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Assessing School-Based Water, Sanitation and Hygiene (WASH) Facilities in Peri-Urban Settings of Kinshasa, DR Congo

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Abstract

Background: Kinshasa's peri-urban settings have a low rate of water access, which has significant consequences for the WASH infrastructures in schools and preventative measures against the spread of waterborne diseases and pathogens. This study aimed to assess the availability, functionality, and gender sensitivity of WASH infrastructures of Kinshasa's peri-urban schools. **Methods:** A cross-sectional study was performed in three of the four educational provinces of Kinshasa, targeting 165 peri-urban schools. Data were collected using a questionnaire and an observation grid. **Results:** An overall proportion of 10.9% of schools possessed a water point, and therefore time-consuming water chores are a necessity in 89.1% of schools. Girl students provided 30% of the labor collecting water during punishments. A total of 98.2% of schools had functional latrines of which 3.6% were found hygienic, associated with water reserve next to the latrines ($P = 0.040$). Only 2.4% of schools displayed posters raising awareness of latrine hygiene, and 3.6% displayed posters on hand hygiene. The ratios of latrines units for girls were 58:1 for toilets and 115:1 for urinals, justifying open defecation and urination reported in 62.4% of schools. Also, 43% of schools had hand-washing facilities whose functionality was significantly associated with the presence of water points in the school's inner courtyard ($P = 0.032$), with water ($P < 0.001$), and with soap availability ($P < 0.001$). In total, 2.4% of schools had laundries for menstrual hygiene management. **Conclusion:** The majority of schools had limited drinking water services, which negatively impact the functionality and gender sensitivity of other WASH provisions. The current evidence as a public health concern would raise government and school authorities' attention to address these environmental threats.

Keywords

Water Access, Latrine Hygiene, Hand Hygiene, Gender Sensitivity, Schooled Girl Students

1. Background

Water, sanitation, and hygiene (WASH) services are essential for promoting population health, especially in the current context of the COVID-19 pandemic where frequent handwashing is an essential preventative measure against the spread of pathogens [1]. WASH services are vital for schools to promote the achievement of their primary mission of ensuring quality education for young people in a healthy environment. A dirty physical environment, poor water quality, and inadequate hygiene practices can have significant consequences on school children's health and well-being [2] [3].

Based on improved and adapted WASH infrastructure, schools can improve health, education, gender equality, and the prevention of gender-based violence (GBV), while using consistent WASH facilities [4] [5] [6]. To achieve this, schools need to be equipped with services that meet the minimum quality requirements for WASH programmes [1] that ensure sustainable provision of water of sufficient quantity and quality, provide sanitation services that enable school community members to dispose of excreta without risk to health and the environment as well as providing menstrual and personal hygiene programmes and equipment for girls [7] [8]. Availability, functionality, and access without structural barriers to WASH facilities for all students should therefore be guaranteed and sustained. It is also important that schools should be provided with gender-specific, or gender-sensitive facilities, meeting WHO standards related to gender-segregated use, and the number of students per latrine and urinal [9] [10].

WHO has estimated that most schools around the world lack water, sanitation, and hygiene facilities [11]. In 2016, 69% of schools worldwide had a basic drinking water service, while 12% had a limited drinking water service (no access to drinking water within 30 minutes of water collection). Nineteen percent of these schools did not even have a supply of drinking water [12].

In sub-Saharan Africa, a third of schools lack toilets and less than half have sanitation facilities [12]. In terms of gender, 335 million girls worldwide attended schools without essentials to ensure menstrual hygiene management [12].

A previous assessment conducted by UNICEF in 49 resource-limited countries reported that only 51% of schools had adequate access to water, and 45% had adequate toilets [3] [13]. The results of these studies suggested that various gender and socio-sanitary consequences are likely to occur as a result of little attention to WASH-related issues. Thus waterborne and dirty-hands diseases such as cholera, salmonellosis, shigellosis, and helminthiasis can emerge and lead to negative impacts on health as well as physical, mental, social well-being, learning

abilities, school attendance, school achievements, and can also increase the inequality between girls and boys [14] [15] [16] [17].

In the DRC, access to WASH infrastructures in rural and peri-urban settings is supported by the National Rural Water Service, and the government partners such as UNICEF, USAID, UKaid, Oxfam through the National Healthy School and Villages Program (PNEVA), a joint programme of the National Ministries of Health and Education.

In the city of Kinshasa, the supply and access to drinking water are characterized by many disparities, and inequalities based on a non-sufficient connection to the industrial water distribution network in the central areas, while the peri-urban areas remain weakly connected to the water distribution network.

This low proportion of water access in peri-urban settings of Kinshasa negatively impacts access to water in most social welfare services such as schools, exposing school communities to the duty of fetching water, which undoubtedly has significant consequences for other WASH infrastructures and services as well as on girl students' school attendance [18].

While peri-urban households bear the brunt of these disparities and inequalities in access to water, the PNEVA, is reportedly struggling to extend its coverage rate to schools, implying that these schools failing to meet the WASH school community's needs, and the WASH access criteria of WHO or DRC WASH standards [10] [19].

To date, there are no studies that document these gaps by providing an overview of WASH infrastructures in peri-urban schools of Kinshasa (PUSK), as well as describing the level of access to water, and other WASH infrastructure, especially for girl students as a part of PNEVA coverage efforts.

Evidence providing an improved understanding of WASH facilities, including a gender component in the schools through the Educational Provinces (EPs), which mostly operate in an undocumented water access context, would be very helpful for guiding and adapting interventions to address potential gaps. Leading to such understanding requires structured and extensive studies which are presently lacking to document the whole WASH and gender-related situation in these schools in the Kinshasa EPs.

Based on interviews and observations performed in the three studied EPs, this study aims to fill the gap in WASH data by painting a picture of peri-urban schools' WASH facilities in the EPs compared to each other as well as the experience of girl students with WASH facilities. Subsequently, the study applies a SWOT analysis to determine the strengths, weaknesses, opportunities, and threats of these WASH facilities.

2. Methods

2.1. Study Site

Kinshasa, the capital of the DRC is divided into four Educational Provinces (EP) including, Funa (FN), Tshangu, Mont-Amba, and Lukunga. Each EP is further

divided into educational sub-provinces (ESP).

2.2. Study Design

We performed a cross-sectional study using analytical and observational approaches on WASH infrastructures, including their gender sensitivity, in schools from the ESPs belonging to three of the four EPs.

1) Study population, sampling procedures, and sample size determination

This study was preceded by another first study carried out at the household level targeting school-going adolescent girls (SGAG) in the same EPs. The population of this second study consisted of SGAGs' school WASH facilities in three EPs: Tshangu, Mont-Amba, and Lukunga.

The SGAGs targeted during the first study were randomly selected during a household survey using the multistage sampling method. The first study applied a 5-degree random sampling that successively performed a selection of 6 out of 12 peri-urban health zones (PUHZ) followed by a selection of 24 health areas in 6 PUHZ. Thereafter we selected 120 streets from 24 health areas. Finally, 858 households were randomly selected based on the criteria of having at least one SGAG. Thus 858 SGAGs were selected of whom 174 were excluded as they did not meet the selection criteria to participate in the survey (Mukiese, JM *et al.*, *in press*). Hence, during the first study 684 SGAGs meeting, the inclusion criteria were interviewed about access to water and WASH facilities as well as in their households and their schools. The 684 SGAGs questioned at the household level stated about the WASH issues in their schools. Subsequently, the first study listed the indicated schools attended by SGAGs in the three study EPs.

Thereafter, this second study has been implemented to establish links between the SGAGs and their cited schools to investigate WASH issues as stated by SGAGs at the household level.

Eligibility criteria

The schools that met the major inclusion criteria (to be cited and attended by a SGAG surveyed at the household level, to be located in one of the three previously studied EPs including Mont Amba, Tshangu, and Lukunga as well as the acceptance of the study by school authorities and availability of a person from the school to complete the study questionnaire) were selected to participate in this school WASH infrastructure assessment survey.

Given the fact that the schools to be investigated were those mentioned by the 684 SGAGs investigated at the household level, their number was determined progressively as they were indicated as schools attended by the SGAGs previously interviewed. A total of 187 schools were mentioned by SGAGs at the household level, of which 165 (88.2%) met the study criteria. The 165 schools selected to be surveyed represented more than a third of the 433 schools listed in the three studied EPs meeting the eligibility criteria.

2) Data collection

Data for this study were collected from March to December 2019. The quanti-

tative data displayed in Table 1 were obtained through interviews with school authorities. The qualitative data recorded on a grid were collected by interviewers using observations on the school WASH infrastructure.

Table 1 shows that half of the schools surveyed were in Lukunga, 60% were in the private sector, and almost all the schools were mixed-level schools and not beneficiaries of PNEVA interventions. On average, there were more girl students than boys in the surveyed schools.

3) Study variables

Socio-demographic variables

We collected information about the status of the schools, the level of the schools, and their PNEVA intervention status.

Variables related to gender sensitivity of WASH infrastructure, and GBV.

The gender sensitivity of the infrastructure was assessed by whether or not latrines, urinals and laundry facilities were used separately for girls and boys, and whether handwashing facilities were located next to girls' latrines and urinals. We also observed whether the schools dispensed modules on gender, GBV, teacher awareness or training on gender. The privacy and safety of the girls using the latrines were assessed by the presence of wooden or metal doors that could

Table 1. Characteristics of schools surveyed in Kinshasa peri-urban settings.

Variables assessed (n = 165)	Frequency	%	Minimum-Maximum
Study district			
Lukunga	83	50.3	
Mont-Amba	43	26.1	
Tshangu	39	23.6	
Status of the school			
Private school	104	63.0	
Denominational school	50	30.3	
Public school	11	6.7	
Type of school			
Mixed school	158	95.8	
High school	4	2.4	
College	3	1.8	
PNEVA status of schools			
Non-beneficiaries of the interventions	156	94.5	
Beneficiaries of the interventions	9	5.5	
Average number of students in schools			
Number of students	214.93 ± 185.590		14 - 987
Number of girls	114.95 ± 109.243		2 - 600
Number of boys	99.88 ± 93.885		1 - 534

be locked from the inside with a key or lock; GBV related to WASH facilities were assessed by the existence of policies on GBV, the Presence of posters raising awareness of GBV, and Denunciation of GBV in the use of WASH facilities.

Variables related to the availability of WASH infrastructure and programmes

The presence of water points, latrines, urinals, laundries and handwashing facilities (HWF) were both observed.

Variables related to the functionality of WASH infrastructure and programmes

The functionality of a water point was measured by the availability of water on the day of the survey, and the functionality of latrines, urinals, and laundry facilities was measured by their use by students on the day of the survey. The hygienic character of the latrines was assessed using an observation grid checking the absence of excreta, soiled toilet paper scattered on the internal and external surfaces; the absence of smell, flies, and other vectors. The functionality of HWF was measured by their use and the availability of water and soap or ash in the facilities on the day of the survey. Awareness-raising activities on WASH issues were assessed by their inclusion in school curricula as well as by statements from school authorities. The WASH club in schools to supervise WASH activities was checked too.

Temporo-spatial variables for water points located outside schools

The physical distance between the school and the water point was measured in metres using a measuring wheel. The time spent per day collecting water was estimated from interviews with the school authorities.

4) Patient and public involvement statement

There were no patients involved in our research. Participants aged 18 or over were recruited not as patients, but as stakeholders in the school system, as users of WASH services, and as members of the school community.

Thus, the development of the research question and outcome measures were not informed by the patients' priorities, experiences, and preferences. Therefore patients were not involved in the research design or in the recruitment to and conduct of the study. In addition, our study is not clinical research or a randomized clinical trial.

5) Data analysis

Data collected were analysed with SPSS software (Version 26.0). The normality of quantitative variables was checked with the Kolmogorov-Smirnov and Shapiro-Wilk tests [20] [21]. Descriptive statistical analysis was used to describe the existing WASH facilities in schools. Relations between main variables, differences in proportions and means between EPs, and subgroups were checked using the Student t-test, Fisher-Irwin Chi-square. The difference was considered significant for $P < 0.05$ [22]. Associations between nominal variables were verified with Pearson Chi-square tests of independence, and Cramer's V was used to measure the strength of associations when $P < 0.05$. A result less than 0.010 was considered to be a negligible association; from 0.10 and 0.20 a weak association;

from 0.20 to 0.40, a moderate association; 0.40 and under 0.60 as a strong association; 0.60 and under 0.80 as a relatively strong association; and 0.80 and under 1.00 as a very strong association [23].

The strengths, weaknesses, opportunities, and threats (SWOT) related to the WASH infrastructures and their gender sensitivity were identified using SWOT analysis [24] [25].

3. Results

The data collected from 165 PUSK on WASH infrastructure and related components are displayed as follows:

3.1. Availability of WASH Infrastructures in PUSK

Table 2 shows first, the proportion of peri-urban schools possessing water points, which is 10.9%. This low coverage rate is not significantly different among the three EPs surveyed ($P > 0.05$). Second, the overall latrine coverage was 98.2%, and of these, 3.6% of latrines were considered hygienic, with no significant difference among the three EPs ($P > 0.05$). Third, the overall coverage of schools with urinals was 13.9% with no significant difference between the three Eps ($P > 0.05$). However, the difference was significant when comparing the proportion of 23.1% of urinals at Tshangu and 7.2% of urinals at Lukunga ($P = 0.0130$). The proportion of schools that had laundries for MHM was 2.4%, and 7.2% had alternative spaces for girls to manage menstrual hygiene, both with no significant differences between the three EPs ($P > 0.05$). Finally, the overall coverage of HWF was 43%, and there was no significant difference when we compared proportions from the three EPs ($P > 0.05$).

3.2. Water Access in Schools without Water Points

3.2.1. Distance from Schools to Water Points

In the absence of a water point in their inner courtyard, 89.1% of the schools visited

Table 2. Availability of WASH infrastructure in PUSK.

Types of WASH infrastructure available in schools ($n = 165$)	Educational province (%)				*P*-value
	Set $n = 165$	Lukunga $n = 83$	Mont-Amba $n = 43$	Tshangu $n = 39$	
Water points	10.9	13.3	4.7	12.8	0.1347
Latrines	98.2	98.8	97.7	97.4	0.5726
Hygienic latrines	3.6	3.6	2.3	5.1	0.5011
Urinals	13.9	7.2	18.6	23.1	**0.0130***
Laundries for MHM	2.4	0.0	2.3	7.7	0.2594
Alternative space for MHM	7.2	4.2	3.0	0.0	0.7391
Handwashing facility/device	43.0	23.0	12.7	7.3	0.1680

*: Statically significant. $P < 0.05$.

were supplied with water from outside. The average distance travelled to collect water was 479.99 ± 381.724 m with extremes ranging from 50 to 2000 m. Pupils from Tshangu travelled an average distance of 423.77 ± 315.703 m, which was not significantly different from 413 ± 280.307 m at Mont-Amba ($P = 0.8796$) and 598.57 ± 520.858 m at Lukunga ($P = 0.0556$). However, with an average of 598.57 ± 520.858 m, school communities in Lukunga travel significantly further than the average of 413 ± 280.307 m in Mont-Amba ($P = 0.0322$).

3.2.2. Time Spent in Water Collection

The average time spent on water collection in schools was 59.68 ± 63.488 minutes with times ranging from 2 to 300 minutes. The average time of 80.71 ± 80.67 minutes spent in Lukunga was significantly higher than 31.27 ± 31.484 minutes spent in Tshangu ($P = 0.0004$), and 41.30 ± 40.988 minutes in Mont Amba ($P = 0.0033$).

3.2.3. People Involved in Water Collection in Schools

This study showed that more than 50% of the water collectors were school workers and nearly 30% were girl students. In addition, in 52.5% of cases, water collection in schools occurs during punishments, which frequently deprived girl students of participation in class lessons.

3.3. Types of Water Points in Schools

The data from this study indicates that of the 10.9% of water points, 89% were "improved", of which 50% of water points in schools were standpipes, followed by 22.5% of unimproved boreholes, and improved boreholes which accounted for 16.5% of water points, with no significant differences among the three EPs ($P > 0.05$).

3.4. Functionality of WASH Infrastructures

3.4.1. Water Points

This study showed that 15 (83.3%) out of 18 available water points were functional. All of the water points in the Mont-Amba schools were functional, significantly higher than 66.7% at Tshangu ($P < 0.0001$). The proportion of functional water points in Lukunga was significantly higher than in Tshangu ($P = 0.0003$).

3.4.2. Latrines

Overall, 130 (80.2%) of 162 latrines visited were functional on the day of our survey, with no significant difference in the functionality rate among the three EPs ($P > 0.05$).

3.4.3. Separate Use of Latrines by Gender

A total of 67.3% of the schools had latrines that were used separately by girls and boys, with no significant difference among the three EPs ($P > 0.05$).

3.4.4. Protection of Privacy and Safety in Latrines and Urinals

Overall, 48.5% of the toilets visited provide privacy to female student users, with

no significant difference in the proportion among the three EPs ($P > 0.05$). In total, 14 (60.9%) of the 23 peri-urban school urinals were used separately by gender, with no significant difference among the three EPs ($P > 0.05$). Of these urinals visited, 22.2% offered safety and privacy for girl users. However, a significantly higher proportion (66.7%) of urinals in Lukunga were safe compared to 14.3% at Tshangu ($P < 0.0001$) and 12.5% at Mont-Amba ($P < 0.0001$).

3.5. Latrines in Peri-Urban Schools

3.5.1. Types of Latrines

Two types of latrines were prevalent in the schools studied: 35.2% had improved latrines with roof, door, and lock, and 26% had pit latrines (ordinary) made of sack or sheet metal walls with neither roof nor door. There was no significant difference among the three EPs in the proportions of latrine types.

3.5.2. Characteristics of Latrines in Schools

A total of 80.2% of the latrines visited in 162 possessing latrines were functional, characterized by the presence of foul smells and 59.3% were characterized by the presence of scattered human excreta, with no significant difference among the three EPs ($P > 0.05$). On the other hand, 54.9% of the latrines had a significantly higher presence of flies, insects, and rodents at Tshangu compared to Mont-Amba and Lukunga ($P = 0.0231$).

3.5.3. Ratio of Latrine Units Rate for Girls in Schools

The median number of latrines used by girl students was two latrines and one urinal per school. Overall, the toilet and urinal ratios for girl students were 58:1 and 115:1 respectively, with no significant difference between these ratios in different EPs ($P > 0.05$).

3.5.4. Queues in Front of School Latrines and Urinals

In the 162 schools with latrines, the presence of queues in front of toilets and urinals, particularly during recess was noted. Queues for toilets with an average number of 4.5 ± 1.3 girl students were observed with no significant difference among the three EPs ($P > 0.05$). A median of 5.22 ± 2.01 girl students was observed queuing for urinals with significantly longer queues in Mont-Amba compared to other EPs ($P = 0.0330$).

3.5.5. Open Defecation and Urination

This study reported that in 62.4% of the schools surveyed, girl students were observed urinating and/or defecating next to or behind toilets. In 37.5% of schools, girl students were observed urinating or defecating next to or behind urinals. Overall, open defecation and urination were observed significantly more often next to and behind toilets than urinals used by girl students ($P = 0.0233$).

3.6. School WASH Clubs

This study reported 4.8% of schools ($n = 165$) that had a school WASH club with

a significantly higher proportion in Mont Amba schools ($P = 0.0206$). In terms of representativeness, with an average of 5.88 ± 6.256 boys versus 3.88 ± 4.42 girls, there were significantly more boys than girl students in these WASH clubs ($P < 0.0001$).

3.7. Actions to Support WASH, and Gender Sensitivity in PUSK

Table 3 summarises data on the availability of WASH and gender issues support actions, as well as the availability of WASH awareness posters in schools. The data reveal that most of these actions were not statistically different among the three EPs studied. However, the data reveal that schools from Lukunga were more likely to monitor pupils' handwashing regularly ($P = 0.0313$), had a clearer policy on gender equality ($P = 0.0019$), and had a higher reporting rate on GBV

Table 3. Actions developed in support of WASH in schools.

Availability of support actions ($n = 165$)	Set $n = 165$	Educational provinces (EP)			*P*-value
		Lukunga $n = 83$	Mont-Amba $n = 43$	Tshangu $n = 39$	
Hygiene and the fight against dirty hands diseases					
Mass awareness on hand hygiene	86.7	90,4	86.0	79.5	0.0973
Presence of hand hygiene awareness posters	3.6	4,8	0.0	5.1	0.9431
Monitoring of regular handwashing by students	23.0	33.7	14.0	10.3	**0.0313***
Mass awareness on drinking water hygiene	67.3	63.9	67.4	74.4	0.4893
Presence of posters raising awareness on water hygiene	1.2	2.4	0.0	0.0	0.3313
Mass awareness on latrine hygiene	74.5	77.1	74.4	69.2	0.3520
Presence of posters raising awareness on latrine hygiene	2.4	3.6	0.0	2.6	0.7733
Mass helminth deworming activities at school	66.7	62.7	60.5	82.1	**0.0316***
Allocation of funds for WASH infrastructure maintenance	24.9	16.4	8.5	0.0	0.2411
Gender sensitivity and menstrual management					
Awareness of students on the body and genital hygiene	71.5	65.1	76.7	79.5	0.1080
Menstrual hygiene management (MHM) awareness	66.7	53.0	76.7	84.6	**0.0008***
Presence of a clear policy on MHM in schools	7.3	9.6	7.0	2.6	0.6372
Presence of posters raising awareness of the MHM	0.6	1.2	0.0	0.0	0.4939
Free distribution of towels for the MHM	11.5	14.5	14.0	2.6	0.6143
Teacher training on gender and the gender approach	11.5	13.3	11.6	7.7	0.3680
Raising awareness of students on the gender approach	6.7	9.6	7.0	0.0	0.6250
Clear policy on gender equality in schools	30.3	41.1	25.6	12.8	**0.0019***
Presence of posters raising awareness of SGBV	1.2	1.2	0.0	2.6	0.5726
Denunciation of SGBV in the use of WASH facilities	44.8	50.6	48.8	28.2	**0.0204***

*: Statically significant. $P < 0.05$.

occurring in WASH facilities than the other EPs (P = 0.0204). On the other hand, activities on menstrual hygiene management (P = 0.0008) and mass helminth deworming in schools (P = 0.0316) were significantly higher in Tshangu compared with the other EPs.

3.8. Association between Variables Studied

The data in Table 4 indicate that the hygienic condition of latrines in schools is associated with the availability of reserve water next to the latrines for maintenance purposes, even if this is a weak dependence (P = 0.040; Cramer's V = 0.162). The presence of a water point in the school's inner courtyard as well as the availability of water next to the latrine has been found to have protective effects. Otherwise, they increase the likelihood of the latrines being kept clean and hygienic and of the HWFs being usable by the school community members. However, the functionality of handwashing facilities was weakly associated with the presence of a water point in the school's inner courtyard (P = 0.032; Cramer's V = 0.167), while there was a strong association with the availability of water in the HWF (P < 0.001; Cramer's V = 0.322), and soap next to the HWF (P < 0.001; Cramer's V = 0.672). Hence, the soap availability next to the HWF as

Table 4. Predictors of latrine hygiene and functionality of handwashing facilities in peri-urban schools in the city of Kinshasa, using Chi-square tests of independence.

Factors	χ^2	AOR (95% CI)	*P*-value	Cramer's V
Hygienic latrines				
Water point possession	0.212	1.671 (0.184 - 15.155)	0.645	
Functionality of water points	0.669	0.889 (0.998 - 1.000)	0.414	
Availability of water next to the latrines	42.30	0.492 (0.329 - 0.738)	**0.040***	0.162
School possession of urinal	0.039	1.245(0.139 - 11.170)	0.844	
Existence of a WASH brigade within schools	0.317	0.950 (0.916 - 1.000)	0.573	
Training of school staff on WASH issues	0.581	0.911 (0.868 - 1.000)	0.446	
Presence of latrine hygiene posters in schools	0.155	0.975 (0.951 - 1.000)	0.694	
Mass raising awareness on latrine hygiene	0.204	0.672 (0.119 - 3.810)	0.652	
Fund allocation to support WASH	0.240	1.538 (0.271 - 8.725)	0.624	
Functional handwashing facilities (HWF)				
Presence of a water point in school	4.604	0.378 (0.149 - 0.957)	**0.032***	0.167
Fund allocation to support WASH	0.831	0.719 (0.353 - 1.463)	0.362	
WASH brigade within the school	1.300	2.298 (0.530 - 9.955)	0.254	
Training of school staff on WASH issues	0.000	1.008 (0.333 - 3.048)	0.989	
Soap availability next to the HWF	17.133	1.203 (1.084 - 1.336)	**<0.001***	0.322
Water availability in the HWF	7.593	2.448 (1.851 - 3.239)	**<0.001***	0.672

*: Statically significant. P < 0.05.

well as the presence of water respectively increase by 20.3% and 44.8% the likelihood for the HWF to be used by the school community members.

3.9. Strengths, Weaknesses, Opportunities, and Threats (SWOT) of WASH Infrastructure

The SWOT analysis data displayed in Table 5 reveals that overall, there are more weaknesses and threats than strengths and unrealized opportunities for WASH infrastructures and items in schools in the study area.

Table 5. WASH infrastructure Strengths, weaknesses, opportunities, and threats.

SWOT analysis matrix	
Gender issues	
Forces	**Weaknesses**
68.5% of latrines and 60.9% of urinals are separated and used by gender	Low gender sensitivity of WASH programmes and infrastructures
44.8% of schools have an SGBV reporting policy	11.5% of teachers trained in gender and gender approach
66.7% of schools raise awareness on menstrual hygiene management	6.7% of schools raise students' awareness of gender issues
	30.3% of schools have a clear policy on gender equality
	Only 1.2% of schools have posters on GBV
	Lack of dedicated toilets and urinals for girls
	Unequal representation of girls in school WASH clubs
	At least 30% of girls draw water on punishments during school hours
Opportunities	**Threats**
Government commitment to gender promotion	Endemic toxic masculinity in peri-urban communities (patriarchy)
Presence of supporting partners (UNICEF, Ministry, USAID) in gender	School environments less sensitive to the gender approach
"Gender" module integrated into the country's school curriculum	Sexual and reproductive health issues
Presence of NGOs, feminist organizations defending the rights of girls	Increased absenteeism and school dropout of girl students
Water	
Strengths	**Weaknesses**
15 out of 18 schools (83.3%) have functional water points	89.1% of schools do not have water points, experiencing water chore
77.5% of schools with water points use improved sources	98.8% of schools lack water awareness posters
67.3 of the schools carry out sensitizations on drinking water hygiene	98% of latrines and 91% of urinals lack water for hygiene
	40.8% of handwashing facilities lack water for hand hygiene
Opportunities	**Threats**
Government's political commitment to the SDGs	Climate change and acts of sabotage by the population

Continued

Presence of the national service of rural hydraulics for water drilling	Student absenteeism, particularly among girls
Presence of technical and financial partners: PNEVA, Unicef, etc.	Risk of the emergence of waterborne and dirty hands diseases
	Increased risk of health, school, and gender impacts of fetching water
Hygiene	
Strengths	**Weaknesses**
86.7% of schools educate students on hand hygiene	43.0% of schools have handwashing facilities
75% of existing hand-washing facilities are functional next to latrines	90.3% of schools lack handwashing facilities next to latrines.
59.2% of handwashing facilities are functional on school grounds	97.2% of schools lack handwashing facilities next to urinals.
Presence of school WASH clubs in some schools	92% of schools lack hand hygiene posters.
	77% of schools do not ensure or monitor handwashing by students
Opportunities	**Threats**
Availability of the PNEVA	The imminent implosion of diarrhoeal and other dirty hands disease
Presence of the hygiene and sanitation module in the school curriculum	Lack of accessible funding for WASH
Presence of handwashing facilities in the market of the city	Covid-19 pandemic in a context of low water availability
	Endemicity of dirty hands and waterborne diseases
Sanitation	
Strengths	**Weaknesses**
98.2% of schools have latrines, of which 35.2% are improved latrines	3.6% of schools have hygienic toilets
52% of latrines have sanitary napkins and papers for intimate hygiene	13.9% of schools have urinals and 2.4% have laundry facilities
74.5% of schools raise awareness on the hygiene of WASH infrastructure	51.5% of toilets and 82.6% of urinals do not provide privacy for girls
Presence of a WASH brigade in some schools	4.8% of schools have a WASH school brigade
	2.4% of schools allocate funds to maintain WASH infrastructure
Opportunities	**Threats**
Presence of the National Healthy Schools and Villages programme	Increased girls' absenteeism in school
Presence of technical support partners: UNICEF, USAID, UKaid, etc.	Increased incidence of diarrhoeal diseases and dirty hands

4. Discussion

4.1. Water Point Coverage Rate

The results of this study demonstrate that fewer schools have water points without significant differences between EPs, and most of them have improved and functional water supply points. Larger holdings of improved water points equivalent to 45% of schools were reported in South Sudan and 57.1% in Uganda

[26]. On the outskirts of Kinshasa, access to drinking water for 9 out of 10 schools involves water collection chores. This poor access can be explained in part by the local context, which is characterized by disparities resulting in the poor water network connection of peri-urban settings, but also by the fact that schools do not take advantage of local opportunities presented by potential partners, such as SHHR, UNICEF, UKaid or different embassies located in Kinshasa.

Consequently, in the schools lacking water in their yards, the average distance travelled and the time spent collecting water exceed the set WHO standards. The patriarchal context has the implication that in the school, girl students are more often used as a workforce to collect water than boy students. In more than half of the cases, girl students collect water during punishment performed during school hours. Such practices have been reported in rural areas of the province of Central Kongo where in consequence, girl students miss lessons and face GBV violence like sexual harassment or rape during water collection [27]. Furthermore, this low access to water could have negative implications on the management and use of other WASH infrastructures' functionality and hygienic status such as latrines, urinals, and handwashing facilities which can lead to the practice of open defecation and urination reported by this study. This is supported by 81.5% of school girls in Ethiopia who stated that the lack of water remains the major challenge to the use of WASH infrastructure in their schools [26], while it has been documented that the availability of water is an essential component associated with supporting hygiene, combatting diarrhoeal diseases and pathogens transmitted by dirty hands [28] [29].

In addition, the lack of funds allocated to the WASH sector as reported in the majority of PUSK could explain a part of this low coverage or its worsening in the study region [30]. For schools with a water point, one of the limitations of this study is that its goal did not include analysing the microbial quality and quantities of water used.

4.2. Availability and Hygiene of School Latrines

With no significant difference between EPs, the majority of the schools surveyed had at least one latrine, of which more than one-third had an improved type of latrine with a door and an internal lock. Among these latrines, nearly 8 out of 10 were functional. This result is similar to the coverage of 83.7% reported from South Sudan [26], 77% from Benin, and 100% from South Africa [31] [32]. However, when this high coverage is normalized to the number of students in peri-urban schools in Kinshasa, specifically for girls, it appears that the ratio of students to toilet units is 58:1. This result is similar to the ratio of 60:1 reported in Ethiopian schools [33]. The latrine ratio for female students in Kinshasa schools was higher than the WHO standards, which recommend an average of 25:1 for girls or 30:1 according to the DRC WASH cluster [10] [19].

These ratios are problematic, given the risk of diarrhoeal diseases, and pathogens transmitted by dirty hands [28] [29], but are also detrimental to the

well-being of users, and would need to be addressed to contribute to the improvement of school attendance, particularly for girls [5] [34]. These ratios contribute to justify the unhygienic status of visited latrines with the presence of human excreta on the surface, several flies, and foul odors. This result qualitatively agrees with research reporting 49% of schools in Zimbabwe, 32.7% in South Sudan, and 33.3% in Ethiopia possessed unhygienic latrines, identified by the presence of human excreta on the surface, several flies and bad smells [26] [33]. In contrast, research from Benin reported that 79% of school latrines were found to be clean and hygienic in the commune of Zè [32].

The high proportion of unhygienic latrines reported in the current study can be explained by various factors, including insufficient coverage of water points in schools, and insufficient allocation of funds for infrastructure maintenance, which also has been reported in other contexts [35] [36]. Other factors studied include the absence of school WASH clubs or their failure to function, the lack of awareness-raising posters on latrine hygiene, and the weakness of mechanisms for monitoring the application of hygiene measures in PUSK as well as the high ratio of students to insufficient or inadequate toilet units reported in PUSK would also affect hygiene and latrine use [33] [36], because of the over-use by several students which can also explain the practice of open defecation and urinating next to toilets as reported repeatedly by studies carried out in other contexts [26] [37]. Likewise, the high ratio of female students to urinals could be taken as an additional factor in the deterioration of latrine hygiene as the toilets were used as an alternative for urination [37].

As such unhygienic latrines are hotbeds for the spread of diarrhoeal pathogens and other hand-transmitted diseases in pupils, it is strongly recommended that multi-faceted interventions targeting WASH to improve the latrine hygiene in these EPs be implemented, to combat the challenges of transmitted diseases as well as student absenteeism, repetition, and dropout in school as reported by other studies. This is especially important for girls, who already face several other factors that affect their schooling [35] [38].

Because of the link between latrine hygiene and multiple other factors [39], the large proportion of unhygienic latrines reported in this study raises concerns about the level of effective students' latrine use and satisfaction, the prevalence of transmitted diseases [37] [40] [41], student absenteeism, school dropout as well as the level of student's knowledge, attitudes, and practices about WASH. In this regard, further studies would be helpful to measure these considerations.

4.3. Handwashing Facilities (HWF) in Schools

The low percentage of schools with HWF is another factor that makes it harder to combat transmissible pathogens in peri-urban schools in Kinshasa. In the three studied EPs, our study has demonstrated a low availability of HWF as well as water and soap for their use. A similar availability of HWF of 46.7% was reported in high schools in the city of Yaoundé in Cameroon [42]. In contrast, a

higher proportion of 93% of schools with HWF, 80% of which contained water and soap, was reported from schools in Bamako [43].

The low availability of HWF in peri-urban schools in Kinshasa could be linked to a lack of interventions targeting WASH items and infrastructures from partners, schools, and governmental authorities as documented in this study. This can also be explained by the lack of school staff training in WASH as well as the low allocation of funds to the management of WASH infrastructure by internal school organizations. A similar situation was reported in schools in Ghana showing a strong association between functional HWF with functional water facilities [30]. The low rate of HWF, their functionality, and their location near latrines reported in this study are also similar to the low rate documented by a study performed in Ethiopian schools [33]. Once detrimental to the control of pathogens, as handwashing practices are highly influenced by the presence of functional HWF, containing water and soap or ash [44] as reported in **Table 4** of this study. We suggest that additional studies be carried out to improve the understanding of the level and determinants of handwashing practice in the communities of PUSK.

4.4. Gender Sensitivity of WASH Infrastructure

From a gender perspective, our study shows that at least 6 out of 10 latrines and urinals may be classified as gender sensitive, as there are separate facilities for boys and girls but not always used separately. This distribution in PUSK remains lower than the 83.8% of schools that offered separate latrine use in Uganda [26]. In the regions studied here, the low hygienic latrine rate could be considered a key factor limiting the optimization of separate latrine use, due to limited choices for students. Likewise, non-separate latrine use was experienced by 22% of girls who reported resorting to open urination in Uganda schools [26].

Of all the facilities visited, almost half of the latrines and urinals did not have doors or had doors without locks that could be closed from the inside for girl users' safety. Such latrines have the potential to become sites where girl students may experience difficulties in ensuring their privacy, and there is also an increased risk of GBV against girls using such latrines as relying upon that safety and dignity are two key components determining latrine use by girl students [36], and if these are lacking, it is possible that girl students will avoid using them and consequently use open defecation and urination as reported in PUSK.

Our study reports a very low proportion of schools in the three studied EPs offering laundry facilities to manage menstrual hygiene for girl students. Among those that do not offer these facilities, only 7.2% offered an alternative space for menstrual hygiene management (MHM). The proportion reported contrasts with the rate mentioned by a study from South Sudan, where 56.6% of the girls interviewed reported lacking spaces for MHM in their schools [26].

The low proportion of MHM facilities noted in our study could be explained

by the low level of gender awareness in schools, inadequate school staff training on gender issues, insufficient funds allocated to the management of WASH infrastructure, the low proportion of school WASH clubs, and the lack of access to water in many schools. Further studies are suggested to clarify the factors associated with the low proportion of MHM facilities and to evaluate the breadth of female students' school impacts resulting in the weakness of menses management mechanisms such as absenteeism reported in other contexts [45]. Given the importance of MHM in the promotion of gender-related interventions is strongly suggested to address these weaknesses in the PUSK to deal with the multiple impacts reported elsewhere as the MHM is a major factor associated with girls' school attendance, and weak school performances [46] [47] [48].

Limitation

The shortcoming of the current study was its cross-sectional status, which is unable to demonstrate correctly the strength of the associations reported.

5. Conclusions

The WASH infrastructure situation remains a public health concern in Kinshasa's peri-urban schools. This study provides a broad picture of the availability, functionality, and gender sensitivity of WASH infrastructures in PUSK, where most of them operate in the context of limited access to water. The results of the SWOT analysis applied to the WASH infrastructure and the gender programme reveal numerous challenges, weaknesses, and threats intersecting on girl students that jeopardize chances of achieving SDGs 3, 4, 5, and 6 related to health, education, gender equality and access to water from their schools.

The current results raise awareness of WASH and gender issues among political and school authorities and could be combined with taking advantage of existing opportunities to strengthen the response to address the current weaknesses and threats identified to improve gender perspective, availability, functionality, and delivery of existing school programmes and WASH facilities.

Further studies assessing the different impacts on students' health and well-being, education, and girls' experiences of safety and dignity, and those assessing the knowledge, opinions, perceptions, and practices of students, particularly female students, are expected to improve understanding of WASH and gender issues in PUSK.

Ethics Approval and Consent to Participate

The study protocol was submitted to the ethics committee of the School of Public Health of the University of Kinshasa. This received approval under the number: ESP/CE/230/2018. Informed consent was obtained from each school staff interviewed. Also, approvals from different authorities of the surveyed EP (Tshangu, Mont-Amba and Lukunga) were previously obtained, and then endorsed by the offices of the ESP and the heads of schools before the data collection process.

Availability of Data and Material

The datasets used and/or analyzed during this study are available from the corresponding author on reasonable request.

Authors' Contributions

JMMN and GMK designed the study and drafted the French and English versions of the manuscript that was revised by JKNN and MKY. All the authors read and approved the final version of the manuscript until submission.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Abbreviations

CI: confidence interval, **DRC**: Democratic Republic of Congo, **EP**: Educational province, **ESP**: Educational sub-province, **HA**: Health area, **HWF**: Handwashing facility, **HZ**: Health zone, **MHM**: Menstrual Hygiene Management, **PNEVA**: Programme National École et Village Assainis, **SDGs**: Sustainable Development Goals, **SGAG**: School-going adolescent girl, **SPSS**: Statistical package for social science, **SWOT**: Strengths, weaknesses, opportunities and threats, **WASH**: Water, sanitation and hygiene, **WHO**: World Health Organization.