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Assessing and comparing knowledge, attitude, and practices related to water, sanitation and hygiene among government and non-government school students in Gujarat: a mixed method study

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Abstract

Background Water, sanitation, and hygiene (WASH) practices are vital for health, especially among school students who can propagate messages. Comparing WASH knowledge, attitudes and practices between government and non-government schools can guide tailored interventions. This study aimed to assess and compare WASH-related knowledge, attitudes, and practices among adolescents in government versus non-government schools in Gujarat, India.

Materials and methods A cross-sectional survey was conducted among 566 students from 17 government and 17 non-government schools. Interviews using a standardized questionnaire provided quantitative data on WASH-related knowledge, attitudes, and practices. Qualitative data was gathered through focus group discussions exploring influences on student WASH behaviors. Analyses included descriptive statistics, group comparisons, multivariate regression, and thematic analysis. A value of $P < 0.05$ was considered significant.

Results In total, 566 students participated, with 257 (45%) from government and 309 (55%) from non-government schools. Non-government students showed significantly better knowledge of handwashing (AOR 1.9, 95% CI 1.3–2.7), fecal-oral transmission (AOR 1.8, 95% CI 1.3–2.5), open defecation (AOR 1.7, 95% CI 1.2–2.4), and menstrual hygiene (AOR 3.2, 95% CI 1.1–9.2). More non-government students had positive attitudes about safe drinking water (AOR 4.1, 95% CI 1.8–9.6), conserving water (AOR 2.0, 95% CI 1.4–2.9), cleanliness (AOR 1.8, 95% CI 1.1–2.9), investing in hygiene (AOR 5.3, 95% CI 3.1–9.2), and menstrual management (AOR 2.1, 95% CI 1.2–3.6). In practices, non-government students showed higher use of soap (AOR 1.9, 95% CI 1.3–2.8), better menstrual hygiene (AOR 5.9, 95% CI 3.2–10.9), and more sanitary defecation (AOR 2.7, 95% CI 1.8-4.0). Superior WASH outcomes were associated with older age (AOR 1.8, 95% CI 1.1-3.0), urban locality (AOR 2.3, 95% CI 1.5–3.5), higher parental education (AOR 2.1, 95% CI 1.3–3.4), and

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affluence (AOR 3.1, 95% CI 1.8–5.2). Qualitative data highlighted knowledge gaps, inadequate facilities, detrimental cultural beliefs, poverty, and the need for government support.

Conclusions Disparities exist in WASH behaviors between school types, suggesting the need for tailored interventions addressing specific gaps. Schools play a critical role in cultivating proper hygiene through infrastructure provision and targeted education. Government schools may require extra support to overcome challenges related to WASH access and quality.

Keywords Hand hygiene, Sanitation, Health knowledge, attitudes, practice, Schools, Health promotion, India

Introduction

Water is the most precious global commodity with its myriad uses for drinking, recreation, sanitation, hygiene, agriculture, and industry. One of the world's most urgent issues is the lack of safe water, sanitation, and hygiene [1]. Despite its significance, a pressing global issue persists the widespread lack of access to safe Water, Sanitation, and Hygiene (WASH). Alarmingly, 780 million people worldwide lack access to improved water sources, and 2.5 billion people live without adequate sanitation. In developing countries, the repercussions of inadequate WASH are stark, with a staggering 88% of diarrheal diseases attributed to unsafe water supply, inadequate sanitation, and poor hygiene. Tragically, an estimated 801,000 children under the age of 5 succumb to diarrheal illnesses annually, underscoring the urgent need for targeted interventions [2].

The potential impact of Water, Sanitation, and Hygiene on global health is immense, with the potential to alleviate 9.1% of the global disease burden and prevent 6.3% of all deaths. Investments in WASH interventions not only prove cost-effective but also yield substantial economic benefits, ranging from US$ 5 to US$ 46 per US$ 1 invested [3]. The Sustainable Development Goals (SDGs) recognize the critical role of WASH in schools, particularly in achieving Goal 6 (Clean Water and Sanitation) and Goal 4 (Quality Education). The "Water, Sanitation and Hygiene Education (WASH) in Schools" initiative emerges as a pivotal strategy to instill healthy behaviors, especially in children who possess the potential to become change agents within their families and communities [4].

Beyond the provision of resources and facilities, the effectiveness of hygiene practices is significantly influenced by students' knowledge and attitudes. A study conducted in Senegal revealed diverse reasons for not washing hands, including factors such as stubbornness, laziness, time constraints, and the perceived unpleasantness of toilets School-going children, especially adolescents, are recognized as key knowledge carriers, often transferring their learnings from schools to homes and communities [5, 6]. Investing in adolescents is deemed an effective strategy to combat poverty and inequalities, as they can become key change drivers when equipped with the right opportunities, information, and tools [7].

In Gujarat, the context of this study, significant WASH challenges persist despite recent progress. As of 2021, the state reports 95% coverage of improved water sources, yet only 62% of rural households have piped water connections. While the state's literacy rate is 79.3%, higher than the national average, there are marked urban-rural and gender disparities. In rural Gujarat, only 71% of schools have functional toilet facilities for girls, potentially affecting school attendance and hygiene practices. The state government's 'Swachh Vidyalaya' initiative aims to improve school WASH infrastructure, but implementation varies between government and non-government institutions. These disparities in WASH access and literacy, particularly in educational settings, underscore the need for comparative assessment to guide targeted interventions [25, 26, 27].

This research acknowledges the pivotal role of adolescents in shaping community behaviors. It aims to bridge existing research gaps by comprehensively examining the Knowledge, Attitude, and Practices (KAP) of school-going students regarding WASH. Focusing on a country like India, where challenges persist for children with disabilities and school drop rates among adolescent girls are alarming, a nuanced evaluation of WASH is indispensable. This study contributes valuable insights into enhancing WASH practices in schools, ultimately fostering healthier, more informed, and empowered student communities. The research explores the intricacies of students' hygiene-related KAP, recognizing the potential impact on reducing diseases and improving overall well-being. This mixed methods cross-sectional study aimed quantitatively to determine and compare the levels of knowledge, attitudes, and practices related to key WASH indicators among students from government versus non-government schools and to analyze the association between students' WASH-related KAP and selected socio-demographic factors like age, gender, residence, parent's education level, and socioeconomic status. Qualitatively to explore and compare factors influencing WASH practices including environmental barriers, access to products, government policies, behaviors, social norms, and availability of support between

students from government and non-government schools. In Mixed Method, integrate and triangulate findings from the quantitative survey and qualitative inquiry to derive a more comprehensive understanding of influences on WASH-related KAP among school students in this setting.

Materials and methods

The present study was designed as a mixed-method study aiming to gain valuable insights into the knowledge, attitudes, and practices related to Water, Sanitation, and Hygiene (WASH) among adolescent students in schools within the municipal corporation area of the designated study city. The research spanned from July 2019 to December 2020, providing a comprehensive overview of the prevailing conditions during this period. The study specifically targeted secondary, co-educational schools, with participation contingent upon meeting predefined inclusion criteria.

The study was conducted in Jamnagar district of Gujarat, India. Jamnagar is the fifth-largest city in Gujarat with a population of approximately 600,000. The district has 120 secondary schools, comprising 39 government and 81 private/trust-funded schools.

Schools that fell within the municipal corporation area, catered to secondary education, operated on a co-educational basis, and willingly provided consent were considered eligible for inclusion in the study. These criteria were established to ensure a representative sample that aligns with the study's focus on adolescent students and their WASH-related knowledge, attitudes, and practices. Conversely, exclusion criteria were applied to schools located outside the municipal corporation area, exclusively catering to boys or girls, limited to primary and pre-primary education levels, and those unwilling to grant consent for participation.

The research aimed to provide a nuanced understanding of WASH-related dynamics among adolescent students in the designated urban context by employing a mixed-method study design and carefully selecting schools based on the specified inclusion and exclusion criteria. The chosen duration allowed for a comprehensive examination of these aspects, contributing to a robust analysis of the prevalent conditions within the selected schools during the defined timeframe.

Selection of study sample

In the study area, there were a total of 120 secondary schools. Out of which 39 were government or government and the rest were private or trust-funded schools (Non-government).

As per our exclusion and inclusion criteria, 17 government schools were eligible to be considered in our study out of 39. Of all private schools (81) located in the study area, 43 schools were eligible. We randomly selected 17 schools for comparison purposes.

Therefore, all government schools in the study area which were eligible were included in our study which came to be 17 in number. Then we took 17 schools randomly selected from eligible non-government schools for comparison. Hence, a total of 34 schools (17 government and 17 non-government) were included in this study. (figure 1)

Of the 39 government schools, 17 met our eligibility criteria: (1) located within municipal corporation limits, (2) offering secondary education, (3) co-educational

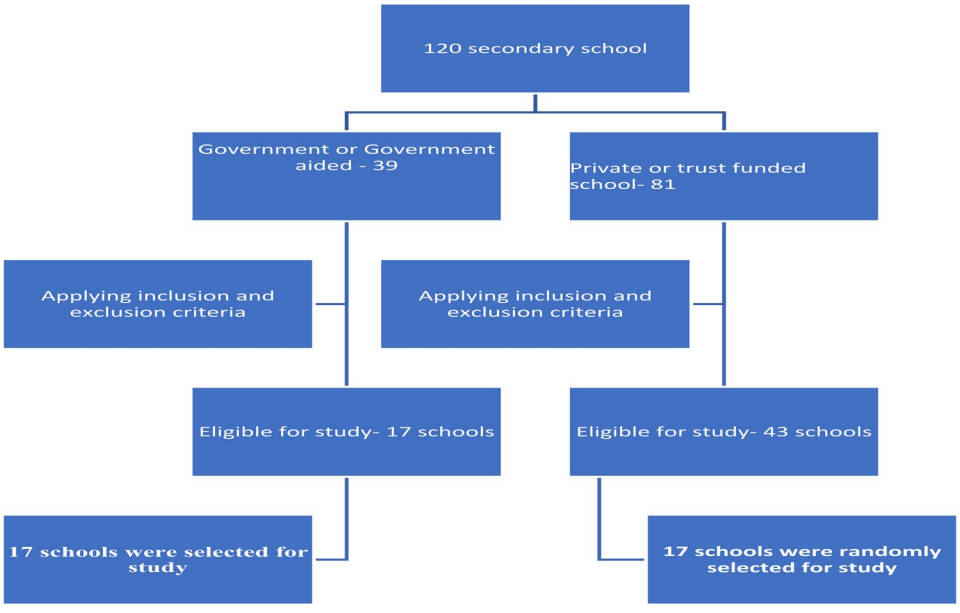

Fig. 1 Shows the selection of schools for the study

status, and (4) having continuous operation for at least 5 years. The remaining 22 schools were excluded as they were either single-gender schools (n = 12), newly established (< 5 years; n = 5), or located outside municipal limits (n = 5)."

Private School Selection: Inclusion Criteria:

- Located within municipal corporation limits.
- Offering secondary education (grades 8–12).
- Co-educational institution.
- Operational for a minimum 5 years.
- Willing to participate in the study.

Exclusion Criteria:

- Single-gender schools.
- Primary/pre-primary only schools.
- Schools outside municipal limits.
- Schools unwilling to participate.
- Schools operational for < 5 years.

A sample of 566 students was recruited from government and non-government schools using stratified random sampling to obtain equal numbers of males and females aged ≤ 16 years (284 males, 282 females, 142 aged ≤ 10 years, 351 aged 11–15 years, 73 aged ≥ 16 years). Stratified random sampling ensures representativeness across key demographic factors [8]. The sample size was calculated using standard methods for cross-sectional surveys, assuming a 95% confidence level and 5% margin of error [9]. The sample size was calculated using the formula for cross-sectional studies: $n = Z^2pq/d^2$ where Z = 1.96 at 95% confidence level $p = 50\%$ (assumed prevalence as no previous similar study was available) q = 1-p d = 5% (absolute precision).

This gave us a minimum required sample size of 384. Accounting for a 10% non-response rate, the final sample size was calculated as 422. We ultimately recruited 566 students to increase the study's precision.

Study period and tools used for data collection.

- KAP assessment was conducted by a structured questionnaire with a sample of 20 students from each school randomly selected from classes 9th and 10th.
- A pre-validated standard tool was used in the form of a questionnaire prepared by the WHO and UNICEF Joint monitoring program for water supply, sanitation, and hygiene monitoring in schools.
- The questionnaire includes questions on the knowledge, attitude, and behavior of students regarding WASH, water supply, and sanitation.

Grade Selection Rationale: "Grades 9th and 10th were selected because:

- Students in these grades (ages 14–16) have adequate cognitive development to understand and respond to complex WASH-related questions.
- These grades typically have stable attendance rates.
- Students this age can serve as effective change agents in their communities.
- They have several years of school experience to reflect on WASH facilities and practices.

This study was done for a period of 18 months from July 2019 to December 2020. A pre-validated standard tool was used in the form of a questionnaire prepared by the WHO and UNICEF Joint monitoring program for WASH monitoring in schools.

Quantitative data was collected via a pre-tested, interviewer-administered structured questionnaire adapted from UNICEF (JMP, 2014) [4] and other standardized tools [10, 11]. The questionnaire captured data on participants' demographic details, as well as knowledge, attitudes, and practices regarding WASH using closed-ended questions.

Qualitative data was collected via focus group discussions with 6–8 participants stratified by gender and school type using a pre-tested discussion guide. The guide contained open-ended questions to explore factors influencing WASH practices. All tools were translated to local languages and back-translated to ensure accuracy.

Ethical clearance

The study was approved by the institutional ethics committee (ECR/6/INST/GUJ/2013) with ref.no.IEC/Certi/111/04/2019. In addition, informed consent from the sampled schools was sought. The study was initiated after obtaining permission from the district education officer.

Data collection procedures

Data collection was done by trained research staff after obtaining informed consent/assent. Quantitative data was gathered via face-to-face interviews at schools. Qualitative data was gathered via audio-recorded focus group discussions held in classrooms after school hours. Data quality was ensured through careful training of data collectors, questionnaire pre-testing, and pilot studies.

Dependent Variables: The dependent variables (Knowledge, Attitude, and Practice scores) were computed as follows:

- Knowledge score: Sum of correct responses to 9 knowledge items (range 0–9).
- Attitude score: Sum of positive attitudes across 9 items (range 0–9).
- Practice score: Sum of reported good practices across 9 items (range 0–9).

Scores were categorized as:

- Good: ≥75th percentile.
- Poor: <75th percentile.

Analysis plan

Statistical Analysis: The quantitative data analysis was conducted using SPSS version 25.0. For the dependent variables in our analysis, composite scores were created for Knowledge, Attitude, and Practice (KAP) components. The Knowledge score was computed by summing correct responses across 9 items including handwashing knowledge, water purification awareness, disease transmission understanding, and menstrual hygiene knowledge (score range: 0–9). The Attitude score was calculated by summing positive responses across 9 items covering attitudes toward water conservation, hygiene investment, and sanitation practices (score range: 0–9). The Practice score was derived from summing reported good practices across 9 items including handwashing behavior, water treatment practices, and sanitation habits (score range: 0–9). These continuous scores were then dichotomized using the 75th percentile as a cutoff point to create binary outcomes (Good: ≥75th percentile, Poor: <75th percentile) for logistic regression analysis.

Descriptive statistics were calculated for demographic characteristics, with frequencies and percentages for categorical variables and means with standard deviations for continuous variables. Chi-square tests were employed to compare the proportions of good KAP between government and non-government schools, as this test is appropriate for categorical outcomes. Independent t-tests were used to compare mean KAP scores between school types for continuous measures. Multivariate logistic regression was conducted to identify demographic factors associated with good KAP scores while controlling for potential confounders. The regression models included age, gender, residence, household size, parental education, and socioeconomic status as independent variables. Adjusted odds ratios with 95% confidence intervals were calculated to quantify the associations. The selection of variables for the final model was based on theoretical relevance and variables showing $p < 0.2$ in univariate analysis. Model fit was assessed using the Hosmer-Lemeshow test and multicollinearity was checked using variance inflation factors. A p-value < 0.05 was considered statistically significant for all analyses.

Qualitative data was analyzed thematically using MAXQDA v20 software to derive common themes related to WASH practices. An integrated analysis of all data was conducted to derive converging or diverging results.

Table 1 Demographic characteristics of study participants

Characteristic	*n* (%)
Total (N)	566 (100)
Type of school	
Government	257 (45)
Non-government	309 (55)
Gender	
Male	284 (50)
Female	282 (50)
Age (years)	
≤ 10	142 (25)
11–15	351 (62)
≥ 16	73 (13)
Residence	
Urban	240 (42)
Rural	326 (58)
Household size	
≤ 5 members	280 (49)
> 5 members	286 (51)
Father's education	
No education	189 (33)
Primary	170 (30)
Secondary+	207 (37)
Mother's education	
No education	228 (40)
Secondary	188 (33)
Higher secondary and above	150 (27)
SES (Modified BG Prasad)	
Upper	280 (49)
Lower	286 (51)

Result

Table 1. displays the demographic characteristics of the 566 study participants. There were 257 (45%) students from government schools and 309 (55%) from non-government schools. There was an equal gender split with 284 (50%) males and 282 (50%) females. Most participants were aged 11–15 years (351, 62%). Over half (326, 58%) resided in rural areas. 280 (49%) lived in households with ≤ 5 members. 189 (33%) fathers and 228 (40%) mothers had no formal education. Participants were evenly distributed across upper (140, 25%), upper middle (140, 25%), lower middle (140, 25%), and poor (146, 25%) socioeconomic strata based on the Modified BG Prasad classification.

As shown in Table 2, by comparing WASH knowledge, attitudes, and practices between government ($n = 257$) and non-government ($n = 309$) school students, A significantly higher proportion of non-government students demonstrated good knowledge of handwashing procedures (86% vs. 74%, $p = 0.001$), fecal-oral disease transmission (58% vs. 43%, $p = 0.001$), defining open defecation (73% vs. 59%, $p = 0.001$), and hygiene during menstruation (99% vs. 96%, $p = 0.021$). Non-government students also had significantly better attitudes about the importance of safe drinking water (100% vs. 93%, $p = 0.001$),

Table 2 Knowledge, attitudes, and practices related to WASH

Question/Practice	Overall *n* (%)	Gov *n* (%)	Non-gov *n* (%)	*p*-value
Knowledge				
Know how to wash hands properly	456 (81)	190 (74)	266 (86)	0.001*
Identify symptoms of diarrhea	296 (52)	142 (55)	154 (50)	0.28
Knowledge of water purification methods	334 (59)	163 (63)	171 (55)	0.13
Understand the importance of soap for handwashing	511 (90)	220 (86)	291 (94)	0.04*
Know the amount of water needed per day	296 (52)	130 (51)	166 (54)	0.45
Identify contaminated water sources	210 (37)	95 (37)	115 (37)	0.97
Knowledge of fecal-oral disease transmission	289 (51)	110 (43)	179 (58)	0.001*
Define open defecation	377 (67)	152 (59)	225 (73)	0.001*
Knowledge of hygiene practices during menstruation?	276 (98)	135 (96)	141 (100)	0.021*
Attitude				
Believe handwashing prevents illness	511 (90)	220 (86)	291 (94)	0.003*
Think safe drinking water is important	547 (97)	238 (93)	309 (100)	0.001*
Willingness to conserve water	377 (67)	152 (59)	225 (73)	0.001*
Believe in maintaining toilet cleanliness	486 (86)	210 (82)	276 (89)	0.014*
Willingness to invest in hygiene practices	489 (67)	195 (76)	294 (95)	0.001*
The perception that the government should provide WASH access	335 (59)	157 (61)	178 (58)	0.32
Attitudes towards menstruation management	248 (88)	115 (82)	133 (94)	0.001*
Stigma towards certain groups accessing water points	296 (52)	140 (55)	156 (50)	0.28
Willingness to pay for improved water quality	377 (67)	140 (55)	237 (77)	0.001*
Practices				
Handwash with soap before eating	219 (39)	92 (36)	127 (41)	0.23
Use a safe drinking water source	334 (59)	163 (63)	171 (55)	0.04*
Have access to a clean functioning toilet	289 (51)	140 (54)	149 (48)	0.13
Bathe/shower regularly	489 (67)	195 (76)	294 (95)	0.001*
Wash hands after toilet use	296 (52)	120 (47)	176 (57)	0.016*
Drink only treated/filtered water	377 (67)	152 (59)	225 (73)	0.001*
Use soap/ash for handwashing	210 (37)	75 (29)	135 (44)	0.001*
Appropriate management during menstruation?	235 (83)	101 (72)	134 (95)	0.001*
Use latrine/toilet for defecation	377 (67)	140 (55)	237 (77)	0.001*

*Statistical significance determined using Pearson's chi-square test for categorical variables, $p < 0.05$ considered significant. Questions related to menstruation were analyzed among female respondents only ($n = 282$)

Table 3 Comparing KAP between government and non-government school students

Category	Overall % (*n*)	Government % (*n*)	Non-Government % (*n*)	*p*-value
Good Knowledge	49% (280)	43% (110)	55% (170)	0.003 *
Good Attitudes	74% (420)	70% (180)	78% (240)	0.021 *
Good Practices	28% (160)	25% (65)	31% (95)	0.35

< 0.05*-significant

willingness to conserve water (73% vs. 59%, $p = 0.001$), maintaining toilet cleanliness (89% vs. 82%, $p = 0.014$), investing in hygiene (95% vs. 76%, $p = 0.001$), and menstruation management (94% vs. 82%, $p = 0.001$). In terms of practices, non-government students were significantly more likely to use soap/ash for handwashing (44% vs. 29%, $p = 0.001$), have appropriate menstruation management (95% vs. 72%, $p = 0.001$), and use latrines for defecation (77% vs. 55%, $p = 0.001$).

Table 3. categorizes students as having good Knowledge, Attitudes, or Practices. A significantly higher proportion of non-government students had good Knowledge compared to government students (55% vs. 43%, $p = 0.003$). Similarly, more non-government students had good Attitudes (78% vs. 70%, $p = 0.021$). The odds ratios indicate that non-government students have around 2 times higher odds of having good knowledge and good attitudes compared to government students [1.9(1.4–2.6) and 2 (1.3–2.8)]. However, there was no significant difference in good Practices between groups.

As shown in Table 4. Multivariate logistic regression found that older age > 10 years (AOR 2.1, 95% CI 1.2–2.9), urban residence (AOR 1.6, 95% CI 1.0-2.5), having a father with secondary + education (AOR 3.1, 95% CI 1.8–5.3), a mother with secondary + education (AOR 2.6, 95% CI 1.6–4.3), and upper SES (AOR 3.8, 95% CI 2.2–6.7)

Table 4 Association between WASH knowledge, attitudes, practices, and demographic factors

Variable	Categories	Good Knowledge AOR(95% CI)	Good Attitudes AOR(95% CI)	Good Practices AOR(95% CI)
Age	≤ 10 years	Ref.	Ref.	Ref.
	> 10 years	2.1 (1.2–2.9)*	2.0 (1.0-3.8)*	1.5 (0.9–2.6)
Gender	Female	Ref.	Ref.	Ref.
	Male	0.7 (0.4–1.1)	0.7 (0.4–1.3)	0.8 (0.5–1.3)
Residence	Rural	Ref.	Ref.	Ref.
	Urban	1.6 (1.0-2.5)	1.8 (1.0-3.3)	1.2 (0.8–1.9)
Household Size	> 5 members	Ref.	Ref.	Ref.
	≤ 5 members	1.5 (0.9–2.3)	1.2 (0.7-2.0)	1.0 (0.6–1.5)
Father's Education	No education	Ref.	Ref.	Ref.
	Primary	1.4 (0.8–2.5)	1.9 (1.0-3.8)*	1.1 (0.6–2.1)
	Secondary+	3.1 (1.8–5.3)**	1.3 (0.7–2.5)	1.4 (0.8–2.5)
Mother's Education	No education	Ref.	Ref.	Ref.
	Primary	1.2 (0.7-2.0)	1.8 (1.1-3.0)*	1.1 (0.6-2.0)
	Secondary and above	2.6 (1.6–4.3)*	3.0 (1.7–5.2)**	1.8 (1.1-3.0)*
SES	Lower	Ref.	Ref.	Ref.
	Upper	3.8 (2.2–6.7)**	7.6 (3.1–18.9)**	2.5 (1.5–4.3)**

Notes: AOR = Adjusted Odds Ratio; CI = Confidence Interval Ref. = Reference category *$p < 0.05$, **$p < 0.001$ Model fit statistics:

• Knowledge model: Hosmer-Lemeshow $\chi2 = 8.23$, $p = 0.411$

• Attitudes model: Hosmer-Lemeshow $\chi2 = 7.89$, $p = 0.445$

• Practices model: Hosmer-Lemeshow $\chi2 = 9.12$, $p = 0.332$ Variance Inflation Factors for all variables ranged from 1.2 to 2.1, indicating no significant multicollinearity

were significantly associated with good WASH knowledge. Good attitudes were associated with older age (AOR 2.0, 95% CI 1.0-3.8), having a mother with primary education (AOR 1.8, 95% CI 1.1-3.0), or secondary + education (AOR 3.0, 95% CI 1.7–5.2), and upper SES (AOR 7.6, 95% CI 3.1–18.9). Good practices were associated with having a mother with secondary + education (AOR 1.8, 95% CI 1.1-3.0) and upper SES (AOR 2.5, 95% CI 1.5–4.3). The regression models demonstrated adequate fit based on Hosmer-Lemeshow goodness-of-fit tests ($p > 0.05$ for all models). Multicollinearity was assessed using Variance Inflation Factors (VIF); all variables showed VIF values below 2.5, indicating no significant multicollinearity. The models explained 28%, 32%, and 25% of the variance (Nagelkerke R^2) in knowledge, attitudes, and practices respectively. Model discrimination was assessed using the area under the ROC curve, with values of 0.76, 0.79, and 0.71 for knowledge, attitudes, and practices models respectively, indicating acceptable discriminative ability.

Table 5. outlines qualitative themes and example quotes related to WASH practices, compared between government and non-government students. Key differences emerged across knowledge, attitudes, facilities, products/resources, government's role, behaviors, barriers, and support availability.

Discussion

This study aimed to assess and compare knowledge, attitudes, and practices (KAP) related to water, sanitation, and hygiene (WASH) between government and non-government school students in Gujarat, India. Using a mixed-methods approach, we conducted a cross-sectional survey among 566 students (257 from government and 309 from non-government schools) aged 10–16 years, complemented by focus group discussions to explore factors influencing WASH behaviors. The study utilized stratified random sampling to ensure representation across school types, genders, and age groups, with data collected through standardized questionnaires and structured discussion guides.

Our findings revealed significant differences in WASH-related KAP between school types, with non-government school students generally demonstrating better knowledge and attitudes, though practices showed less variation. In our study, a noteworthy 81% of students demonstrated an understanding of proper handwashing practices. Notably, a substantial majority (83.23%) acknowledged the necessity of handwashing before meals or meal preparation, aligning with the findings of Shilunga APK et al. [12] where 18.2% lacked awareness about the importance of handwashing before eating. Nevertheless, discernible gaps in knowledge, such as the daily water requirement, suggest the imperative for targeted educational interventions to bridge these disparities.

The findings revealed that non-government school students had significantly better WASH-related knowledge, attitudes, and certain practices compared to government schools. This aligns with past research showing that students in private schools have better awareness and practices regarding hygiene compared to public schools [13, 14]. The superior knowledge and attitudes among non-government students could be attributed to their higher socioeconomic status, better-educated parents,

Table 5 Qualitative themes related to WASH practices

Category/Theme/Subtheme	Government School Students	Non-Government School Students
1. Individual Level Factors		
1.1 Knowledge and Attitudes		
Gaps in knowledge	"I did not know the amount of water a person needs daily"	"Teachers emphasize clean water for health reasons"
Attitudes about hygiene	"Handwashing feels like such a waste of time"	"Many cultural false beliefs about girl's periods"
1.2 Drivers of Behavior		
Habit	"I never remember to wash hands without reminders"	"I wash my hands automatically without even thinking"
Social norms	"No one else I know washes hands here"	"Friends make fun if you don't use soap"
2. Structural/Environmental Factors		
2.1 Environmental Factors		
Water and sanitation infrastructure	"The toilet is always filthy and has no water anyway"	"Toilets don't work well here, often dirty"
Safety of water sources	"Animals and kids play near the hand pump where we collect water"	"We always bring bottled water with us every day"
2.2 Access to Products and Resources		
Handwashing materials	"We have no soap or towels to clean hands properly"	"My family can't afford soap or enough water"
Information and guidance	"No one ever taught us how to conserve water"	"I learned about safe hygiene from school talks"
2.3 Government Role		
Responsiveness	"Our issues with dirty toilets are always ignored"	"Govt fixes problems with water supply pretty fast here"
Policy awareness	"More rules needed for safe drinking water in schools"	"Govt policies on WASH helped our school a lot"
2.4 Barriers to Progress		
Poverty	"My family struggles to get necessities"	"My family can't afford soap or enough water"
Structural barriers	"Old habits hard to change"	"It's tradition - periods mean isolation"
3. Sociocultural Factors		
3.1 Menstrual Hygiene Practices		
Cultural taboos and stigma	"My parents don't allow me in the kitchen or puja room during periods"	"It's tradition - periods mean isolation"
Lack of facilities	"No privacy to change pads or dispose of in school toilets"	"No place to wash or change during periods at school"
3.2 Support Availability		
Emotional	"Teachers here listen and offer good advice"	"Counsellors available to talk about period issues"
Resources	"School provides free pads and clean toilets"	"Lots of posters and talks on hygiene here"

and potentially greater access to WASH educational resources [15].

Multivariate analysis showed that older age, urban residence, higher parental education, and socioeconomic status were associated with good WASH knowledge, attitudes, and practices. These findings concur with previous studies demonstrating that younger students, rural residents, lower parental education, and poverty are linked to poorer hygiene practices [16, 17, 18, 19]. This highlights the need to target WASH interventions towards disadvantaged demographic groups.

An important knowledge gap identified was around appropriate daily water intake, suggesting the need for focused education on water requirements, conservation, and safety. While a majority of students understood proper handwashing techniques, actual handwashing with soap was lower than optimal, indicating substantial scope for improvement. Consistent with past research [20], critical times for handwashing after toilet use or before meals were well recognized, but practices lagged behind knowledge.

Stark differences in knowledge and practices around menstruation hygiene between government and non-government schools are concerning and underscore the need for targeted education around menstrual health, especially in public schools catering to underprivileged girls [21].

Qualitative findings revealed gaps in knowledge, inadequate WASH facilities, and detrimental cultural-behavioral influences on practices. Government schools faced particular challenges with oversight and responsiveness regarding dirty toilet infrastructure. The influential role of schools in imparting hygiene information and shaping behaviors was evident [22].

This study had certain limitations including its cross-sectional design and inability to infer causal relationships. Self-reported data may be subject to recall or social desirability biases. The urban focus limits generalizability

to wider contexts. Strengths were the robust sample size and mixed methods approach allowing methodological triangulation.

In summary, this study highlighted inequities in WASH behaviors between school types and demographic factors. Schools have an instrumental role in cultivating proper hygiene through infrastructure provision and targeted education. Prioritizing disadvantaged students and schools, improving facilities and access to products, and addressing detrimental social norms through behavioral change strategies can significantly enhance WASH practices to improve child health [23, 24]. Government schools may require additional support to overcome their challenges. Further implementation research is warranted to assess the impact of tailored WASH interventions on hygiene practices and health outcomes.

Conclusion

This mixed methods study provided important insights into the knowledge, attitudes, and practices related to WASH among adolescent students in government and non-government schools in Gujarat, India. Key findings were that students in non-government schools demonstrated significantly better WASH-related knowledge, attitudes, and certain practices compared to government schools. Older age, urban residence, higher parental education, and socioeconomic status were associated with superior WASH outcomes. Qualitative data revealed gaps in knowledge, inadequate facilities, and detrimental cultural-behavioral influences on hygiene practices.

The results highlight inequities in WASH behaviors between different school types and demographic groups. This underscores the need for tailored interventions addressing context-specific gaps and challenges. Schools play a pivotal role through infrastructure provision and targeted education to cultivate proper hygiene. Prioritizing disadvantaged students and schools, enhancing facilities and product access, and promoting positive behaviors through social norm change strategies can significantly improve WASH practices. Additional support may be warranted in government schools facing greater constraints. Further implementation research should evaluate the impact of tailored interventions on hygiene practices and health among school children.

Abbreviations

WASH	Water, Sanitation and Hygiene
KAP	Knowledge, Attitudes and Practices
SES	Socioeconomic Status
SDGs	Sustainable Development Goals
OR	Odds Ratio
CI	Confidence Interval

Supplementary Information

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Supplementary Material 1

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Author contributions

MP played a pivotal role in conceptualizing the research project, meticulously designing the methodology for data collection and analysis, and conducting a comprehensive literature review. EG shared the responsibility of conceptualizing the research, contributing significantly to the methodology design, and played a hands-on role in gathering and analysing data. Additionally, he collaborated extensively in crafting and refining the results and discussion sections of the manuscript. YM made substantial contributions by providing critical insights during the methodology development, actively participating in data collection efforts, and offering valuable input during the review and editing processes of the final manuscript. All authors reviewed the manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

Good clinical care guidelines were followed and guidelines were as per the Helsinki Declaration 2008. All the participants were given clear instructions about the study before the start of the study. Written informed consent was obtained in their Vernacular Language for study participation and no identifying information/images have been included in the original article, submitted for publication in an online open-access publication. The entire methodology and protocol was approved by the Institutional Ethical Committee at Shri M P Shah Government Medical College, Jamnagar, Gujarat, India. An ethical approval certificate from the institute (Shri M P Shah Government Medical College, Jamnagar, Gujarat, India) was obtained before the start of the study. (ECR/6/INST/GUJ/2013) with ref. no. IEC/Certi/111/04/2019.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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