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Practical Paper

Water, sanitation, and hygiene (WASH) coverage and practices of children from five public primary schools in Guinea

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ABSTRACT

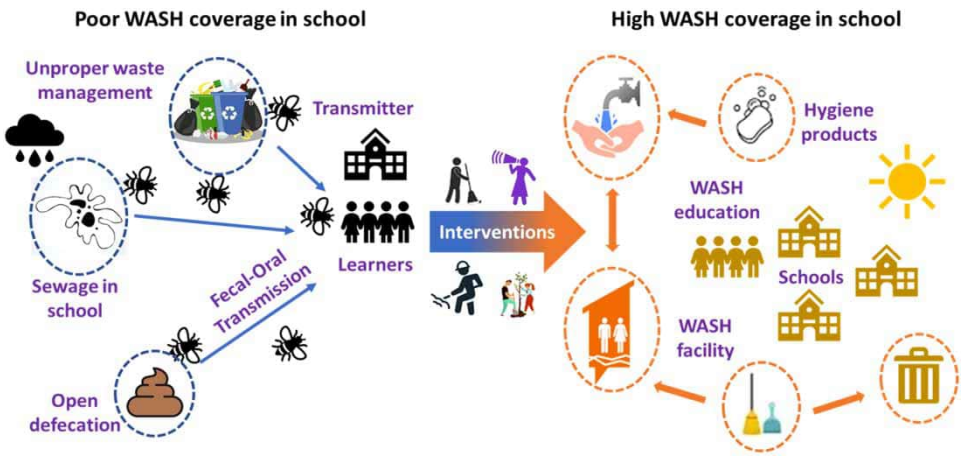
The water, sanitation, and hygiene (WASH) coverage and practices in and out of primary schools are crucial to the well-being of children. Using a questionnaire analysis method, this study focuses on the WASH coverage and practices of children from five public primary schools in the city of N'Zerekore, the second-largest city in Guinea. Our results reveal that the WASH coverage and practices in all five schools are inadequate. Our data indicated that 100% (n=1,048) of pupils don't wash their hands with soap after defecation in school, and over 87.9% (n=922) of students do not wash their hands before eating. The poor WASH coverage, inadequate hygiene practices, and other activities and/or causes result in a higher incidence of diseases among children, such as malaria, typhoid, and diarrhea. Some effective interventions, including the provision of clean water, sanitation and hygiene infrastructure, and widespread and effective health education, should be implemented to address these health issues among young African students.

Key words: hygiene, incidence and prevalence, primary school pupils, sanitation, water

HIGHLIGHTS

- The current study highlights the WASH coverage and practices of children in Guinea.
- WASH interventions such as access to an improved water source and improved water quality are urgently needed.

GRAPHICAL ABSTRACT



INTRODUCTION

The water, sanitation, and hygiene (WASH) coverage and practices in and out of primary schools play a vital role in affecting the health, education, and welfare of children, particularly in low-income nations. Inadequate WASH coverage and practices have significantly contributed to increasing disease burdens among the populations of less developed countries (Pruss *et al.* 2002; Fewtrell *et al.* 2005). Significant efforts and progress have been made in combating the diseases derived from inadequate access to safe WASH conditions (Gine-Garriga *et al.* 2017). However, diarrhea and other diseases such as cholera and typhus are still responsible for 10% of all childhood deaths on a global scale in 2010 (Liu *et al.* 2012). Particularly, school-age children are among the most vulnerable to such diseases in developing countries, with an estimated 2–3 million deaths annually from diarrhea-related diseases, many of which could be prevented by improving WASH coverage and practices (Thakadu *et al.* 2018). Water- and sanitation-related diseases kill approximately 10,000 Africans each day, with thousands more suffering from incapacitating illnesses (Armah *et al.* 2018). The improvement of WASH coverage and practices in primary schools can significantly improve the living standards of pupils and lead to better hygiene behavior throughout their lifetimes (Delea *et al.* 2019). Enhanced hygiene and personal sanitation practices are of great importance for minimizing the risks of increasing communicable diseases and improving public health (Thakadu *et al.* 2018). Nevertheless, millions of Africans still lack access to soap and clean water for handwashing, which otherwise would help prevent the spread of diseases (WHO & UN-Water 2014).

Guinea is ranked 32nd out of 56 African nations with respect to the Sustainable Development Goal (SDG) 6 targets for ensuring the global accessibility and sustainable management of water and sanitation (Nhamo *et al.* 2019). The country has often suffered from acute public health events associated with the lack of accessible public toilets (Collins *et al.* 2020). Consequently, fecal wastes were discharged directly to the water bodies. Notably, the disposal of children's feces is more likely to be a source of pollution than the household environment (WHO 2006).

This study presents an exploratory analysis of WASH coverage, including water supply and quality, waste management, sanitation, hygiene practices, and health education within five public primary schools in N'Zerekore, Guinea. The main objective of this practical paper is to correlate the WASH coverage and practices with the high incidence and prevalence of diseases in children and to inform the local governments on the need for school-level WASH interventions and continuous improvement in WASH coverage and practices to reduce the incidence of common illnesses among children.

METHODOLOGY

Site

The survey was conducted by five undergraduate volunteers led by the authors, and from December 2018 to May 2019 in five public primary schools in the city of N'Zerekore, the second-largest city in Guinea. These public primary schools are as follows: Mamadou Konate (**MK**), Mohomou (**Mh**), Gbanhana (**Gh**), Tilépoulou (**TL**), and N'zegbela Tokpa (**N'ZT**) (Figure 1).

Data and methods

A questionnaire (in French) was designed to cover the following sections: (i) general information about the institutions (6 questions), (ii) drinking water supply (10 questions), (iii) waste management (4 questions), (iv) sanitary conditions of toilets (9 questions), (v) personal health protection (18 questions), (vi) handwashing practice, and (vii) total sanitation situation of the school.

A mixed research approach (Pfadenhauer & Rehfuess 2015) was adopted in this study. The primary data were collected by a face-to-face questionnaire survey of 1,048 random students from grades 3 to 6 in these schools (Table 1). It is worth specifying that all students were capable of answering the questions on the questionnaire in the official language, i.e., French. Individual interviews with the headmasters and the teachers were also performed to verify the authenticity of the data from the pupils. Data collection was based on students' knowledge of hygiene practices, and handwashing situations at school and after school. Data were analyzed by using OriginLab Origin v9.0 software and Microsoft Excel 2010.

Ethical approval

Ethical and scientific approval was obtained from the NUIST and the University of N'Zerekore Ethics and the Scientific Review Committee.

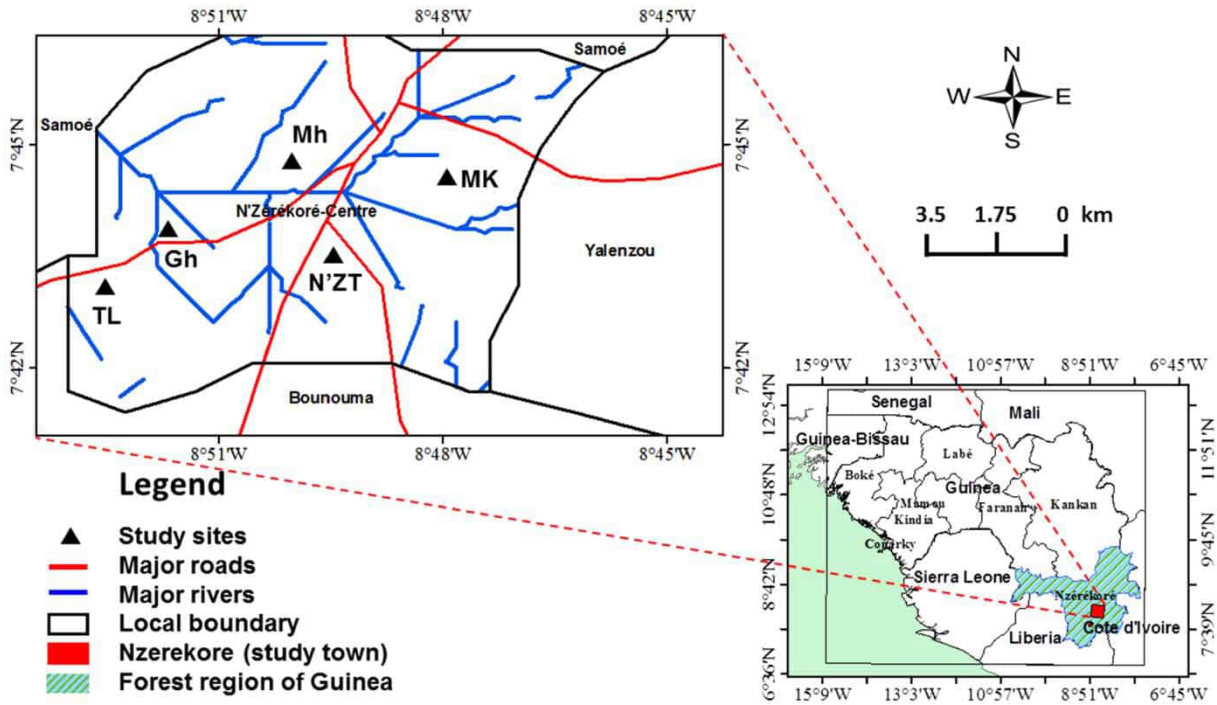


Figure 1 | Map of the surveying sites.

Table 1 | Information on the five public primary schools and the sampling statistics

School name	Year established	Number of classrooms	School capacity	Current enrollment	Overcapacity	Pupils sampled
MK	1917	13	650	896	246	179
Mh	1963	24	1,200	1,284	84	257
Gh	2000	9	450	712	262	142
TL	1992	13	650	711	61	142
N'ZT	1960	14	700	1,640	940	328
Total		73	3,650	5,243	1,593	1,048

RESULTS

Socio-demographic profile

The sample numbers (n) are 179, 257, 142, 142, and 328 for **MK**, **Mh**, **Gh**, **TL**, and **N'ZT**, respectively. A total of 1,048 pupils (~20% of the total enrollment) were sampled and interviewed. The detailed sampling information is listed in Table 1.

Water availability and quality in schools

The most common drinking water sources in the selected schools originated from the on-campus boreholes by hand-pumping. Three primary schools (i.e., **Mh**, **Gh**, and **N'ZT**) used boreholes as their only drinking water source. The main problem associated with the boreholes, according to the school headmasters, was the frequent breakdown of the hand pumps. One of the five primary schools, i.e., **MK**, obtained drinking water from a local water company (i.e., SEG), who distributed the water to **MK** by water transporting vehicles once or twice a week. **TL** usually drew water from an unprotected dug well within the school and used it as drinking water.

Water quality surveys were also carried out in the five schools, and the results are given in Table 2. The percentages of the surveyed pupils who have no doubts about the water quality of the borehole or well water account for 88.8, 80.9, 62.7, and 62.5% for **MK**, **Gh**, **TL**, and **N'ZT**, respectively. Our survey indicates that the majority of these students who appreciated the

Table 2 | Survey data on water quality, garbage disposal, and latrine use in the five primary schools

School name	Opinion	MK	Mh	Gh	TL	N'ZT
Water quality survey (%)	No opinion	10.1	73.9	15.5	21.8	14.6
	Drinkable	88.8	26.1	80.9	62.7	62.5
	Undrinkable	1.1	0.0	3.5	15.5	22.9
Garbage disposal survey (%)	Trash bins (TBs)	75.4	54.1	14.1	41.5	90.5
	Anywhere (AW)	24.6	45.9	85.9	58.5	9.5
	Ratio of TBs:AW	3.1	1.2	0.2	0.7	9.5
Whether or not using water in latrines? (%)	Yes (Y)	63.1	28.0	38.1	16.9	54.9
	No (N)	36.9	72.0	61.9	83.1	45.1
	Ratio of Y:N	1.7	0.4	0.6	0.2	1.2

water quality made their choices mainly in terms of the clarity of the water, i.e., if the water is clear, it was considered drinkable. However, most pupils (73.9%) in **Mh** claimed that they have no opinion because they used to bring their drinking water with portable bottles from a borehole near the school rather than the on-campus boreholes.

Waste management and sanitation in schools

Waste management and sanitation situations in these schools were investigated by surveying and on-site inspection. In all five schools, there were many trash bins (TBs) sponsored by some local Non-Governmental Organizations (NGOs). Unfortunately, many pupils are used to depositing their trash anywhere (AW) in schools rather than discarding them into the provided bins (Table 2). Some pupils complained that there were no TBs in their classrooms, so they are used to discarding their trash everywhere.

Waste management systems such as garbage removal and transporting systems for further treatment or recycling have not been established in all five schools. The most commonly used method of waste disposal was incinerating it in the open air, without the use of any equipment such as a metal incinerator with an alkaline or acidic scrubber. This treatment will consequently pollute the local atmosphere, and can cause breathing disorders and eye diseases (Lin *et al.* 2022), particularly to the onlookers. Indeed, our survey found that an average of 22.9% (n=248) of pupils surveyed was suffering greatly from respiratory diseases (e.g., asthma, bronchitis, etc.) (Figure 2). Furthermore, although Saturday is the day for school sanitation in the city of N'Zerekore as recommended by the Director of Prefectural Education (DPE), this regulation has not been well

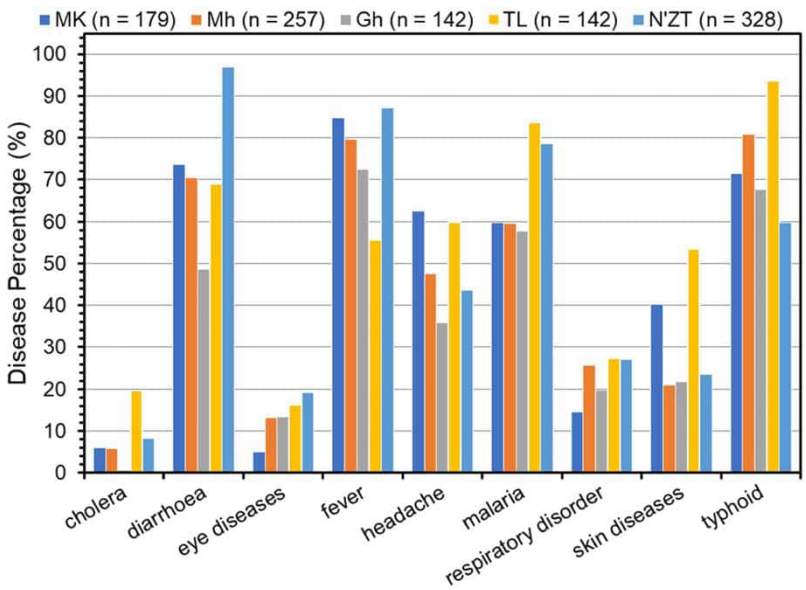


Figure 2 | Percentage of surveyed pupils presenting with different types of diseases.

implemented by some schools. Some students, for example, claimed that they just swept the classrooms and picked up the garbage on campus without the use of any detergents and disinfectors on Saturdays.

Hygiene practices in schools

It is worth noting that none of the primary schools have access to healthy hygiene practices due to the scarcity of essential hygiene facilities, particularly in the bathrooms, e.g., toilet roll, running tap water, handwashing soaps, etc. (Figure 3). As shown in Figure 3, the latrines did exist in all primary schools surveyed, but the state of their insalubrity was notable. A survey on whether or not to use water for personal hygiene and feces clean-up after toilet use shows that most pupils in **Mh**, **Gh**, and **TL** did not use water because of the unavailability of water in the bathrooms (Table 2). In **TL**, for example, 83.1% of pupils interviewed said that they did not use water in the toilets as there was no water. However, some students who responded positively to this issue claimed that they used to draw water from the on-campus boreholes or the nearby residents for handwashing after using the toilet. Surprisingly, some pupils did not recognize the existence of bathrooms in their schools, although the United Nations High Commissioner for Refugees (UNHCR) has set a minimum standard of toilets in schools to 50 pupils per toilet to reach SDG-6 (UNHCR 2022).

Furthermore, our surveys of 1,048 pupils (Table 3) show that 100% of pupils were not used to washing their hands with soap after using the toilet, 87.9% were not accustomed to washing before eating, 90.8% were not conditioned to washing after eating, and 94.4% were not habituated to washing after playing. Most of the pupils were not likely to wash their hands at the critical moments for hand hygiene in schools mainly due to the scarcity of water and soap and the ignorance of the importance of hand hygiene in personal and health care. Thakadu *et al.* (2018) have conducted a similar study and found that poor water supply hindered washing hands, with 65.7% of students 'always' cleaning their hands if tap water is accessible, which is consistent with our findings. Furthermore, they also noted that even when sanitary facilities are always available there is no guarantee that students will use them for a variety of reasons, e.g., lack of awareness of hygiene, concerns about privacy, etc.

Figure 3 | Photos of unsanitary toilets and a garbage dump in these schools: (a) **MK**, (b) **Mh**, (c) **TL**, and (d) **N'ZT**.

Table 3 | Survey on crucial moments for hand hygiene in and after school

	In school (%)		After school (%)	
Critical moments for hand hygiene	**Yes**	**No**	**Yes**	**No**
After using the toilet	0.0	100.0	69.5	30.5
Before eating	12.1	87.9	99.7	0.3
After eating	9.2	90.8	81.7	18.3
After playing	5.5	94.6	55.2	44.8

WASH practices after school

The WASH practices of the pupils after school (i.e., at home) were also assessed to identify the critical factor that impacts students' hygiene behavior in and out of school. As shown in Figure 4, the primary drinking water sources at the pupils' homes vary from school to school. Tap water and well water from either dug wells or boreholes are the two primary drinking water sources in all pupils' homes. For instance, students using tap water as the primary drinking water source at home accounts for 53.1, 37.1, 51.4, 33.8, and 37.8%, respectively, for **MK**, **Mh**, **Gh**, **TL**, and **N'ZT**. On the other hand, in **TL**, 58.4% of pupils obtained their drinking water from either nearby boreholes or dug wells, followed by 38.1% in **N'ZT**, 36.6% in **Gh**, 31.2% in **MK**, and 26.4% in **Mh**. Moreover, there were 34.6% of pupils in **Mh** and 21.3% in **N'TK** who could not get drinking water from their homes but had to acquire water from their neighbors. Nevertheless, it is worth noting that the accessibility of water at students' homes is often better than at school.

As shown in Table 3, it appears that the hand hygiene of the surveyed pupils at home (or after school) has significantly improved from that observed in school. Our data indicate that 99.7% of the participants washed their hands before eating, 81.7% after eating, 55.2% after playing, and 69.5% after defecating (Table 3). This improvement in hand hygiene at home is likely due to the fact that the accessibility to water is often better in most students' families than in schools, and that students tend to maintain good personal hygiene when water is available at home.

DISCUSSION

Summary of main results

Due to overpopulation, lack of teachers, and probably inadequate primary schools in the region surveyed, all five primary schools were overcrowded with a total overloading rate of 143.6% (Table 1). As expected, overpopulation has led to extra intake in schools. (e.g., there was an excess of 940 students in **N'ZT** school), and also put undue pressure on the school WASH facilities. This situation appears to facilitate the transmission of diseases, particularly the spreading of infectious

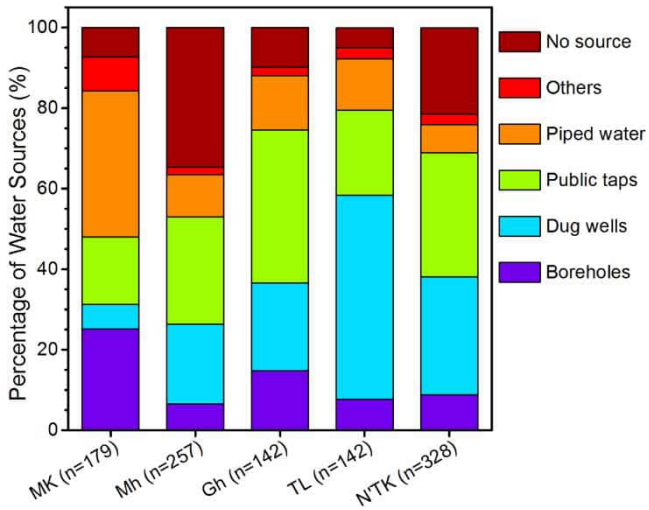


Figure 4 | Primary drinking water sources at pupils' homes.

diseases as confirmed long ago by Garnett & Lewis (2007). The water access and quality varied from school to school, and only three schools, i.e., **Mh**, **Gh**, and **N'ZT**, can meet the SDG-6 standards to some degree for the safe management of the drinking water from the on-campus boreholes. However, they often experience severe water shortages in dry seasons when the wells dried up. Either the water accessibility or the water quality cannot meet the SDG-6 requirements in the cases of **MK** and **TL**. Besides, our data indicate that the waste management (e.g., access to the trash can, garbage collection, and disposal on campus), sanitation access (e.g., access to handwashing kits with soap and water, access to latrines with water, latrine maintenance, and fecal sludge management), and hygiene practices (e.g., handwashing before eating and after defecation, soap use) in schools were insufficiently implemented by the school administrators and/or operators (Tables 2 and 3), resulting in a higher incidence and prevalence of disease in children in all primary schools (Figure 2).

The need for proper WASH interventions

Many reports demonstrated that WASH interventions can reduce illness through improvements in drinking water, sanitation facilities, and hygiene practices in less developed countries (Stocks *et al.* 2014; Wolfe *et al.* 2018). Our data indicate that the illnesses found in the children from all five primary schools include cholera, diarrhea, eye diseases, fever, headache, malaria, skin diseases, and typhoid (Figure 2). All of these illnesses can be reduced or eliminated by appropriate WASH interventions. According to Jones *et al.* (2020), the five general WASH interventions e.g., water treatment, water source/supply, sanitation, hand hygiene, and water storage, can reduce the risk of cholera transmission.

Different interventions may play different or similar roles to reduce the odds of some diseases, and multiple interventions would likely be more efficient than a single one. However, for a specific condition, e.g., diarrhea, it has been demonstrated that water quality interventions such as point-of-use water treatment would be more efficient than multiple WASH interventions (Fewtrell *et al.* 2005). Therefore, it is essential and urgent to conduct a WASH intervention trial in these primary schools focusing on which intervention would be the most efficient for lowering the odds of the most common illnesses in children. A detailed WASH strategy should be developed for each primary school based on their specific survey results. In terms of our survey, improving the water source and quality and providing the essential excreta disposal facilities are likely to be among the most efficient interventions for controlling waterborne diseases among children. Nevertheless, maintaining the WASH facilities, raising awareness, and sustaining practices of children remain challenges, which must also be properly addressed in the long run.

CONCLUSION

Basic sanitary services, such as running tap water and handwashing soaps, are required in a learning institution to protect students and staff from disease. Students have the right to learn in safe places with appropriate WASH facilities. However, the WASH coverage in five Guinean primary public schools was deplorable, significantly contributing to their high incidence and prevalence of diseases in children. Consequently, school-level WASH intervention trials are needed to elucidate what package of specific interventions will maximize the health benefits to each school and to ensure the most efficient use of limited resources. Constructive policies must be initiated and enacted at all levels, from the national to the district, and from the community to the school, to encourage and facilitate efficient WASH coverage and practices in schools. Besides, the local WASH sector and the global WASH professionals should work together to find long-term solutions that leave behind the challenge of WASH facilities maintenance and sustainable practices.

DATA AVAILABILITY STATEMENT

Data cannot be made publicly available; readers should contact the corresponding author for details.

CONFLICT OF INTEREST

The authors declare there is no conflict.

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