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A Comparative Study of the Parasitic Load of Male and Female Toilets in a University

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Abstract

Parasitic infections remain a global public health challenge, particularly in public places with inadequate sanitation and hygiene practices. This study assessed the parasitic load on toilet seats used by male and female students at Lagos State University, Ojo Campus, between July and August 2024. A total of 140 toilet seats (70 male, 70 female) 20 each, across seven faculties were sampled using sterile swab sticks dipped in 70% normal saline. The samples were examined microscopically using wet mount, Lugol's iodine, and Giemsa staining techniques. A total of 254 parasites were recovered with at least a specie from each toilet. Findings from the female toilets revealed four parasite stages, with *Ascaris lumbricoides* ova (48%) as the most prevalent, followed by *Necator americanus* larvae (31%), *Strongyloides stercoralis* larvae (12%), and *Entamoeba histolytica* cysts (9%). Male toilet samples revealed seven parasite types, dominated by *S. stercoralis* larvae (42.6%), N. americanus larvae (22.2%), and *A. lumbricoides* ova (15.7%). Faculty of Science toilets had the highest parasite load for both sexes. Risk perception was high as 93.3% of female and 73.3 % male students believed shared toilets were infection-prone. Overcrowding, inadequate water supply, and poor maintenance of the toilets were key contributing factors. The findings highlight the urgent need for improved sanitation infrastructure, regular cleaning with adequate materials, and health education campaigns. Addressing these gaps is critical to reducing the parasitic burden and ensuring safe public toilet use on the University campus.

Keywords: Toilets, Parasites, Sanitation, Students, Rest Room

Introduction

Oyerinde described a parasite as a living organism in physiological association with the host's tissues, with the host typically being larger and stronger, providing food, and suffering some degree of injury while reacting against the parasite [1]. Lucuis et al simply defined parasites as organisms which live in or on another organism, drawing sustenance from the host and causing it harm [2]. These include animals, plants, fungi, bacteria, and viruses, which live as host-dependent guests.

Parasites maintain a continuous and intimate association with a larger organism, known as the host, belonging to a different species. They are metabolically dependent on the host to varying degrees, either directly or indirectly [3].

Parasites can be described as permanent, temporary, periodic or intermittent according to their duration on host. Based on habitat, they can be termed as endoparasites or endoparasites. While obligate parasites are completely dependent on the host, the facultative parasite exhibits both parasitic and non-parasitic modes of living and does not absolutely depend on the parasitic way. Parasites may be host specific or non-host specific and zoonotic or non-.zoonotic. Macroparasites are seen with the naked eye such as helminthes or arthropods while microparasites are identified under a microscope and this includes protozoans, mites, viruses and bacteria. Whatever type of parasite, they are all of public health importance for undermining the health status of humans and the larger community [2,4].

A toilet is a piece of sanitary hardware designed to collect human urine and feaces, typically for disposal. Flush toilets use water, while dry or non-flush toilets are connected to a pit, removable container, composting chamber, or other storage and treatment device. In urban areas, flush toilets are usually connected to a sewer system or a septic tank. The black-water waste, and the combined effluent is sewage. Water closet toilet is a basic form of a flush toilet where water is used to flush away both feaces and urine into a sewage system through running pipes leading to an odourless environment. This type of toilet is common in urban areas and many developing countries. The invention of the flush toilet had a major impact on toilet waste disposal within households, eliminating the need to transport feacal wastes by container [5-8].

Public toilets are essential in providing access for people who spend most of their time outside their homes such as in schools, offices, hospitals and restaurants. Concerns regarding sanitation in non-home spaces like schools, hospitals, prisons, and work place play a crucial role in public health [9].

McMichael reviewed the negative impact of water, sanitation and hygiene (WASH) in schools in low-income countries [10]. While toilets may be better than open defecation in low-income urban areas, they carry significant health risks in the absence of water and improved sanitation systems. Health risks may arise from exposure to pathogens due to lack of basic sanitation, water scarcity, multiple users, fly access, spillage, and unhygienic emptying and disposal practices [11,12].

Toilet seats can harbour various parasites such as protozoan e.g. *Giardia lamblia* and *Entamoeba* species which can spread through feacal contaminated water or foods. *Trichomonas vaginalis* a sexually transmitted infection can be contracted from toilet seats. Helminthes eggs such as *Ascaris lumbricoides, Trichuris trichiura* and larvae of Hookworms are also transmitted via the fecal oral route [13,14].

Proper toilet facilities, promote health by allowing people to dispose of waste appropriately, preventing environmental contamination and reducing risks. Globally, many people lack access to toilet facilities, leading to improper waste disposal that results in an unhealthy environment. Without proper sanitation, waste from infected individuals can contaminate a community's land and water, increasing the risk of infection for others [15].

Inadequate waste disposal drives the infection cycle of many pathogens that can be spread through contaminated feacal –oral routes. Proper waste disposal can slow the infection cycle of many disease-causing agents and prevent the spread of illnesses and deadly diseases [16-18].

Toilets have long been viewed as a significant potential contributor to the transmission of many human infectious diseases [19,20].

Toilet infections can be contracted through several methods. Sexual intercourse is a method of transmission of toilet-related diseases and unhygienic toilet conditions can lead to urinary tract infections [7].

Feacal-oral method involves the transmission of toilet diseases by contaminated feacal materials entering the mouth, primarily through contaminated hands, water, food, or any other oral object. The transmission of toilet diseases can occur through contact with various objects in the toilet, such as the toilet seats, and other toilet facilities. Transmission of toilet diseases through aerosol particles that survive in the air current for a period before reaching a susceptible person by inhalation can also occur [21,22].

Burton stated that despite several small-scale studies addressing the effects of poor restroom facilities and hygiene standards in educational settings, the results have not had the significant influence they should have [23].

Therefore, the aim of this study is to detect and determine the species of parasites from the toilet seats of male and female students of Lagos State University. Estimation of the parasitic load of the toilet seats and the predisposing risk factors in the use of the toilet seats is also investigated. The recommendations from this study are expected to make significant influence in the usage and maintenance of students' toilet facilities in the University.

Materials and Methods

Study Area

The study was carried out at Lagos State University (LASU), Ojo Campus, located in Ojo area of Lagos State, Nigeria, along the Lagos-Badagry Expressway. The institution, established in 1983, has eleven faculties, serving a student population of over 70,000. The beautiful campus environment includes various floras, with vegetation affected by human activities. Multiple public toilets used by both male and female students are available on the campus and formed the basis of this study.

Research Instruments

The instruments used included: binocular microscope, microscope slides, cover slips, Giemsa stain, Lugol's iodine stain, swab sticks, normal saline solution, distilled water, cleansing agents, beakers, test tubes, test tube racks, slide racks, pipettes, cotton wool, applicator sticks, detergent, paper tape, 100ml cylinders, centrifuge bottles, centrifuge machine, gloves, nose masks, cardboard, plastic containers, questionnaires, pencils, notebooks, and pens.

Study Population

The study population comprised of registered male and female students of LASU, Ojo. Toilets from seven faculties: Science (FOS), Law (FOL), Education (FOE), Management Science (FMS), Social Science (FSS), Transport (FOT), and Communication (FOC) were sampled. For logistical reasons, the Faculty of Arts (FOA) toilets were not accessed directly. However, complementary data were obtained through a questionnaire survey of students from this faculty.

Collection of Samples

Samples were collected from toilets used by male and female students across the seven faculties mentioned above. A total of 140 toilet seats (70 male and 70 female) were examined over a period of three weeks, five days a week. 20 toilets were visited per faculty for both male and female use. Sterile swab sticks dipped in 70% normal saline for 3 minutes were used to swab the seats and rims of toilets before cleaning. Each swab was returned to a capped tube to prevent contamination and transported to the parasitology laboratory within 30 minutes for analysis.

Laboratory Preparation of Samples

Approximately 5ml of distilled water was poured into centrifuge bottles containing the swab sticks. After six minutes of soaking to release parasitic elements, the samples were centrifuged at 250 rpm for 5 minutes. After settling, the supernatant was decanted, and the pellet (cloudy residue) was transferred to slides for microscopic examination.

Microscopic Examination and Identification

Samples were examined using direct wet mount, Giemsa stain, and Lugol's iodine. Wet mount allowed observation of motile trophozoites under x40 objective lens. Giemsa and Lugol's iodine stains were used to identify cysts and larvae under x10 and x40 magnification, using an Olympus compound binocular microscope. The parasites identification were confirmed with the aid of 'Biology of Parasites' by Lucius et al [2].

Selection Criteria for Questionnaire Survey

Due to inaccessibility of the FOA toilets, 30 male and 30 female students from that faculty were randomly selected for a complementary questionnaire-based study. Participants were selected randomly from different levels and departments, and results were based on their responses. Only willing students were requited into the study by informed consent.

Preparation and Validation of Questionnaire

The questionnaire covered demographic data (age, level of study, department, religion and literacy level of parents. Section B had 16 questions: 6 on toilet infrastructure, sanitary knowledge, state of toilets, and 10 on knowledge of parasitic and toilet infections and toilet use practices. The questionnaire was piloted with four students and refined before final administration. Final validation was done by the project supervisor.

Questionnaire Administration

The descriptive study used both quantitative and qualitative data collection. Thirty male and 30 female students completed the validated questionnaire voluntarily. Confidentiality and anonymity were ensured. Each survey took about 2 hours to complete.

Data Analysis

Data collected were analyzed statistically using the Chi-square test at a significance level of $p < 0.05$. Formula**:** X2=(O−E)2EX^2 = \frac{(O - E)^2}{E}X2=E(O−E)2

Where: O = Observed value, E = Expected value, DF (degree of freedom) = (r - 1)(c - 1)

r = number of rows, c = number of columns

Results

Parasite load on Toilet Seats of Male and Female Students

The study examining 70 male student toilets found a total of 108 parasites. FOS had the highest parasite prevalence at 22.22%, followed by FMS at 19.44%, FOE at 16.67%, FOL at 12.97%, FSS at 12.03%, FOT at 10.19%, and FOC at 6.48% (Table1).

Similarly, 70 female toilet seats were examined, with 146 parasites detected. The FOS toilets showed the highest prevalence at 27.27%, followed by FOL with 18.18%. FMS and FSS both had a prevalence of 14.29% each, while FOE had 10.39%. The lowest prevalence was found in FOT and FOC at 7.79%.

Significant differences in parasitic loads were observed across faculty toilets. However, the distribution of parasite prevalence across toilets in faculties does not significantly differ between males and females ($p>0.05$) (Table 1). Figure 1 shows the overall prevalence of parasitic load on the toilet seats from the seven faculties.

Table 1: Prevalence of Parasites in Toilets Across Faculties (M+F)

Toilet No	FOS	FOL	FOE	FMS	FSS	FOC	FOT	Total (M+F)
1	2+3=5	2+3=5	2+3=5	1+2=3	1+2=3	2+1=3	1+0=1	25 (13.23%)
2	4+2=6	2+2=4	2+2=4	1+2=3	2+0=2	1+3=4	2+0=2	25 (13.23%)
3	1+3=4	1+2=3	1+0=1	2+1=3	2+0=2	1+2=3	2+1=3	19 (10.05%)
4	1+0=1	3+2=5	1+1=2	1+1=2	0+1=1	0+0=0	0+2=2	13 (6.88%)
5	2+1=3	0+1=1	1+0=1	2+2=4	3+0=3	1+0=1	1+2=3	16 (8.47%)
6	2+3=5	2+2=4	4+1=5	3+0=3	0+0=0	0+0=0	1+2=3	20 (10.58%)
7	4+3=7	2+0=2	1+1=2	2+1=3	2+1=3	0+0=0	0+0=0	17 (9.01%)
8	3+3=6	1+1=2	2+2=4	3+1=4	2+1=3	1+0=1	1+0=1	21 (11.11%)
9	2+3=5	0+1=1	3+0=3	3+0=3	1+2=3	1+0=1	2+0=2	18 (9.52%)
10	3+0=3	1+0=1	1+0=1	3+1=4	0+0=0	0+0=0	1+0=1	10 (5.29%)
Total	45(23.5)	32(16.7)	28(14.6)	32(16.7)	20(10.4)	16(8.3)	18(9.42)	**140 (100%)**

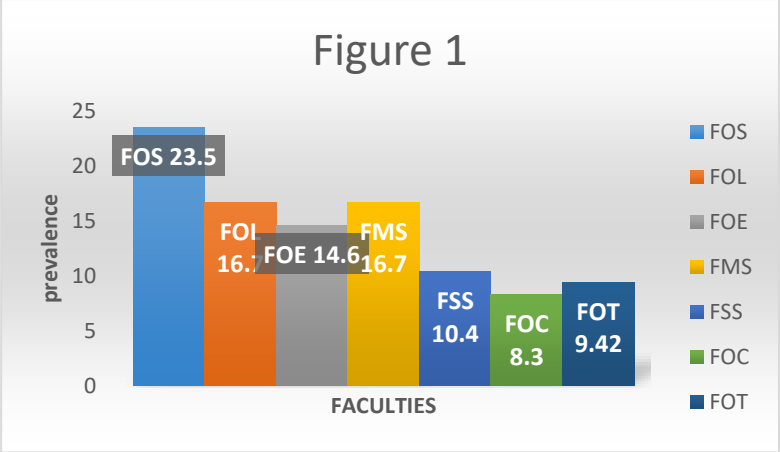

Figure 1: The Overall Parasitic load across the seven Faculties

Species and Prevalence of Parasites on Toilet seats of male and female students

In male toilet samples, the identified parasite species were *Ascaris lumbricoides, Strongyloides stercoralis, Necator americanus, Entamoeba* species, *Giardia lamblia,* and *Trichuris trichiura. S. stercoralis* was the most prevalent with 46 (42.60%), followed by Hookworms with 24 (22.22%), *A. lumbricoides* with 17 (15.74%), and *Entamoeba* species with 10 (9.25%). *G. lamblia* accounted for 7 (6.50%), while *T. trichiura* had the lowest prevalence with 4 (3.70%) (Table 2).

Table 2: Prevalence of Parasite Species in Faculties Toilets (M+F)

Parasite	FOS	FOL	FOE	FMS	FSS	FOC	FOT	Total (M+F)
S.s	10+6=16	6+1=7	7+1=8	9+5=14	6+2=8	5+0=5	3+0=3	61 (26.1%)
Hw	5+6=11	4+10=14	5+5=10	4+3=7	2+3=5	2+4=6	2+7=9	62 (26.5%)
A.l	3+11=14	2+7=9	4+3=7	3+23=26	3+13=16	0+3=3	2+0=2	77 (32.9%)
E.h	2+2=4	2+0=2	0+2=2	2+0=2	2+1=3	0+4=4	2+0=2	19 (8.1%)
G.l	2+0=2	0+0=0	2+0=2	1+0=1	0+0=0	0+0=0	2+0=2	7 (3.0%)
T.t	2+0=2	0+0=0	0+0=0	2+0=2	0+0=0	0+0=0	0+0=0	4 (1.7%)
Total	46+25=71	14+18=32	18+10=28	21+31=52	13+20=33	7+11=18	11+9=20	**254 (100%)**

$df = 30, \chi^2 = 41.74, \ p > 0.05$

S.s-*Strongyloides stercoralis*, N.a- *Necator americana,* A.l-*Ascaris lumbricoides*
E.h-*Enterobius vermicularis*, G.I-*Giardia lamblia*, T.t- *Trichuris trichiura*

For female toilet samples, the detected species included *A. lumbricoides, N. americanus* larva, *S. stercoralis,* and *E. histolytica. A. lumbricoides* was the most prevalent, representing 48% (60 cases), followed by *N. americanus* larva with 38 (31%), *S. stercoralis* with 15 (12%), and *Entamoeba histolytica* with 11 (9%). *A. lumbricoides* had the highest parasitic load across all faculties. A significant difference was noted in the species of parasites detected on female toilet seats across faculties ($p<0.05$) (Table 2).

Comparatively, the distribution of parasites across toilets and parasite species across faculties shows similar patterns between male and female populations. *A. lumbricoides* had the highest combined prevalence (32.9%), followed closely by *N. americanus* and *S. stercoralis,* indicating they are the most common intestinal parasites in the study area. FOS, FOL and FMS had relatively higher overall counts, suggesting possibly poorer sanitation or higher population use in those locations (Table 2).

The occurrence of specific parasite species across faculties for both sexes does not differ significantly, suggesting a similar parasitic burden in both male and female toilet environments ($p > 0.05$). Figure 2 shows the overall prevalence of parasites species recovered.

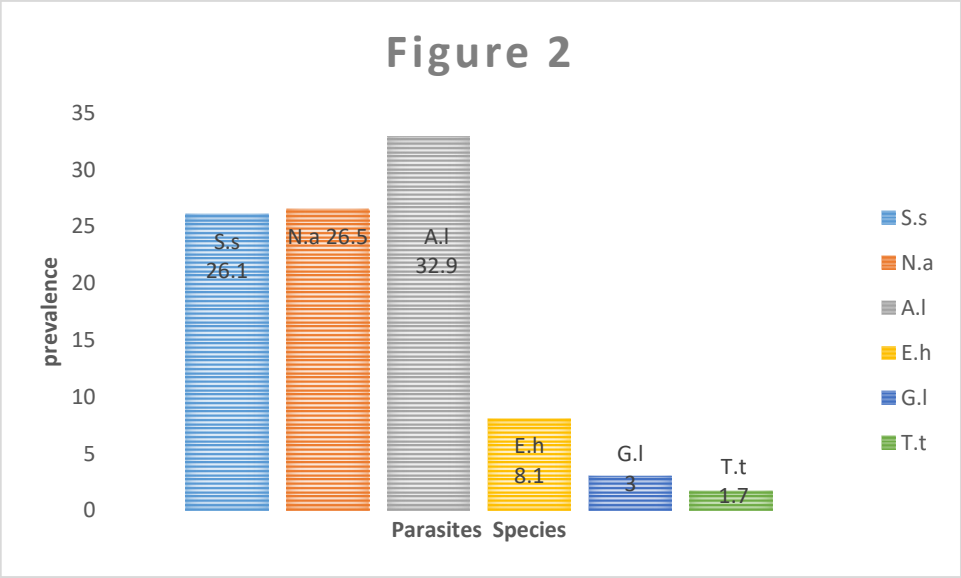

Figure 2: The Overall Parasite Species Prevalence across the seven faculties

Respondent Data (Faculty of Arts)

A total of 30 questionnaires were administered to both male and female students of FOA.

The age distribution for male students showed 16-20 were 10(33.33%), 21-25 years were 14 (46.67%) while 26-30 years were 6 (20%) indicating a predominance of students aged 20-25. Regarding academic level, 100-level students predominated at 11 (36.67%) followed by 200-level at 9 (30%), 300-level at 6 (20%), and 400-level was at 4 (23.33%) .

Christians were more than Muslims, though not statistically significant (56.67% vs. 43.35%). The Department of Religion had the most male students with 12 (40%), showing a significant difference across departments ($p<0.05$). Fathers with tertiary education were 14 (46.67%) and mothers with tertiary education were 12 (40%), which was not statistically significant ($p>0.05$) (Table 3).

Table 3: Respondent data of Faculty of Arts Students N=60 (Male and Female)

Characteristics	Options	Male No (%)	Female N (%)	Total N (%)	Statistical Analysis
Age	16-20	10 (33.3)	20 (66.7)	30(50)	df =2 χ^2=6.83
	21-25	14 (46.6)	9 (30)	23 (38.3)	p-value=0.033,
	26-30	6 (20)	1 (3.3)	7 (11.6)	P<0.05
Level of Study	100	11 (36.6)	9 (30)	20 (33.3)	df =3 χ^2=0.91
	200	9 (30)	12 (40)	21(35)	p-value=0.823,
	300	6 (20)	7 (23.3)	13(21.6)	P>0.05
	400	4 (3.33)	2 (6.67)	6 (10)	
Religion	Christian	17 (56.6)	14 (46.6)	31(51.6)	df =1 χ^2=0.53
	Muslim	13 (43.3)	16 (53.3)	29 (48.3)	p-value =0.467
					P<0.05
Department	Religion	12 (40)	15(50)	27(45)	df =3 χ^2= 2.93
	Theatre Art	5 (16.67)	7(23.3)	12 (20)	p-value =0.402
	History	6 (20)	5(16.67)	11(18.3)	P>0.05
	Foreign lang.	7 (23.3)	3 (10)	10 (16.6)	
Father's Educational level	Tertiary	14 (46.6)	13(43.3)	27(45)	df =2 χ^2=0.13
	Secondary	9(30)	9 (30)	18(30)	p-value =0.937
	Primary	7 (23.33)	8(26.6)	15(25)	P>0.05
Mother's Educational level	Tertiary	12 (40)	11(36.6)	23(38.3)	df =2 χ^2=1.21
	Secondary	11 (36.6)	9(30)	20(33.3)	p-value =0.547
	Primary	7 (23.3)	10(33.3)	17(56.6)	P>0.05
		30 (100)	30(100)	60(100)	

Among female respondents, the majority were aged 16-20 (20, 66.7%), followed by 21-25 (9, 30%), and 26- 30 with 1 (3.3%). Most respondents were in 200 level 12 (40.0 %), followed by 100 level 9 (30.0%), 300 level 7 (23.3%), and 400 level 2 (6.67%). The Department of Religion also had the most female students 15 (50%), showing a significant difference across departments ($p<0.05$). Fathers with tertiary education were 27 (45 %) and mothers with tertiary education were 11 (36.6%), which was not statistically significant ($p>0.05$) (Table 3).

Comparatively, a larger proportion of female students fell within the 16–20 age group (66.7%), compared to males (33.3%). Males dominate the 21–25 and 26–30 age categories. There was a significant association between gender and age group ($P<0.05$) (Table 3).

Distribution across levels (100 to 400) show**s** no significant gender difference. Slightly more females (53.3%) are Muslims, and more males (56.6%) are Christians. The differences are not statistically meaningful, showing a balanced religious distribution.

There was no gender-based departmental preference; both sexes are fairly distributed across Religious Studies, Theatre Arts, History, and Foreign Languages. There was no significant gender-based disparity in parental education. Both genders have similar background distributions: Parental education was highest at tertiary level, followed by secondary and primary. Slightly more female respondents reported mothers with primary education (33.3%) (Table 3).

Knowledge, Attitude and Practices on Toilets and Infections among FOA students

Among male students, 21(70%) declared that their toilets are clean, 25(83.3%) had knowledge of parasitic infections, 22(73.3%) believed one can contract infections from school toilets. However, 28(93.3%) felt reluctant or nervous to use the toilets even though 21 (70%) claimed the toilets were clean (Table 4).

Table 4: Knowledge, Attitude and Practices on Toilets and Infections among FOA Students

Questions	Male N (%)	Female N (%)	Total N (%)	Statistical Analysis
What is the state of your Faculty toilet?				df =2 χ^2=38.58
Neat	21(70)	1(3.33)	22 (36.6)	P-value =0.001
Not Neat	09 (30)	28(93.3)	37 (61.6)	P< 0.05
I don't Know	0(0)	1(3.33)	1 (1.66)	
Are you aware of Parasitic infections?				df =2 χ^2=2.40
Yes	25(83.3)	24(80)	49 (81.6)	P-value =0.301
No	5(16.6)	4(13.3)	09 (15)	P> 0.05
Don't know	0(0)	2(6.66)	2 (3.33)	
Do you think you can contract-infections from your Faculty toilets?				df =2 χ^2=5.27 P-value =0.072 P> 0.05
Yes	22(73.3)	28(93.3)	50 (83.3)	
No	8(26.6)	0(0)	08(13.3)	
Don't Know	0(0)	2(6.66)	2 (3.33)	
Do you feel reluctant or nervous when you want to use your Faculty toilet?				df =2 χ^2=8.95 P-value =0.011 P> 0.05
Yes	28(93.3)	20(66.6)	48 (80)	
No	2(6.66)	9(30)	11 (18.3)	
Indifferent	0(0)	1(3.33)	1(1.66)	

Do you wash your hands after using your Faculty toilet?				df =2 χ^2=19.91 P-value =0.001
All the time	14(46.6)	27(90)	41(68.3)	P> 0.05
Sometimes	0(0)	3(10)	03(5)	
No	16(33.3)	0 (0)	16 (26.6)	
	30 (100)	30(100)	60(100)	

Most female respondents 28(93.3%) confessed that their faculty toilet was not neat, 24(80%) had knowledge of parasitic infections, 28(93.3%) believed that one can contract infections from using toilets, 20(66.6%) felt reluctant or nervous when using the toilets while 27(90%) claimed they washed their hands after using the toilets (Table 4).

Comparatively, 70% of males said the toilets are neat, while 93.3% of females said not neat. This suggests that female students are much more dissatisfied with toilet hygiene. There was high awareness of parasitic infections among both genders as over 80% said yes. This indicates general good knowledge regardless of gender. Moreso, 93.3% of females believe contracting infection from toilets is possible vs 73.3% of males. This suggests females may perceive more risk, though the result falls short of significance (Table 4).

There was a significant difference in attitude as 93.3% of males reported feeling nervous, compared to 66.6% of females. This is interesting, despite females perceiving the toilets as dirtier, more males reported reluctance. There was a highly significant difference in hygiene behavior as 90% of females always wash hands, compared to only 46.6% of males. Therefore, female's students show better toilet hygiene practices overall (Table 4).

Discussion

The studies reveal a widespread presence of parasites on both male and female toilet seats, indicating a significant public health concern. By comparing parasite load between male and female toilets, the study identifies possible gender-related disparities in toilet maintenance, usage behavior, and cleaning frequency of the toilet facilities.

The overall count of toilets parasites in this study in LASU, Ojo Campus was 254 from 140 toilets and this is attributed to overcrowding, inadequate water supply, poor maintenance due to lack of toilet equipments, and cleaning materials leading to reluctance in effective toilet cleaning. On the contrary, studies had shown that the prevalence of toilet parasites in Nigeria is higher in rural areas by 63.5% and in urban area is 40.0% as a result of poor education. Lack of toilet leads to open defecation, level of skin contact with soil and poor drinking water in the rural areas [24].

Ibrahim et al observed that toilet seats were the most contaminated area in restrooms in a survey of bacteria on surfaces of public restrooms [25]. The prevalence of parasites isolated from toilet seats in other studies were as follows: 80.9% in rural and 51.4% in urban places in Eastern Nigeria, (75.7%) by Wosu and Onyeabor and (45.5%) by Emeka (2015) in South Eastern, Nigeria [26,27]. In the South West, Adekunle obtained (30.6%) [28].

The result of this study is in line with that of Wogu and Ogunbotimiti who carried out a study on public restroom surfaces in Benin City, Edo State Nigeria, for enteric helminth parasites and obtained 20.6% prevalence [11]. Four types of surfaces were examined in female and male restrooms but toilet seats recorded the highest contamination of 37.5%. Another study by Wogu and Ogunbotimiti reported that toilet seats had a high prevalence of protozoan infections and there was no significant difference in contamination between male (11%) and female (5%) restrooms in Benin City, Nigeria [12]. This is also in line with this present study.

Borges et al described the occurrence of intestinal parasites inside public restrooms from a Brazilian city [13]. Thirty two public restrooms were investigated and two (6.25%) were contaminated with helminth eggs *A. lumbricoides* and *E. vermicularis*. This two helminths were also isolated in this present study. It was concluded in that study that public restrooms can be an important source of parasite transmission and sanitary education could be improved on the usage which is true of this study.

FOS consistently showed the highest prevalence of parasites across both genders, with the male student's toilets with the highest prevalence of parasites recovered (22.22%). This suggest this faculty's toilets might be particularly contaminated or highly trafficked. This could also be due to the to the fact that this faculty services other faculties at the 100 level resulting in a high student population. This higher prevalence of toilets parasite could also be attributed to accessibility and location of the toilets on the ground floor with swampy vegetated surroundings. This indicated overcrowding which means that the number of students using the toilets is much greater than the provided toilets.

Eroglu et al and Solomon et al concluded that communal use of toilets in educational settings play an important role in the transmission of faecal-oral parasites [18,29]. The trend of more students to less toilets was also observed in the other Faculties. However, some of the students were restricted from using the toilet while some do not use the toilet because of poor management of the toilet and unavailability of toilet equipments and inadequate water supply. Sanitary information revealed that many students were not using the toilets because of the level of risk factors and the fear of been predispose to infection.

Sampson et al., had reported that the number of users as well as the personal hygiene or sanitary practices of the individual users may have an impact on the biological hazards

connected with using public toilets [8]. According to the WHO and UNICEF, 2.4 billion lacked improved sanitation facilities world-wide in 2015 [30]. Wogu and Okubotimibi opined that, the risk of intestinal helminths infection could increase with the frequent use and routine contact with contaminated restroom surfaces [11]. This implies that, frequent touching of restroom surfaces could lead to the transfer of parasites from hand to mouth or hand to food.

Regarding specific parasite species, *A. lumbricoides* was the most prevalent in female toilets, while *S. stercoralis* dominated in male toilets. This difference could be attributed to various factors such as hygiene practices, environmental conditions, or the specific user behavior within each gender's facilities. The presence of species like N. americanus, Entamoeba species, *G. lamblia*, and *T. trichiura* further highlights the diverse parasitic contamination in these toilets. The analysis of data revealed that *A. lumbricoides* ova was found to be the most prevalent parasite found on the toilet seats across the faculties. Okwa had reported that *A. lumbricoides* is the most widespread intestinal helminth in Nigeria [31].

Questionnaires were administered at FOA, due to the inaccessibility of the faculty toilets. Respondent analysis provided insights into the demographics of the student population.

Only age showed a statistically significant difference between male and female respondents, suggesting gender-related trends in age distribution with a predominance of students aged 16-20 years at 50%. All other variables such as level of study, religion, department, and parental education showed no significant differences, indicating a broad balance between male and female students in those categories. Department of Religion had majority of participants and this is relevant for targeted interventions if specific departmental differences in toilet usage or hygiene are identified.

The results showed that (61.6%) of respondents disagreed that their faculty toilet is not neat while 80% are reluctant to make use of it because of the fear of toilet infections. This observation is similar to that of Kaewla and Wiwanikit, and Johnson et al, where they stated that the spread of many diarrheal diseases are assumed to be linked to toilets [17,19]. Shao et al also indicated that cleanliness impacted the toilet frequency of students and the visual experience of the overall cleanliness of toiles had the most significant impact [32].

The result of this present study revealed that 90% females and 46.6% males claimed to wash their hands after visiting the toilet. This is a clear gender-based differences in both perception and practice regarding toilet hygiene among FOA students: Females are more critical of toilet conditions and more consistent in hand hygiene. Males, although perceiving toilets as neater, reported more nervousness in usage. Educational interventions may benefit from being gender-targeted, focusing on encouraging consistent hygiene practices among males and improving toilet facilities for females. Hand hygiene is very important as the feacal-oral route is the primary mode of transmission of intestinal protozoa infections and most of the

geohelminthes. These study indicate that, dirty, unclean and contaminated toilet seats are possible potential risk factors that could contribute to the spread of toilet infections.

This study agrees with Kabir et al who observed that improved hygiene and sanitation measures in educational settings are useful for the prevention of infections, limiting the spread of pathogens, and improving health [33]. Lack of personal hygiene, inadequate hand washing can lead to the transfer of pathogens from feacal matter, touched contaminated surfaces (fomites) to the mouth, this can also be transmitted from person to persons [25].

Solomon et al reported that knowledge of toilet infection preventive measures was significant among students in a study in North East Nigeria [29]. On the other hand, Cha et al reported low knowledge of preventive methods as risk factor in a study among students [34]. In this present study, female respondents demonstrated a high level of awareness regarding parasitic infections and the potential for contracting them from school toilets, leading to nervousness during toilet use. This awareness aligns with the finding that most female respondents practiced handwashing after toilet use in contrast to the males. Despite reasonable awareness and knowledge, sanitation and hygiene practices of male students were relatively low [33].

Conclusion

It can be deduced from this survey that students' toilets may serve as potential risk factors for parasitic infections. The findings highlight significant contamination of both male and female students' toilets with parasitic organisms, indicating poor sanitation and hygiene practices. This poses a risk of feacal-oral transmission of parasites, which can lead to outbreaks of diseases. Since the female toilets has significantly higher contamination, targeted interventions should include more frequent cleaning or hygiene education campaigns tailored to that group.

The study further emphasize the importance of adequate water supply, cleaning materials, and consistent cleaning efforts in maintaining toilet hygiene to prevent infections. The significant difference between taking preventive measures and avoiding toilet infections in students suggests that awareness campaigns and access to preventive resources could be effective. Handwashing after toilet use and adequate water supply and cleaning materials suggests that the absence of water and equipment may prevent handwashing, leading to contamination and potential infections. This was significant, implying that adequate water supply and cleaning materials influence handwashing practices. Toilet cleanliness showed a significant difference, indicating that the presence and frequency of cleaning impact toilet cleanliness and usability. Knowledge of contracting infections from toilets was significant implying that a higher number of students took measures to prevent toilet infections

The study provides data that could inform school administrators, health officials, and education ministries about the urgent need to improve public toilet facilities and sanitation infrastructure. The study sets a precedent for future research into seasonal variation in parasite load, impact of hygiene interventions on parasite prevalence and the correlation between toilet contamination and infection rates among students.

Regular parasitological assessment of toilet facilities can serve as a low-cost surveillance tool for assessing the overall environmental hygiene status of schools. This can help in early detection and prevention of potential public health threats. This includes ensuring regular disinfection, availability of clean water, soap, and maintenance staff. These findings from this survey showcase the importance of reinforcing health education among students regarding proper toilet use, handwashing, and personal hygiene [35].

Recommendations

Public Health Enlightenments

To ensure hygienic toilets and safeguard student's health, health education can reduce the spread of infections and promote a healthier learning environment. These campaigns will make students aware of the adverse effects of poor toilets practices.

Hand Hygiene

The use of detergents, disinfectant, and hand sanitizers will minimize the risk of toilet infections. The students should be mandated to have hand sanitizers or imbibe the habit of washing their hands after using the toilets.

Proper Use of Toilets

Proper use and flushing of the toilets before and after using the toilets should be enforced. Adequate water supply should be provided for personal hygiene and sanitation.

Newer Cleaning Tools

Appropriate toilet cleaning facilities should be provided to encourage effective utilization of the toilets. Toilet cleaners should be supervised to carry out thorough cleaning, effective regular maintenance with modern and well- equipped cleaning tools. Mukandayishimiye et al suggested the use of bleach and disinfectants are the best ways to keep toilet seats free of pathogens [20].

Construction of more public toilets

Students health concern should be prioritize at highest level with critical attention. University management, Government and Non-Government organisations and stakeholders such as alumni associations should assist in the construction of more public toilets so as to supplement already available ones.

Overall, the results of this work underscores the need for improved sanitation infrastructure, consistent cleaning protocols, and targeted health education campaigns to mitigate the risk of parasitic infections associated with shared university toilet facilities.

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Ethical Statement

No invasive method was used during the research. The questionnaire admitted was based on informed consent, confidentiality and anonymity

Conflict of interest

The authors have no conflict of interest to declare

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