binary logistic regression for factors associated with the level of WASH practice among students in schools (N = 1536)

Predictor variables	Adequate (Reference) Vs Inadequate practice				
	B	p-value	AOR	95% CI for AOR	
				Lower	Upper
Age					
Under 10 years	0.338	0.609	1.402	0.383	5.13
10-12 years	0.516	0.384	1.675	0.524	5.356
13-15 years	0.049	0.931	1.05	0.349	3.163
16-18 years	-0.095	0.86	0.909	0.316	2.615
Over 18 years	Reference				
Gender					
Male	0.087	0.537	1.09	0.828	1.435
Female	Reference				
Level of study					
Primary school (Standard 5-7)	0.549	0.303	1.732	0.609	4.921
Secondary school (Form 1-4)	0.281	0.56	1.325	0.515	3.409
High school (Form 5-6)	Reference				
School Location					
Urban	-0.17	0.332	0.844	0.598	1.189
Rural	Reference				
Type of school					
Public	0.756	< 0.001*	2.129	1.448	3.13
Private	Reference				
School district					
Iringa	N/A				
Kilolo	2.771	< 0.001*	15.979	11.022	23.165
Mufindi	Reference				
Living situation					
Boarding student	1.056	< 0.001*	2.874	1.892	4.365
Day student	Reference				

* P<0.05 is statistically significant, **B** = Coefficient, degree of freedom (**df**) = 1, **CI**=Confidence Interval, **AOR**=Adjusted Odds Ratio, **NA** = Excluded due to perfect separation

DISCUSSION

WASH practices among students in rural and urban schools revealed disparities. The study found that 53.5% of rural students practiced adequate WASH standards, compared to 85.9% of urban students. A Mann-Whitney U test revealed a notable difference in practice scores ($Z = -3.545, P < 0.001$), with urban schools reporting a median score of 78.57% compared to 57.14% in rural schools. Furthermore, bivariate analysis revealed a significant difference ($p < 0.001$) between the two groups, highlighting the

need for targeted interventions in rural areas, where nearly half of the students have inadequate practices despite lacking support in logistic regression. These results are similar to another Tanzania study, which revealed that 95% of students from urban primary schools reported having access to clean water and functional sanitation facilities, which facilitated better hygiene practices, such as regular handwashing [19]. In Uganda, a similar trend was observed with a higher prevalence of urban students (80%) washing their hands with soap after using the

toilet, compared to only 45% of their rural counterparts [20].

The findings align with a study conducted in Harar, Ethiopia, which found that urban students were more likely to practice proper handwashing than their rural counterparts [21]. Similarly, the study of Talukda et al. on menstrual hygiene management among adolescent girls revealed that urban respondents had better access to WASH facilities and resources, significantly influencing their hygiene practices than those in rural settings [22]. Additionally, the study from Malawi reported that urban students frequently brushed their teeth, which was statistically validated through bivariate analysis [23]. This may explain why the Kilolo district, a rural area, reported a higher likelihood of inadequate practices in this recent study. These disparities may be attributed to differences in educational resources and access to dental care information, which were more readily available in urban areas.

In contrast, a study in Bangladesh reported that rural girls had greater access to traditional menstrual hygiene methods, which they preferred due to cultural beliefs and practices [24]. This aligns with Tanzanian studies which revealed that cultural beliefs impact rural girls' menstrual hygiene practices, leading them to prefer traditional methods over sanitary products, which urban girls access more easily [25,26]. These insights highlight the importance of understanding local contexts when designing WASH interventions.

This study found that public school students were more likely to have inadequate WASH practices than private school students. However, the results contrast with one study in Colombia, which revealed that although students in private schools had better knowledge about air pollution, their environmental practices were not significantly different from those in public schools [27]. Furthermore, the findings of this current study are similar to those of one study in Nigeria, which found that students attending private schools typically have higher levels of personal hygiene compared to those in public schools [28]. Another study in Pakistan found that the overall oral hygiene status was higher in private school students than in public school students [29]. These disparities arise as private school parents typically have higher education and income, ensuring better access to WASH facilities while public schools struggle with issues like low motivation, limited information

access, and lower parental income and education [28,30].

This study reported significant inadequate practices among boarding school students compared to day students. In contrast, a study in Ethiopia revealed that adolescent girls in boarding schools had better access to information and support related to menstruation management compared to their counterparts in day schools [31]. This indicates that the more controlled and resource-rich environment of boarding schools may contribute to improved hygiene management. Moreover, a study in Nigeria found that incorporating WASH knowledge into school curricula and emphasizing WASH practice in boarding schools improved WASH-related practices among students [32]. Some studies have shown that both day and boarding school students demonstrate high rates of good handwashing practices, indicating that the relationship between their boarding status and their WASH practices may be more nuanced [2, 33]. However, the lack of essential WASH resources in schools, especially in boarding schools, negatively impacts students' ability to follow proper WASH practices [34].

LIMITATIONS OF THE STUDY

As a cross-sectional study captured data at a single point in time, limiting the ability to assess changes in WASH practices over time. External factors like seasonal changes, public health crises (e.g., COVID-19), and local governance were not fully considered, which can potentially influence WASH practices. The quantitative focus may also limit qualitative insights into students' behaviors and attitudes regarding WASH practices. These limitations highlight the need for further research in Tanzania to better understand the dynamics of WASH practices and their influencing factors among school students.

CONCLUSIONS

The analysis highlights a crucial disparity in WASH practices between rural and urban students, underscoring the urgent need for targeted interventions in rural schools. The difference in practice levels indicates that rural students may be at a higher risk for health-related issues due to inadequate hygiene practices. To address this gap, it is essential to develop and implement effective educational programs and resource allocation to enhance WASH practices in rural areas. By improving these conditions, we can contribute to

better health outcomes and overall well-being for students in underserved regions.

ACKNOWLEDGMENTS

The author expresses gratitude to Ruaha Catholic University (RUCU) for granting ethical clearance and acknowledges the support of regional and district education officers, school heads, and administrators for their valuable contributions to this study.

Financial Disclosures: No any funding support in this study.

Conflict of Interest: No any conflict of interest in this study.

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Citation

Magwe, E. A. Water, Sanitation and Hygiene (WASH) Practices among Rural and Urban School Students in Iringa, Tanzania. *Zagazig University Medical Journal*, 2025; (435-445): -. doi: 10.21608/zumj.2024.339646.3704