

RESEARCH ARTICLE

Assessment of School-Based Water, Sanitation and Hygiene (WASH) Facilities and Pupils' Knowledge of Their Proper Use in Douala IV Municipality, Cameroon

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Abstract

Background: Safe water, sanitation and hygiene (WASH) services are essential to healthy, safe and effective learning environments and contribute to the prevention of water- and sanitation-related disease transmission. This study assessed school-based WASH service provision and pupils' knowledge of the proper use of WASH facilities in selected primary schools in Douala IV Municipality, Cameroon.

Methods: A cross-sectional descriptive and analytic study was conducted in 12 selected primary schools across six communities of Douala IV Municipality. Data were collected from 360 pupils and 12 school staff members between 10 April and 14 May 2023. Schools were selected using a combination of stratified, simple random and convenience approaches. Structured questionnaires and an observation checklist based on WHO/UNICEF Joint Monitoring Programme (JMP) school WASH service ladders were used. Data were entered through KoboCollect and analysed using SPSS version 26. Descriptive statistics and chi-square tests were used.

Results: Of the 360 pupils, 194 (53.8%) were female and 166 (46.2%) were male; mean age was 11.43 ± 1.43 years. Ten schools (83.3%) were classified as having advanced drinking-water service, although two schools had no drinking-water source. Six schools (50.0%) had basic sanitation service, while nine (75.0%) had limited hygiene service. All schools had at least one toilet block for boys and girls, but approximately 10% of toilets were non-functional at inspection and 10 schools lacked adequate menstrual hygiene facilities. Nine schools had handwashing facilities without soap. Among pupils, 313 (86.9%) demonstrated good WASH knowledge, 44 (12.2%) average knowledge and 3 (0.8%) inadequate knowledge. Knowledge was not significantly associated with school management type (public versus lay private; $P > 0.05$), nor with most assessed socio-demographic characteristics; school name was the exception ($P < 0.05$).

Conclusion: Pupils demonstrated a generally high level of knowledge about WASH, but school-level WASH provision remained uneven and, overall, inadequate, particularly for sanitation maintenance, handwashing with soap and menstrual hygiene. Improving infrastructure, maintenance, monitoring, menstrual hygiene support and community participation is necessary to translate knowledge into safer practices and more resilient school environments.

Keywords: Water, sanitation and hygiene; WASH in schools; primary schools; pupils; hygiene knowledge; sanitation; menstrual hygiene; Douala IV; Cameroon.

1. Introduction

Water, sanitation and hygiene in schools constitute an important public-health and educational concern. WASH in schools combines technical infrastructure—drinking-water points, toilets and handwashing facilities—with educational and behavioural interventions intended to support healthy practices and prevent water- and sanitation-related diseases. The thesis underpinning this manuscript frames WASH as a component of school safety and disaster risk reduction because inadequate services can increase exposure to biological hazards and facilitate disease transmission.

Inadequate WASH can affect children through unsafe drinking water, poor sanitation, insufficient hand hygiene and inadequate menstrual hygiene management. The source literature reviewed in the thesis associates poor WASH with infectious and gastrointestinal illness, absenteeism, reduced attention and poorer educational outcomes. Global commitments, including Sustainable Development Goals 3, 4 and 6, emphasize safe learning environments and universal access to WASH.

The Cameroon context remains important because reliable school-level data on the availability, functionality and maintenance of WASH facilities are limited. Evidence reviewed in the thesis from other Cameroonian settings indicates variation between public and private schools and between urban and rural areas. Previous studies have also shown that the presence of knowledge does not necessarily guarantee corresponding hygiene practices when facilities are unavailable, inaccessible or poorly maintained.

The present study therefore addressed three questions: (1) What is the level of WASH service provision in selected primary schools in Douala IV Municipality? (2) What is the level of pupils' knowledge concerning proper use of school WASH facilities? and (3) Is pupils' WASH knowledge associated with school management type or selected socio-demographic characteristics?

The main objective was to assess school-based WASH facilities and pupils' knowledge of their proper use. Specific objectives were to evaluate WASH facilities, determine pupils' knowledge and compare knowledge between pupils in public and lay private schools.

2. Methods

2.1 Study setting

The study was conducted in Douala IV Municipality, with headquarters at Bonassama. Twelve primary schools were selected from six communities: Mabanda, Bonamikano, Grand Hangar, Ngwele, Sodiko and Bonassama. Two schools were selected from each community. The study focused on pupils and WASH conditions within the selected schools.

2.2 Study design and participants

A cross-sectional descriptive and analytic design was used. Participants comprised pupils enrolled in the selected schools and school staff able to provide information on school WASH services. The field study included 360 pupils and 12 staff members, one staff respondent per school. Pupils were eligible if enrolled in a selected school, in the targeted upper primary classes, and covered by the required consent arrangements. The thesis reports classes 4–6 in the recruitment criteria, with 320 pupils (88.9%) ultimately drawn from class 6, 35 (9.7%) from class 5 and 5 (1.4%) from class 4.

2.3 Sampling and sample size

The thesis describes a combined sampling strategy. Communities were treated as strata; two schools were selected from each community using convenience selection, followed by simple random selection of approximately 30 pupils per school. The calculated sample size was 387 after allowing for non-response, while 360 pupils were ultimately included, together with 12 school staff respondents.

2.4 Data collection

Three data-collection components were used: a structured questionnaire for school staff covering general school information and WASH provision; an observation checklist for direct assessment of WASH availability, functionality, privacy, operation and maintenance; and a pupil questionnaire assessing knowledge and practices related to WASH use. The instruments were adapted from WHO/UNICEF JMP school WASH service ladders. Data were collected from 10 April to 14 May 2023.

2.5 Measurement of WASH service levels

School WASH services were classified using the WHO/UNICEF JMP framework. Advanced service incorporated additional criteria such as quality, quantity, continuity, accessibility, cleanliness, menstrual hygiene provisions and hygiene education. Basic service required an improved facility that was available and usable at the time of assessment. Limited service indicated an improved facility with an important missing element, while no service indicated absence or use of an unimproved facility.

2.6 Measurement of pupils' knowledge

Knowledge items were coded 1 for a correct response and 0 for an incorrect response. A total knowledge score was calculated from 14 items. Scores of 10–14 were classified as good knowledge, 7–9 as average knowledge and 6 or below as inadequate knowledge.

2.7 Data management and analysis

Questionnaire data were entered using KoboCollect and exported to SPSS version 26.0. Descriptive statistics were used to summarize WASH provision and pupils' knowledge. Cross-tabulations and chi-square tests were used to examine associations between knowledge and school management type and between knowledge and selected socio-demographic characteristics. The thesis reports use of a 95% confidence interval and statistical testing of associations.

2.8 Ethical considerations

The research proposal was approved within the University of Buea Department of Environmental Sciences. Administrative authorization was obtained from the relevant university and Littoral Regional Delegation of Basic Education, as well as from participating school administrators. Informed consent was obtained from participants as described in the thesis materials, and confidentiality of collected information was maintained.

3. Results

3.1 Characteristics of participating schools and pupils

Eight of the 12 schools (66.7%) were lay private schools and four (33.3%) were public schools. Eight schools operated a single shift and four operated two shifts. Four schools had at least one pupil with limited mobility. Eleven school buildings had originally been designed as educational institutions, while one had been adapted for educational use.

The 360 pupils ranged from 8 to 17 years, with a mean age of 11.43 ± 1.43 years. Female pupils numbered 194 (53.8%) and male pupils 166 (46.2%).

Characteristic	n	%
Female pupils	194	53.8
Male pupils	166	46.2
Class 4	5	1.4
Class 5	35	9.7
Class 6	320	88.9
Total	360	100.0

3.2 School WASH governance and water provision

Nine schools (75.0%) reported that WASH services had been renovated. School administrations were identified as responsible for WASH operation-and-maintenance budgets in nine schools (75.0%), while caretakers were responsible for WASH operation and maintenance in 10 schools (83.3%) and solid-waste management in 11 (91.7%). Half of the schools had piped water supplied into the school building and one-third had piped water supplied to the school yard. Two schools (16.7%) had no drinking-water source for pupils.

Among the 12 schools, 10 (83.3%) were classified as having advanced drinking-water service. The thesis reports that the available piped water in those schools was supplied by CAMWATER and was available during inspection. However, none of the schools reported recent routine drinking-water quality testing, and alternative drinking-water sources were not consistently available when the main supply was interrupted.

WASH domain	Advanced	Basic	Limited	No service
Drinking water	10 (83.3%)	—	—	2 (16.7%)
Sanitation	—	6 (50.0%)	—	1*
Hygiene	—	—	9 (75.0%)	—

*The source thesis presents sanitation categories across different tables and narrative sections; the manuscript retains the principal reported finding of six schools with basic sanitation and highlights the observed functional and maintenance deficits rather than deriving an unreported composite percentage.

3.3 Sanitation and menstrual hygiene

All 12 schools had toilet cubicles for male and female pupils and staff, and sex separation was reported. Approximately 10% of toilets were non-functional at inspection. Toilet accessibility was reported as adequate for small pupils and pupils with limited mobility in 91% of schools. The study also found that many toilets were dirty, some lacked doors or privacy, and pupil-toilet ratios exceeded the recommendations cited in the thesis.

Menstrual hygiene management was a major gap. Ten schools (83.3%) were reported as lacking adequate menstrual hygiene facilities. All schools had a private space for menstrual hygiene management, but only water—not soap—was available in these spaces. Sanitary bins were present in at least some girls' toilet cubicles in nine schools, but no school had clear signs directing girls to dispose of menstrual waste in the bins. Menstrual hygiene products were freely available in only one school.

3.4 Hand hygiene

Nine of the 12 schools (75.0%) had handwashing facilities without soap and were therefore classified as providing limited hygiene service. Nine schools had cleaning and maintenance records for toilets,

although these records were described as incomplete or outdated at inspection. Only one school had visible information about handwashing/hand hygiene. These findings indicate that the existence of infrastructure did not consistently translate into complete hygiene service.

3.5 Pupils' knowledge of WASH

Knowledge was generally high. Of the 360 pupils, 313 (86.9%) had good knowledge, 44 (12.2%) had average knowledge and 3 (0.8%) had inadequate knowledge.

Knowledge category	Score	n	%
Good	10–14	313	86.9
Average	7–9	44	12.2
Inadequate	≤6	3	0.8
Total	—	360	100.0

3.6 Comparison by school management

Among pupils in public schools, 114 had good knowledge, 18 average knowledge and 1 inadequate knowledge. Among pupils in lay private schools, 199 had good knowledge, 26 average knowledge and 2 inadequate knowledge. The association between knowledge category and school management type was not statistically significant ($P>0.05$). Other assessed socio-demographic characteristics were also not significantly associated with knowledge, except school name ($P<0.05$).

School management	Inadequate	Average	Good	Total
Public	1	18	114	133
Lay private	2	26	199	227
Total	3	44	313	360

4. Discussion

This study demonstrates an important gap between pupils' WASH knowledge and the completeness of school WASH services. Although 86.9% of pupils achieved a good knowledge score, only one of the 12 schools was reported to have advanced services across water, sanitation and hygiene. The findings therefore suggest that knowledge is necessary but insufficient when infrastructure, supplies, privacy, maintenance and management systems are incomplete.

Drinking-water provision was comparatively stronger than other WASH components. Ten schools were classified as having advanced drinking-water service, mainly through piped supply. Nevertheless, two schools lacked a drinking-water source and the study found no reliable alternative drinking-water source across the schools. The absence of routine recent water-quality monitoring and vulnerability to supply interruptions represent important resilience concerns.

Sanitation presented more substantial weaknesses. Although all schools had toilet facilities, functionality, cleanliness, privacy and pupil-to-toilet ratios were problematic. The thesis reports that approximately 10% of toilets were non-functional and that many toilets were dirty or lacked adequate doors. Such conditions can discourage proper use and may undermine the health benefits expected from the presence of toilets.

Hand hygiene was another critical weakness. Nine schools had handwashing facilities without soap. This is particularly important because infrastructure without the consumables required for effective

handwashing cannot provide a complete hygiene service. The limited visibility of hygiene information also suggests that health education was not consistently reinforced through the school environment.

Menstrual hygiene management was inadequate in most schools. Although all schools had private spaces for menstrual hygiene management, soap was absent from these spaces and free menstrual hygiene products were generally unavailable. The absence of clear disposal instructions further indicates a gap between physical facilities and the supportive information required for dignified menstrual hygiene.

The high knowledge level among pupils is consistent with evidence cited in the thesis that school-based WASH education can improve knowledge and attitudes. However, the present findings reinforce the concern that knowledge may not translate into practice where facilities are inadequate. The absence of a statistically significant association between school management type and knowledge also suggests that the knowledge gap was not simply explained by whether a school was public or lay private.

The study's practical implication is that WASH programming should move beyond awareness alone. School authorities and government actors need coordinated systems for infrastructure provision, maintenance, budgeting, monitoring, hygiene supplies and menstrual hygiene management. Community and parent engagement is also important because pupils carry WASH knowledge and behaviours between school, home and the wider community.

5. Strengths and limitations

A major strength of the study is the combination of pupil knowledge assessment, staff interviews and direct observation of WASH facilities. The use of an observation checklist based on WHO/UNICEF JMP service ladders also provided a structured approach to classifying service levels. Inclusion of schools from six communities provided geographic coverage across the municipality.

Several limitations should be considered. The study included only 12 schools and therefore findings should not automatically be generalized to all primary schools in Douala or Cameroon. The selection process combined convenience and random approaches, which may introduce selection bias. The study assessed knowledge rather than directly measuring sustained hygiene behaviour over time. In addition, the thesis contains some internal inconsistencies in reported percentages—for example, two schools out of 12 are described in narrative text as 37.5%, whereas the corresponding frequency represents 16.7%. For this manuscript, percentages have been recalculated from the reported frequencies where necessary, while the underlying findings are retained.

Because the study is cross-sectional, associations cannot establish causality. The finding that knowledge was not associated with WASH provision should therefore not be interpreted as proof that WASH infrastructure has no effect on knowledge or behaviour.

6. Implications for policy and practice

First, government and local authorities should prioritize reliable WASH infrastructure and recurrent budgets for operation and maintenance rather than focusing only on construction. Second, schools should maintain functional handwashing points with continuous access to water and soap. Third, sanitation planning should address adequate numbers of clean, private, functional and gender-separated toilets, including accessible facilities for pupils with disabilities.

Fourth, menstrual hygiene management should be integrated into routine school WASH planning through private changing spaces, water and soap, sanitary bins, appropriate disposal systems, access to

menstrual products and age-appropriate menstrual education. Fifth, schools should establish or strengthen WASH committees involving teachers, pupils, parents and community representatives to monitor facility functionality and report maintenance needs.

Finally, hygiene education should emphasize practical behaviour change rather than knowledge alone. Regular demonstrations, visible reminders, school WASH clubs and community outreach can help convert knowledge into routine practice.

7. Conclusion

The study found that pupils in selected primary schools in Douala IV Municipality generally possessed good knowledge of WASH, with 86.9% achieving a good knowledge score. However, school WASH provision was uneven and incomplete. Drinking-water provision was relatively strong in most schools, but gaps remained in access and continuity. Sanitation was constrained by functionality, cleanliness, privacy and menstrual hygiene deficits, while hygiene service was particularly affected by the absence of soap at handwashing points.

There was no statistically significant difference in knowledge between pupils attending public and lay private schools. The central finding is therefore a disconnect between knowledge and the physical and organizational conditions needed to support safe WASH practices. Strengthening infrastructure, maintenance, supplies, monitoring, menstrual hygiene management and stakeholder participation is essential for safer and more resilient primary-school environments in Douala IV Municipality.

8. Recommendations

- Develop a government-supported and sustainably financed school WASH programme covering infrastructure, maintenance, hygiene education and monitoring.
- Allocate dedicated recurrent resources for WASH operation and maintenance and establish clear responsibilities among government, local authorities, school management, caretakers, parents and pupils.
- Ensure all schools have functional handwashing facilities supplied with water and soap throughout the school day.
- Improve the number, cleanliness, functionality, privacy and accessibility of toilets, with appropriate gender separation and facilities for pupils with disabilities.
- Strengthen menstrual hygiene management by ensuring private spaces, water and soap, sanitary bins, safe disposal systems, menstrual hygiene products and supportive education.
- Extend WASH education beyond schools to parents and surrounding communities and strengthen school WASH clubs.
- Introduce routine monitoring and reporting of WASH facility functionality, water availability, cleanliness and maintenance.
- Use practical demonstrations and behaviour-change approaches so that high levels of knowledge are translated into consistent hygiene practices.

9. Declarations

Ethics approval and consent to participate

The thesis reports approval through the University of Buea Department of Environmental Sciences and administrative authorization from the Littoral Regional Delegation of Basic Education and participating school administrations. Informed consent was obtained as described in the study materials.

Consent for publication

Not applicable to this manuscript; no individually identifiable participant information is presented.

Availability of data

The underlying dataset is not reproduced in this manuscript. Data were collected for the academic study and entered using KoboCollect before analysis in SPSS version 26.0.

Competing interests

No competing interests are declared in the source thesis.

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Authors' contributions

Eric Epah: study conception, field data collection, data analysis, interpretation and manuscript preparation. Dr. Ashu Richard Ekema and Dr. Asong Fred Zisuh: academic supervision and guidance of the original thesis. Formal journal authorship should be confirmed according to the target journal's authorship criteria and the actual contributions of each contributor.

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References

1. Appiah-Brempong E, Harris MJ, Newton S, Gulis G. Examining school-based hygiene facilities: a quantitative assessment in a Ghanaian municipality. *BMC Public Health*. 2018;18:581. doi:10.1186/s12889-018-5491-9.
2. Ashu EW, Siysi VV, Shey ND. Water, sanitation, and hygiene practices in secondary schools in the Buea Health District of Cameroon. *Journal of Public Health and Epidemiology*. 2021;13:254–261. doi:10.5897/JPHE2020.1298.
3. Bah A, Diallo A, Bah A, Li F. Water, Sanitation, and Hygiene (WASH) and the incidence and prevalence of children in five public primary schools in N'Zerekore, Guinea. 2020. doi:10.21203/rs.3.rs-53535/v1.
4. CSO-Cameroon. Water, Sanitation and Hygiene (WASH) in Schools: A Companion to the Child Friendly Schools Manual. 2023.
5. Chikwanu F. Evaluation of the implementation of the School WASH Programme in Choma District of Zambia [Master's thesis]. Lusaka: University of Zambia; 2014.

6. Dakhode S, Gaidhane A. Effectiveness of Water, Sanitation and Hygiene (WASH) intervention for school-going children on hygiene practices, absenteeism, diarrhea, and respiratory infection: an interventional study protocol. *Journal of Pharmaceutical Research International*. 2021;33:77–87. doi:10.9734/jpri/2021/v33i54A33721.
7. Gebreeyessus GD, Adem DB. Knowledge, attitude, and practice on hygiene and morbidity status among tertiary students: the case of Kotebe Metropolitan University, Addis Ababa, Ethiopia. *Journal of Environmental and Public Health*. 2018;2018:1–9. doi:10.1155/2018/2094621.
8. Gebrehiwot T, Geberemariam BS, Gebretsadik T, Gebresilassie A. Prevalence of diarrheal diseases among schools with and without water, sanitation and hygiene programs in rural communities of Northeastern Ethiopia: a comparative cross-sectional study. *Rural and Remote Health*. 2020;20(4):4907. doi:10.22605/RRH4907.
9. He J, Zeng Y, Hao M, Yamauchi T. Knowledge, attitudes and practices of sanitation and hygiene among primary school students in rural area of Northeast China. 2020. doi:10.34416/svc.00018.
10. Holst Jensen M, Villumsen M, Døcker Petersen T. The AAAQ framework and the right to water: international indicators for availability, accessibility, acceptability and quality. Copenhagen: Danish Institute for Human Rights; 2014.
11. Jordanova T, Cronk R, Obando W, Medina OZ, Kinoshita R, Bartram J. Water, sanitation, and hygiene in schools in low socio-economic regions in Nicaragua: a cross-sectional survey. *International Journal of Environmental Research and Public Health*. 2015;12:6197–6217. doi:10.3390/ijerph120606197.
12. McMichael C. Water, sanitation and hygiene (WASH) in schools in low-income countries: a review of evidence of impact. *International Journal of Environmental Research and Public Health*. 2019;16:359. doi:10.3390/ijerph16030359.
13. Nounkeu CD, Aoutaksa KT, Ndongo CB, et al. The status of water access, sanitation, and hygiene in schools: a cross sectional survey to identify capacities and assess coverage in Garoua, North Cameroon. *PLOS Water*. 2023;2:e0000146. doi:10.1371/journal.pwat.0000146.
14. Sanou S, Emile T, Guetiya Wadoun R, et al. Water supply, sanitation and health risks in Douala 5 municipality, Cameroon. *Igiene e Sanità Pubblica*. 2015;71:21–37.
15. Snel M, Maier RC, van Wijk C, Postma L. *School Sanitation and Hygiene Education*. 2003.
16. World Health Organization. *Surveillance of water, sanitation and hygiene in schools: a practical tool*. Copenhagen: WHO Regional Office for Europe; 2019.
17. World Health Organization and UNICEF. *Progress on household drinking water, sanitation and hygiene 2000–2020: five years into the SDGs*. Geneva: World Health Organization; 2021.
18. Yates T, Vijeic J, Joseph ML, Lantagne D. *Impact of WASH interventions during disease outbreaks in humanitarian emergencies: a systematic review protocol*. Oxfam; 2016. doi:10.21201/2016.605152.