ORIGINAL ARTICLE

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Wash Practices in Schools, Cameroon

Mercy A. Manjong-Kofete, Kenneth A. Yongabi, and Wilfred F. Mbacham

ABSTRACT

This study investigated the influence of Water, Sanitation and Hygiene (WaSH) management on the bacteriological quality of students' palms in some schools within the Bamenda municipality, to serve as baseline data for strengthening of hygiene management and health policies in schools. The study employed a descriptive cross-sectional approach with data generated through questionnaires, swabbing of the palms of selected students and doorknobs, as well as culturing of the swabs for microbial identification. SPSS version 16.0 was used for data analysis and Chi-square test to determine significant differences in the level of bacteria on the palms of participants by gender. None of the schools met WHO standards, and the gap between toilet usage and hand washing after defecation was very significant ($p < 0.0001$). Bacteria isolated included: Staphylococcus spp (63%), Escherichia coli (31%), Enterobacter sp (10%), Bacillus sp (10%), and Coliforms (5%). Two Fungi species: Yeast (10%) and Moulds (3%) were also isolated. The content of the curriculum, teaching and assessment mechanism for the WaSH programme management in schools was found to be in need of greater attention, schools and local governments focus on it being below expectation.

Keywords: Gaps, Hygiene, Management, Sanitation practices, School.

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I. Introduction

Studies in developing countries show the threat to urban health posed by microbial contamination and associated increase in waterborne enteric diseases [1]. Cameroon's urban areas largely echo this pattern, with acute water shortage worsening the sanitation situation. In the context of scientific developments on medication and vaccines, it needs to be stressed that prevention deserves greater advocacy, given the emergence or re-emergence of new/old microbial and viral pathogens. The case of Covid-19 has brought mankind to this, highlighting the need for systems take up heightened preventive measures. School environments instance vivid disease transmission by contagion — touching of objects, bodily and post-faecal interactions— as well as the fact that proper hygiene management significantly responds to these pathogenic paths.

Assob *et al.* [2] in their Buea (Cameroon) study highlight a 61.33% prevalence of faecal-oral parasites in street food vendors and Akoachere *et al.* [3] and Awah *et al.* [4] document the biological pollution of wells, backwaters and rivers from poor domestic and industrial waste management. The Bamenda Health District records confirm the prevalence of waterborne diseases, including occasional cases of cholera [4]. Yet, water provision and sanitation facilities have not been upgraded relative to the rapid population growth [5], which raises the risk factor in health and the environment. Most educational institutions in Cameroon lack or only have water in short supply and inadequate, poorly managed toilet facilities compound the deplorable hygiene practices. The curriculum for the management of school WaSH programme needs greater attention; the teaching and assessment mechanism of hygiene education in schools lack the practical component. These growing structural health concerns, particularly in schools, necessitate school-based studies for better understanding of the stakes.

Allegranzi and Pittet [6] have compared different hand hygiene methods in hospital settings but little has been published on the effect of hand hygiene vis-à-vis the bacterial contamination of hands in schools. This study was therefore conducted to bridge the gap in the management of hygiene and sanitary practices in secondary schools and thereby provide baseline data to facilitate governmental efforts at improving and creating safe, healthy, inclusive, and equitably resourced educational environments.

II. Materials and Method

A. Study Site

Where this study was carried out, the Bamenda Urban Municipality of North West Region is on the Western Highlands of Cameroon, between Latitudes 5° 40' and 7° North of the Equator and Longitudes 9° 45' and 11° 10' East of the Prime Meridian. It is bounded by Akum to the east, Bambui to the North, Bafut to the west and Bali to the south.

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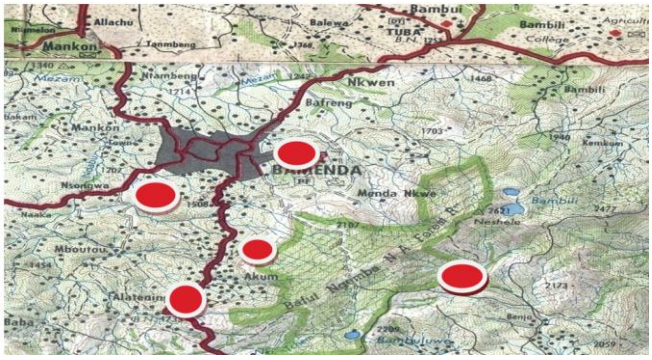

Fig. 1. Map of study area showing sampled schools.

From Carte du Cameroun: Bafoussam NB-32-XI Yaoundé: SOPECAM 1978. and Carte du Cameroun: Nkambe NB-32-XVII: Yaoundé: SOPECAM 1983.

The largest and closest municipality to Nigeria and the Western Region of Cameroon, Bamenda (Fig. 1) has witnessed rapid population growth, projected to double in 2030 and triple in 2050 [5]. In 2010 Bamenda population stood at 322,889 with a density of 104.3 inhabitants per km^2 [7] and growth rate of 7.95%, above the national average of 5.6%. Understandably and projecting an early return to normalcy from the on-going conflict in Anglophone Cameroon of which Bamenda is a part, the number of school-goers rose, with record more than thirty secondary schools of private and public status for each of the three subdivisions of the municipality. The student concentration multiplies the chances of disease propagation, especially since enough focus has not been directed to waste and/or sewage treatment beyond garbage disposal efforts, as garbage recycling techniques are non-existent and untreated sewage is randomly discharged into the environment [5].

B. Study Design

Approved by the Institutional Review Board of the Catholic University of Cameroon, Bamenda and the Regional Delegation of Public Health, consent for this study was from both the school authorities and focal students. Based on an updated list of the municipality schools from the Regional Delegation of Secondary Education, the study employed a descriptive, cross-sectional design. The municipality was carved out into five sections (north, south, east, west and centre) and one school randomly selected from each. A total of 249 students from these schools were selected and stratified into respective cycles (First cycle, aged 10-15 and the Second cycle, aged 16-20). Within each cycle they were further stratified according to the two sexes. Two data collection models – questionnaires and experimental methods with palm and door swabs – were employed.

C. Questionnaire Survey

The questionnaire, with designated response options [8], had five sections which respectively required demographic information, students' sanitary habits, the hazards present, risk assessment, and the measures to control the hazards and reduce risks. An observational checklist documented the sanitary conditions of the schools, sources of water supply, sanitary facilities (including toilets and tap water) and other disease-related environmental factors (waste disposal, and vector breeding around the school premises).

D. Swab Sample Collection Methods Preservation and Transportation

Wetted sterile swabs immerged in sterile water were swiped over fingers and the palm of each student's dominant hand of all participating students and on the most frequently used doors; the swab sticks were then sealed in their tubes and stored in a cool box at 4^o temperature and moved within an hour to a research laboratory at the Phytobiotechnology Research Foundation Bamenda. There the swabs sticks were immediately put in a fridge.

E. Culture Media Preparation

The microbes on the swabs were cultured in Nutrient Agar and MacConkey Agar, prepared as guided by the manufacturer, and sterilized at 121 °C in an autoclave for 15 minutes. For sterilization, all glassware was passed over a flame.

F. Culture Technique and Incubation Period

The swab sticks and Petri plates for cultures were assigned specific codes and inoculated by sterile techniques, streaking the swabs onto the Petri plates containing MacConkey Agar and Nutrient Agar before covering and incubating the plates for 48 hours at 37 °C.

G. Characterization, Identification, and Confirmation of Isolates

Pure cultures were picked through streak plaiting with a loop and subjected to Gram staining catalase test, coagulase test for suspected growth isolates being presumptively identified by morphological, cultural, and biochemical characteristics. The results were compared with the standard bacteria characteristics expressed in Bergey's Manual of Systemic Bacteriology [9].

H. Data Analysis

The statistics were set to a frequency distribution with percentages displayed on tables and graphs. The Chi-squared test carried out established the association between categorical variables. P- Values less than 0.05 were considered statistically significant on a 95% confidence interval. The statistical analysis was conducted using SPSS (statistical package for social sciences) version 16.0.

III. Results and Discussion

A. Socio-demographic Characteristics of Respondents

A total 249 students of whom 146 (58.63%) were boys and 103(41.37%) were girls. with a preponderant age bracket of 10-15 years (Fig. 2) participated in the study, males being greater because 50 of the random sampling students came from an all-boys school. Some 99 (39.8%) of the students were from Day government school (GBHS Bamenda and GBHS Atiela); 59(23.7) from a Mission Boarding school (SHC); 44 (17.7%) from a Holiday school (HSHS) and 47 (18.9%) from a Lay private school (LCC) (Fig. 3).

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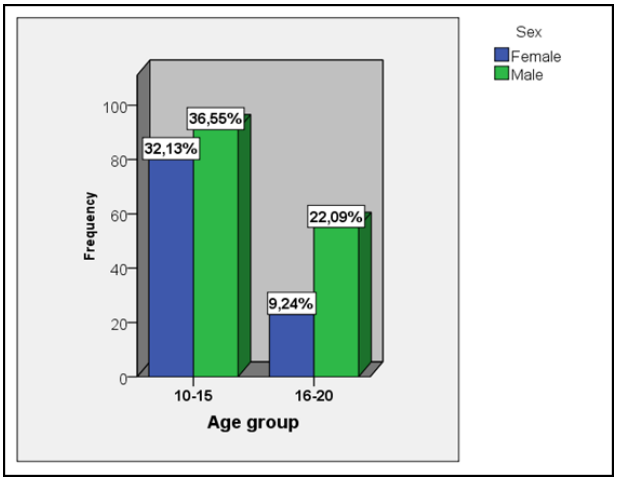

Fig. 2. The distribution of students by age and by sex.

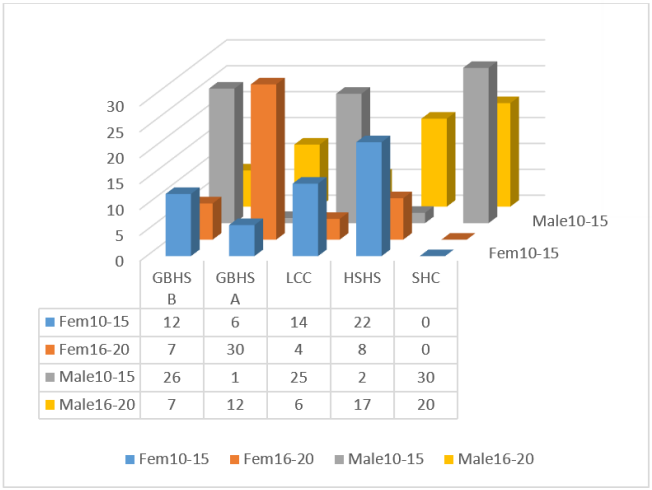

Fig. 3. Distribution of respondents according to school, gender, and age.

B. *Sanitary Habits of the Students*

The surveyed schools each had at least one toilet facility, pit latrine being most common. One toilet block with an average of three compartments or drop holes served both the male and female students. The gender-segregated toilet compartments serving many students had better ratios in private (LCC, HSHS and SHC) than in the government (GBHSB, GBHSA) schools, but none met the WHO standard ratio of 1:25 for girls and none provided male urinals, anal cleansing materials, or accessibility for the physically challenged; water was absent, inadequate or in inconsistent supply and defecation on toilet floors or in the open field was common.

The frequency of toilet usage and the hand-washing practice after toilet usage (Table 1) indicate more frequent use of toilets in private schools than in government school. Gender further varied the frequency of toilet usage, 33.6% (49/146) of males always using the school toilets whereas only 3.4% (5/103) females used the toilets regularly. By the statistical test, students of the 10-15 years bracket used school toilets more often than those 16-20 years ($p<0.005$). However, 62.2% of students indicated using school toilets occasionally, i.e., when hard-pressed, if water was available, or on days of general campus cleaning. Hand washing facilities were available in all the schools but located far the toilets and lacked water. No school provided soap for students' hand washing and only 108 (43.4%) and mostly 10-15 year old males (65.9%) washed their hands after toilet usage. The gap of toilet usage and hand washing after defecation was significant (p-value < 0.001).

TABLE 1: SANITARY HABIT OF THE STUDENTS

Variable	Female		Male		Total
Age (Year)	10-15	16-20	10-15	16-20	
Usage of school toilets					
Always	1(1.3)	4(17.4)	35(38.5)	14(25.5)	54(21.7)
Never	18(22.5)	4(17.4)	3(3.3)	15(27.3)	40(16.1)
Once in a while	61(76.3)	15(65.2)	53(58.2)	26(47.3)	155(62.2)
Hand washing practice after toilet usage					
If there is water	23(28.8)	12(52.2)	24(26.4)	27(49.1)	86(28.9)
No	30(37.5)	6(26.1)	7(7.7)	12(21.8)	55(22.1)
Yes	27(33.8)	5(21.7)	60(65.9)	16(29.1)	108(43.4)

C. *Hazards Present and Risk Assessment*

The hazard and risk assessment (Table 2) are indicated by students exchanging clothing and other items, besides their drinking habits. Commonly (27.7%) of students exchanged clothing and footwear, 38.2% saying they did so only occasionally. Females 10-15 years and 16-20 years respectively had 45.0% and 34.8% prevalence of exchange and only 34.1% of all students said they did not exchange school clothing with their mates. Chi square test shows a significant difference (p- value 0.005) between the groups of students as far as the exchange of clothing is concerned. All the participants (100%) in the study indicated that they do not bath before going back to class after sports.

TABLE 2: ASSESSING FACTORS AFFECTING HAZARDS EXPRESSION

Variable	Female		Male		Total
Age (Year)	10-15	16-20	10-15	16-20	
Exchanging of school clothing					
No	36(45.0)	8(34.8)	24(26.4)	17(30.9)	85(34.1)
Sometimes	19(23.8)	8(34.8)	49(53.8)	19(34.5)	95(38.2)
Yes	5(31.3)	7(30.4)	18(19.8)	19(34.5)	69(27.7)
The practice of exchanging materials and food in school					
No	5(6.3)	0(0.0)	1(1.1)	1(1.8)	7(2.8)
Sometimes	0(0.0)	0(0.0)	5(5.5)	0(0.0)	5(2.0)
Yes	75(93.8)	23(100)	85(93.4)	54(98.2)	237(95.20)
Drinking water from school taps and what is used					
Don't drink	27(33.8)	7(30.4)	72(79.1)	24(43.6)	130(52.20)
Use of hands	52(65.0)	15(65.2)	19(20.9)	30(54.5)	116(46.6)
Sucking directly	1(1.3)	1(4.3)	0(0.0)	1(1.8)	3(1.2)

D. *The Practice of Exchanging Materials and Food in School*

Most of the students 237/249 (95.2%), irrespective of age and sex, exchanged materials and food in school. The Fisher exact test performed showed a p-value of 0.06, greater than 0.05. Thus, the exchange of materials was insignificant. In the study, only 2.8% of students were not exchanging clothing, 5 students (2%) saying they only did so sometimes.

E. *Presence of Taps and Drinking Habit of Students*

The survey confirmed that all the participating schools had school taps for students to drink. However, among students who did not wash their hands after toilet usage, up to 69.09% used their hands to drink water from the school tap (Fig. 4).

As indicated in Table 2, 52.2% of students did not drink from school taps, 46.6% drank using their hands and 1.2% sucked directly from the tap. Of reporting females, 65% of

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the 10-15 age group and 65.2% of the 16-20 age group drank from school taps using their hands; 54.5% males of 16-20 years and 20.9% of 10-15-year also used their hands to drink. However, 79.1% of males of the 10-15 year bracket reported not drinking from the school tap with the Fisher exact test showing a p-value of 0.000.

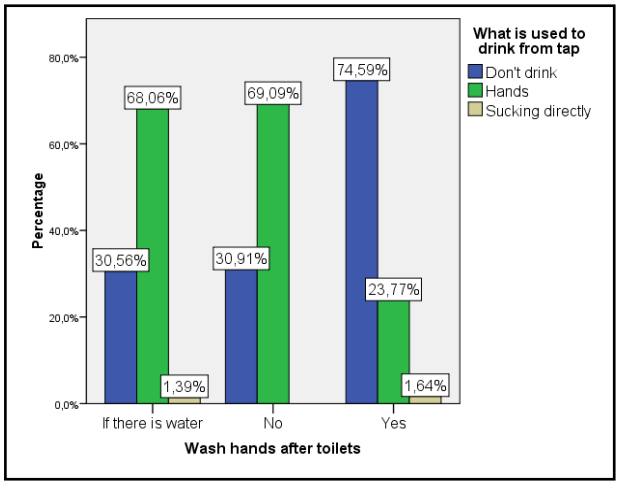


Fig. 4. Hand washing practices in relation to what is used to drink from taps.

F. Provision of Waste Bin in School

Paper, empty plastic wrappings, empty cans, and plastic bottles comprised common waste observed in the schools. Most schools (60%) lacked both safe waste disposal methods and appropriate waste disposal systems, littering their campuses, streets, empty spaces outside their premises or using open ditches. Only 40% used private waste collectors and waste pits, some using communal waste pits outside their premises. One school alone used composting for gardening.

G. Cleanliness of the School Surrounding

An observational Checklist determined the cleanliness of the school surroundings and classrooms. Classrooms and surroundings not littered with solid waste, observable human, or animal faeces, cleared wastewater drains, wastewater not contaminating the surroundings marked up the school as clean. LCC and HSHS reported fairly clean, SHC clean and the rest not clean. By another checklist, most sales food courts were poorly constructed, with no handy hand washing structure. In private schools, discipline masters and sanitation prefects controlled food sales but government schools were not so organized.

H. Measures to Control Hazards and Reduce Risk

More boys than girls bathed before school in both age groups (Fig. 5), with 90% of 10-15 year-old females attesting to bathing before classes against 83% of 16-20 year-old girls. For both age brackets, proportionately the same attested to only bathing if they were early (6.3%) or did not bathe at all before classes (10%). Males who only bathed when they were early were far fewer (02.2%) and belonged to the 10-15 years brackets.

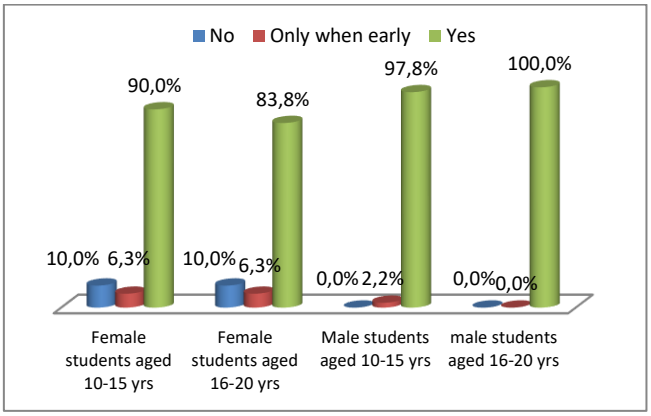


Fig. 5. Bathing practice of the students.

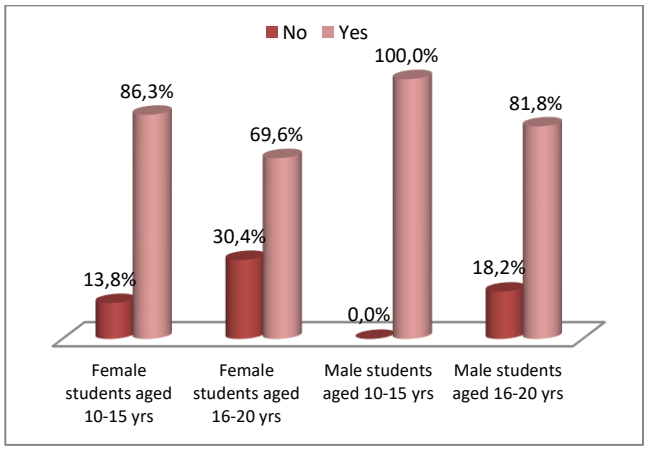


Fig. 6. The provision of breakfast before school.

More boys took breakfast than girls (Fig. 6), all 10-15 year-olds (100%) and 81% of the 16-20 year-old boys; 86.3% of girls 10-15 years and 69.6% of 16-20 year-old girls ate breakfast. While boarding students ate breakfast in the refectories, day students indicated that they were given money for snacks in school when they missed breakfast at home.

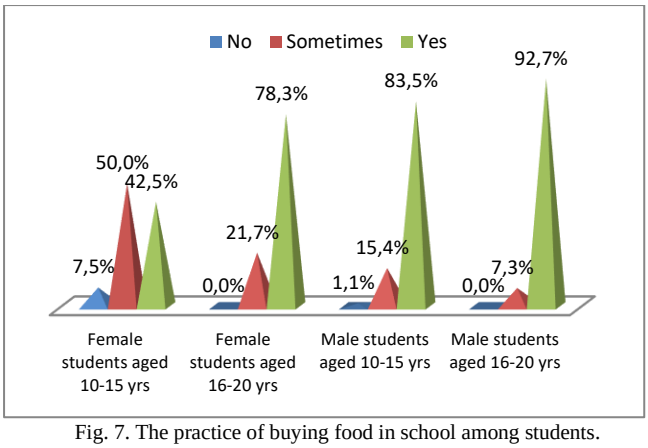
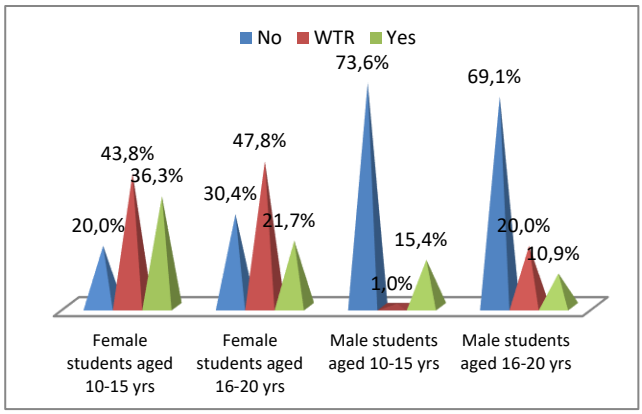


Fig. 7. The practice of buying food in school among students.

While more 16-20 year-old females (78.3%) regularly bought food in school than 10-15 year-olds (42.5%), more 10-15 year-old girls (50%) said they occasionally bought food in school than the 16-20 years (21.7%). Of those who attested to never buying food in school, 07.5% were 10-15 years and none (00.0%) of the 16-20 year bracket.

More 16-20 year group of boys bought food in schools (92.7%) than the 10-15 year olds (83.5%) but more 10-15 year-olds (15.4%) attested to only occasionally buying food

in school as opposed to 7.3% of the 16-20 year old boys.



WTR =When they remember.

Fig. 8. Taking water from home to school among students.

As per Fig. 8 more female students of 10-15 years took water from home to school (36.3%) than those 16-20 years old (21.7%). Slightly more of the 16-20 year old girls only brought water to school if they remembered (47.8%) than the 10-15 year ones (43.8%). More girls of the 16-20 age brackets (30.4%) attested to not taking water to school at all than the 10-15 year old girls (20.0%).

Slightly more 10-15 year-old boys indicated bringing water from home (15.4%) than the 16-20 year-olds (10.9%). Far fewer 10-15 year-olds (01.0%) attested to only occasionally bringing water to school than 16-20 year-olds (10.9%). The 10-15 year olds who did not at all bring water to school were 73.6% against 69.1% of 16-20 year-olds.

I. Laboratory Methods and Culture Techniques

While Table 3 shows the characterization of the isolated bacteria in this study according to cultural, morphological and biochemical characteristics, Table 4 describes the characteristics of the isolated fungi from the students' palms and school door handles. *Yeast* and *Mould* as well as five bacterial colonies (*Enterobacter*, *Staphylococcus* spp, E. *coli*, *Bacillus* spp, and *Coliforms*) were isolated from these palms and door handles.

TABLE 3: THE MORPHOLOGICAL AND BIOCHEMICAL TEST RESULTS OF BACTERIAL ISOLATES FROM THE PALMS AND DOOR HANDLES IN FIVE SCHOOLS

Parameters	B1	B2	B3	B4	B5
Cellular Shape	Cocci	Rod	Rod	Rod	Cocci
Colonial Elevation	Raised	Raised	Raised	Raised	Raised
Colonial Edge	Entire	Entire	Entire	Entire	Entire
Colonial surface	Smooth	Smooth and shiny	Smooth	Rough	Smooth
Colonial Opacity	Opaque	Opaque	Translucent	Opaque	Opaque
Colonial Pigmentation	Creamy white	Yellowish cream	Grayish pink	Cream	Pinkish cream
Cellular Arrangement	Clusters, Single	Pairs, Chains	Grapelike Chains	Chain	Chains not regular
Gram`s Staining	+ve	-ve	-ve	+ve	-ve
Catalase test	+ve	+ve	-ve	-ve	-ve
Coagulate Test	+ve	-ve	-ve	-ve	-ve
Probable Identity	Staphylococcus	Coliforms	Bacillus	Enterobacter	E.coli

B1-B5=Isolates.

TABLE 4: CULTURAL AND MORPHOLOGICAL CHARACTERISTICS OF FUNGI ISOLATED FROM THE PALMS AND DOORS OF THE 5 SCHOOLS

Isolate	Appearance	Probable organism
F1	The colony was white and woolly. The hypha was thick and non-septate. The Columella was round. The sporangia were filled with spores.	Mould
F2	The colony was white and mucoid. The hypha was thick and septate, with no sporangia. They appeared as single cells and in colonies of several spherical cells.	Yeast

J. Prevalence of Bacteria and Fungi Isolates on the Palms of the Students According to School

The most prevalent isolates among students in GBHSB was *Staphylococcus* (Fig. 9), recording 100% among 16-20 year-old boys, 80.0% among 16-20 year-old girls, 62.2% among 10-15 year old boys and 58.0% among 10-15 year-old girls.

Second in prevalence on male and female students' palms was *Escherichia coli* and third was *Enterobacter*, found only among 16-20 year-old males (43.0%). Closely following with 42.0% prevalence were *Bacilli* on 10-15 year-old girls' palms. *Yeast*, *coliforms* and *moulds* were least prevalent (17.0%) mainly among 10-15 year-old girls.

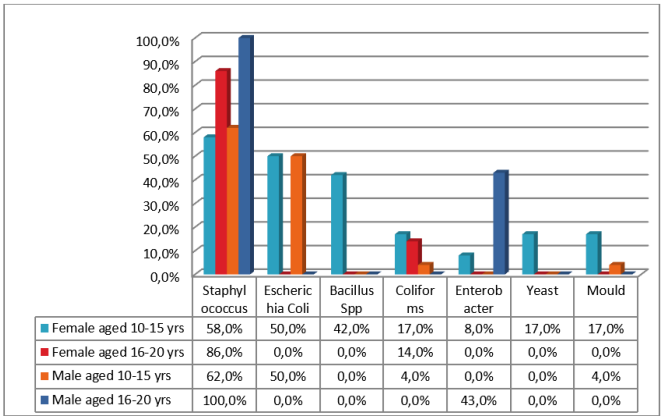


Fig. 9. Prevalence of bacteria and fungi isolates on palms of students of GBHSB (Government Bilingual High School Bamenda).

Among the GBHSA, *staphylococcus* was 100% prevalent among 10-15 year-olds (males and females), 42.0% among 16-20 year-old boys and 13.0% among 16-20 year–old girls. *Escherichia coli* came second in prevalence, mostly among 16-20 year-olds' palms, 57.0% for girls and 83.0% for boys. The *Bacillus* was 25.0% prevalent among 16-20 year-old boys and 10.0% among 16-20 year-old girls while *yeast* featured 17.0% with 10-15 year-old girls and 08.0% among 16-20 year-old boys. No *Mould* and no *Enterobacter* isolates featured.

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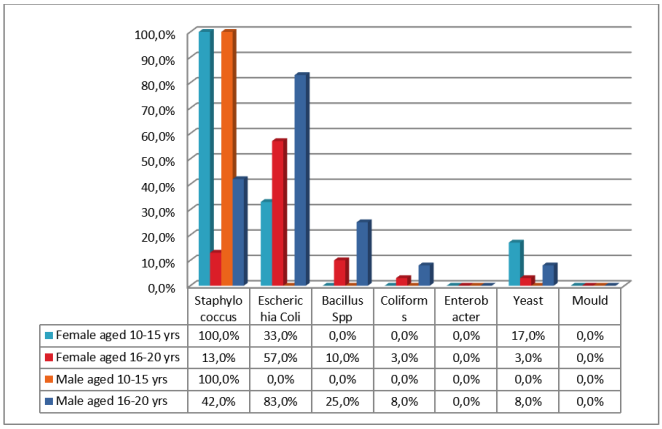
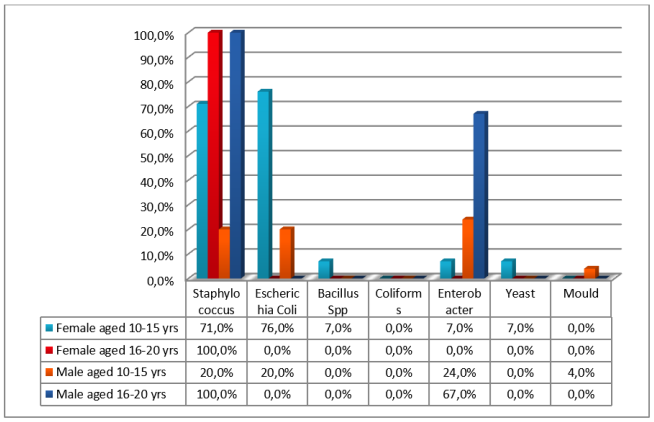


	Staphylococcus	Escherichia Coli	Bacillus Spp	Coliforms	Enterobacter	Yeast	Mould
Female aged 10-15 yrs	100,0%	33,0%	0,0%	0,0%	0,0%	17,0%	0,0%
Female aged 16-20 yrs	13,0%	57,0%	10,0%	3,0%	0,0%	3,0%	0,0%
Male aged 10-15 yrs	100,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Male aged 16-20 yrs	42,0%	83,0%	25,0%	8,0%	0,0%	8,0%	0,0%

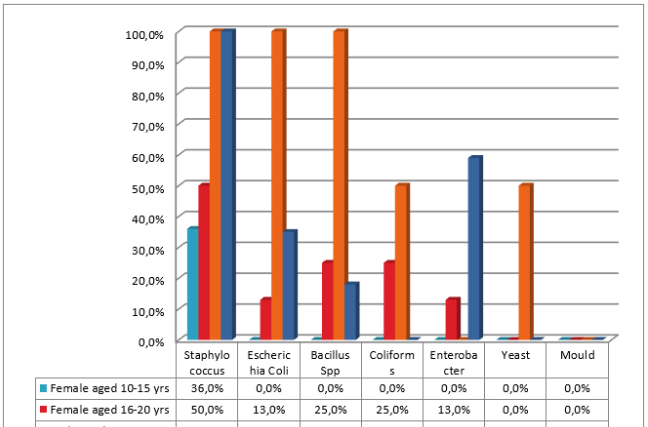
Fig. 10. Bacteria and fungi isolate prevalence on GBHSA students' palms.

Staphylococci featured on all 16-20 year-old male and female students' palms (100%), but 10-15 year-old girls had 71% prevalence, distantly followed by 10-15 year-old boys with 20.0% prevalence. *Escherichia coli* evinced 76.0% prevalence on the palms of 10-15 year-old girls but only 20.0% among 10-15 year-old boys. *Enterobacter* came third in prevalence, indicated at 67.0% in 16-20 year-old boys but only 24.0% for the 10-15 year-old boys. *Bacilli* and *yeast* had equal (07.0%) prevalence on 10-15 year-old girls' palms.



	Staphylococcus	Escherichia Coli	Bacillus Spp	Coliforms	Enterobacter	Yeast	Mould
Female aged 10-15 yrs	71,0%	76,0%	7,0%	0,0%	7,0%	7,0%	0,0%
Female aged 16-20 yrs	100,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Male aged 10-15 yrs	20,0%	20,0%	0,0%	0,0%	24,0%	0,0%	4,0%
Male aged 16-20 yrs	100,0%	0,0%	0,0%	0,0%	67,0%	0,0%	0,0%

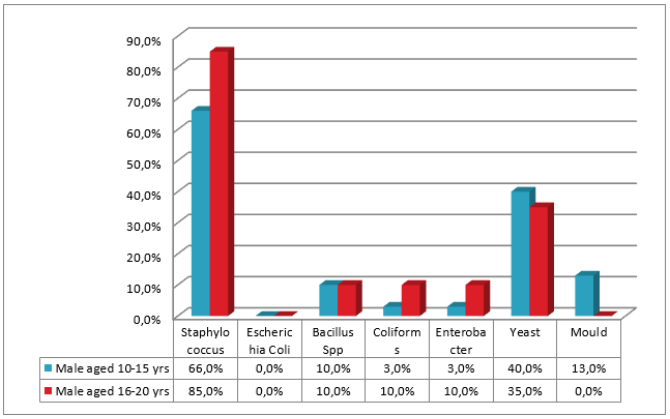
Fig. 11. Bacteria and fungi isolate prevalence on LCC students' palms.



	Staphylococcus	Escherichia Coli	Bacillus Spp	Coliforms	Enterobacter	Yeast	Mould
Female aged 10-15 yrs	36,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Female aged 16-20 yrs	50,0%	13,0%	25,0%	25,0%	13,0%	0,0%	0,0%
Male aged 10-15 yrs	100,0%	100,0%	100,0%	50,0%	0,0%	50,0%	0,0%
Male aged 16-20 yrs	100,0%	35,0%	18,0%	0,0%	59,0%	0,0%	0,0%

Fig. 12. Bacteria and fungi isolate prevalence on HSHS students' palms.

Staphylococcus indicated 100% prevalence in HSHS boys' palms, 36.0% for 10-15 year-old girls and 50% for the 16-20 year-old girls. *Escherichia coli* isolates also indicated 100% prevalence on w0-15 year-old boys' palms although only 35.0% 16-20 year-old boys had it. *Baccilus spp* in the third position indicated 100% prevalence in 10-15 year-old boys but only 25.0% for girls and 18.0% for boys of 16-20 years, respectively. Tailing the prevalence were *yeast* and *coliforms*, 50% among 10-15 year-old boys.



	Staphylococcus	Escherichia Coli	Bacillus Spp	Coliforms	Enterobacter	Yeast	Mould
Male aged 10-15 yrs	66,0%	0,0%	10,0%	3,0%	3,0%	40,0%	13,0%
Male aged 16-20 yrs	85,0%	0,0%	10,0%	10,0%	10,0%	35,0%	0,0%

Fig. 13. Bacteria and fungi isolate prevalence on SHC students' palms.

Staphylococcus isolates (Fig. 13) had 85% and 66% respective prevalence among the 16-20 and 10-15 year-old males. Both age groups had 10.0% *bacilli spp* isolates and yeast isolates were 40.0% and 35.0% prevalent with the 10-15 and 16-20 year-old boys, respectively.

K. Summary of Bacteria and Fungi Isolate Prevalence Students' Palms by Gender and Age

Indicated in Fig. 14 below, 10-15 year-old girls had 39.0% *Staphylococcus spp* prevalence, 24/.0% *Escherichia coli* prevalence, 11.0% *yeast* prevalence and 03.0% of *Coliforms* and *Enterobacter* prevalence. Prevalence among the 16-20 year-old girls was 96.0% of *Staphylococcus spp*, 78.0% *Escherichia coli* prevalence, 17.0% *Coliforms* and *Yeast*, 04.0% *Enterobacter* and *Mould* prevalence. On the door handles of all the schools, mostly *Staphylococcus* isolates with no particular pattern occurred.

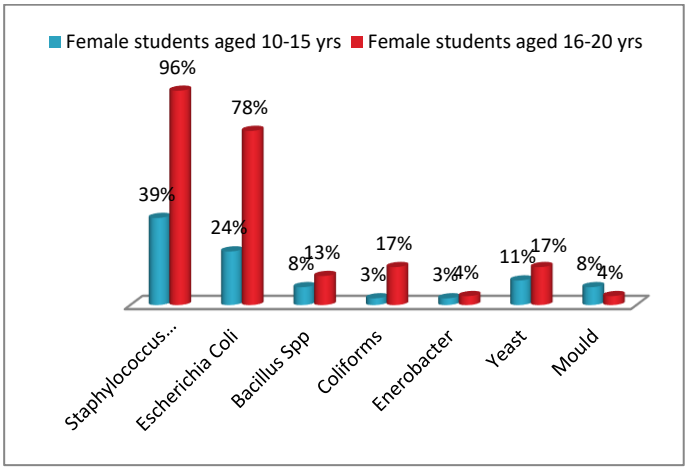


Fig. 14. Summary prevalence of bacteria and fungi isolates on the palms of female students by age.

Male students aged 10-15 had a 56.0% *Staphylococcus spp* prevalence, 29.0% *Escherichia coli* prevalence, 19.0% *Enterobacter* prevalence and only 01% prevalence of *Mould* while 16-20 year-old male students had 95.0% *Staphylococcus Spp* prevalence, 35.0% *Enterobacter*, 24.0%

Escherichia coli but 0.0% *Mould* prevalence.

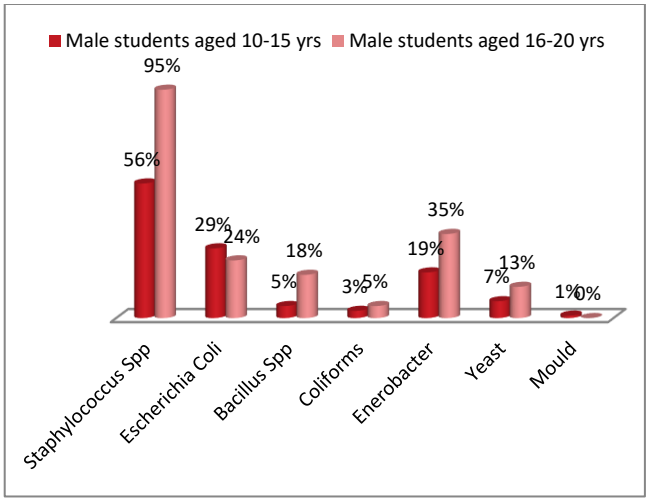


Fig. 15. Summary of bacteria and fungi isolate prevalence on male students' palms by age.

IV. Discussion

In this pilot cross-sectional study, an attempt was made to understand the gaps in the management of hygiene and sanitary practices in five randomly sampled public and private schools within the Bamenda municipality. The socio-demographic information of respondents provided the characteristics of the study population where the age range of the sampled students were 10-15 and16-20, coinciding with the expected secondary and high school levels of Cameroon students. The boys-only included sampled schools scaled up the male students' ratio. Three major indications in the study relate fact that the school toilet structures do not meet WHO standard ratio, the general inadequacy of the WaSH facilities, and the practice of exchanging body contacting utilities and items, all three components seen as health hazards especially as they breed or spread bacteria and fungi that are pathogenic.

The WHO ratio of one toilet to 25 girls, one toilet and a urinal to 50 boys [10] was indicated as unmet by any of the schools. True, private schools were better than the public schools whose toilets were mostly constructed by Parents-Teachers Associations (PTA) which also undertook other school projects. The unmet WHO standard toilet to student ratio restrict students' stooling, cause stool retention, dysfunctional voiding and promote disease spread. This connects with the general inadequacy of WaSH facilities, their dysfunctional status and non-promotion of soap and water usage along with the gap between stooling and hand washing and consequent faecal contamination vectoring diseases through the spread of differentiated pathogenic bacteria and fungi.

Evidently, however, students are unlikely to use the toilet when there is a queue, particularly during the planned breaks [11], indicative of the importance of proper student-toilet ratio. This was compounded by the absence of user-friendly facilities and the non-consideration of disabled students, a negative discrimination against the vulnerable lot. Much of this explained why most students only used the toilets occasionally, when hard-pressed, when water was available, or on days of general campus cleaning. These shortcomings work against the need for children's easy access to toilets at school relative to time voiding, which is part of the treatment for dysfunctional voiding [11].

Secondly, the study found that although water, sanitation, and hygiene (WaSH) facilities were available, they were inadequate, often dysfunctional and had inadequate maintenance. Inadequate or no water partly accounted for the gap between defecation and hand washing indicated in this study. Other studies have indicated a close correlation between poor sanitation amenities and the prevalence of infection among learners and their effect on their participation in curricular activities [12]. Students defecating on toilet floors compounds the improper disposal of excreta, bringing about contaminants that breed the bacteria and fungi isolates observed in this study.

Noted to vary according to the sex, the frequency of toilet usage is low when compared with Jano's results [13] obtained from a similar study in Ethiopia which indicated up to 12% usage for females. The present study indicated relatively more students in the 10-15 year bracket using the school toilets than the 16-20 year-olds. Jano [13] also associated age factors with students of the lower age group using available toilets without looking for alternatives as opposed to students of the higher age group.

Among low income settings, hygiene campaigns have not unanimously recommended soap hand wash to prevent vendor-student pathogens transmissions. Existing regulations on street-food industry in Cameroon is poorly enforced. Assob *et al*. [2] in a Buea, Molyko, Soppo, Bolifamba and Muea (Cameroon) study reveals that 57.67% of street vendors had faecal-oral parasites. Related to this, Muinde and Kuria [14] showed that street vendors wash and rinse utensils only once, in the same water content and repeatedly till it becomes very dirty. These unhygienic manipulations compound with the unacceptable quality of washing water for cleaning and other operations favour student-vendor transmission [15]. Inadequacy also featured with no school in the study providing students with washing after defecation, which Ajayi *et al*. [16] recommend against bacteria spread.

Exchange of utilities and items was seen to have no significant difference (p-value 0.064) among the students by sex and age since only 2.8% of students were not practising exchanges – one possible factor of epidemiology, hygiene and sanitation being a rapid means of micro organismal propagation and disease. Investigating the associations between hygienic behaviours and hand contamination [17] indicate bacteria of possible faecal origin as more common in people frequently shaking hands and reporting soil contact. Prasai *et al.* [18] investigating the microbial Load on Paper Currency and Coins, found 98.4% of currency being contaminated.

Ajayi *et al*. [16] report that non-sharing of personal items like towels, razors, clothing or equipment, as well as cleaning surfaces where the bare skin rubs (like exercise equipment, surfaces, common shower soap and water after work or sports) help prevent *Staphylococci* spread and infections. Students exchanging clothing and footwear and the poor personal hygiene indicated by 16.2% of 16-20 year-old girls not bathing before schools heighten the spread of pathogens. Even water brought from home by 21.7% of

students due to irregular school water supplies is not always potable. Additionally, when water containers pass from mouth to mouth both pathogenic and potentially pathogenic bacteria species as identified through cultural, morphological characteristics and biochemical tests is spread.

The various bacteria and fungi have their patent pathogenic effects. It is true that their predominance per school indicates GBHSA having neither *Mould* nor *Enterobacter*, LCC no *Coliforms*, HSHS no *Mould*, and SHC no *Escherichia coli*. The 16-20 year-olds dominated the indication for the isolates, which statistics, along with the schools differences might be due to the sampling/swabbing time, since schools were not too differentiated in sanitation facilities and practices. The staying result is that bacteria and fungi, each having pathogenic peculiarities, were prevalent in students' palms and in school facilities.

A flora of the skin, *Staphylococcus spp*, is a pathogen associated with community-acquired urinary tract infections and food intoxication [19]; conjunctivitis, scalded skin syndrome, toxic shock, respiratory and skin infections [16]. *E. coli*, another major public health concern, indicated for recent contamination with fecal matter and the possible presence of intestinal pathogens, besides the fact that some of its pathogenic strains are found predominant in enteropathogens responsible for several outbreaks of bloody diarrhea [20] and possible bacterial meningitis [21].

Total *coliforms* and *heterotrophic* bacteria serve in the evaluation the hygienic status of water; *coliform* group presence indicates contact with sewage [4] with low species differentiation, however. These faecal *coliforms*, prevalent in the digestive tracts of mammals, correlate with pathogenic organisms that have similar survival characteristics to pathogens like *Salmonella* and *Shigella* [22]. *Coliforms* thus indicate pathogens and associated animal wastes in water, a definite evidence of faecal contamination and risk of zoonotic pathogens [4].

Yeast and *Mould* may cause mycoses — fungal diseases in humans, especially of *yeast* —which are increasingly agents of the morbidity and mortality of patients with HIV/AIDS [23] also thanks to the patients' weakened immunity.

V. Limitations of the Study

Sampling schools from one municipality possibly narrowed the research implications, other variables considered. The lack of hand washing facilities closes to toilets and food courts most likely played on the students' hand washing practice. In addition, the applied bacteriological methods did not quantify bacterial load; differentiation between species was low. Then too, cultural practices like the greater housekeeping roles of girls or the budding manhood of the boys might explain some hygienic occurrences rather than the assumed presence or absence of WaSH facilities. Indeed, several variables could be given interpretative causes other than those posited in this study although the interpretations only add and do not contradict the validity of the projected views.

VI. Conclusion

This study shows that there are gaps at various levels for school WaSH management capacity, coordination, integration, commitment, and activity harmonization. Almost all of the schools lacked adequate sanitation facilities and available facilities were poorly managed. The inadequate, inconsistent, and insufficient school WaSH facilities likely contributed to student behaviour and ill-practices. Noted was the absence of stakeholders' integration to direct efforts towards appropriately synchronized school WaSH management.

From the recorded bacterial and fungi pathogens in this study, schools receive contaminants and hand hygiene methods closely relate with pathogens, exposing students with poor hygiene practices to public health risks. Action should be taken to minimise the risk, including the allocation of funds for WaSH hardware and software components in the municipality's schools, WASH-related capacity building of teachers and School management committees should include operation, maintenance, monitoring and financial management; improvement in the ratio of latrines-to-students', due consideration of the physically challenged in amenities, hygiene should constitute part of the taught curriculum along with a detailed practical cause-and-effect components. Pandemics, not excluding covid-19, remind the world of the need for organized and consistent application of WaSH in schools and our communities.

Abbreviations

DSCN: Direction de la statistique et de la Comptabilite Nationale (Directorate of Statistics and National Accounts)

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