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Full Length Research

Smart-Phones and Fingertips in the Transmission of Gastrointestinal Parasites among Students in a Tertiary Institution in Lagos, Nigeria

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Smart-Phones (SPs) are indispensable devices operated with fingertips (FTs) which put pathogens on SPs. Addiction to the use of SPs is a concern among Nigerian students. Studies on contamination of SPs with parasitic stages (Ps) has not received deserved interest. We examined 500 SPs and 500 FTs of 500 students of Lagos State University, Nigeria for Gastrointestinal Parasites (GIPs). Samples were collected with sterile swabs, sedimented and examined microscopically. Questionnaires determined student's data and risk factors that influenced infestations. We observed that 290 (58%) of SPs and 350 (70%) of FTs had Ps and all students with infested SPs had infested FTs. Female students' SPs had more Ps 160 (55.2%) than SPs of males 130 (44.8%). However, male students' FTs had more Ps 180 (51.4%) than FTs of females 170 (48.5%) but were not statistically significant (P< 0.05). The most recovered Ps were *Entamoeba coli* cyst 110 (22%) on SPs and FTs and *Ascaris lumbricoides* ova 50 (17.2%) on SPs and 60 (17.1%) on FTs. Identified risk factors were lack of hand washing (0.04%), use of SPs in toilets (65.5%), sharing of SPs (62%) and only 60 (20.6%) cleaned their SPs. The right index FT was most preferred in operating SPs. Regular hand washing, cleaning SPs, avoidance of sharing SPs and non-usage of SPs in toilets will reduce transmission of GIPs.

KEYWORDS: Fingertips, Gastrointestinal Parasites, Nigeria, Smart-Phones, Students.

INTRODUCTION

Mobile phones have been instrumental to the rapid increase in telecommunications accessibility. In the past, mobile phones were mainly about making calls and sending text messages. Today's Smart-Phones (SPs) are portable fully fledged computers that can fit into the pocket and with touch screen controls operated with the fingertips (Miners, 2009).

SPs do more than people even think they can do. They serve as Clocks, Organizers, Reminders, Calculators, Short Message Services (SMS) for text messaging, email, pocket switching for access to the Internet and Multimedia Service (MMS) for sending and receiving photos and video depending on the mobile phone accessories. Educational institutions have witnessed an astronomical increase in the use of mobile phones among students. Students use their SPs not only for calls, to send text, download and store information, email, share pictures and access social media sites and many other usages (Cheung, 2008). The use of SPs among students is habitual and is a serious concern which became a necessity in the COVID-19 (SARS-CoV-2) pandemic when with personal computers became non-negotiable options for online lectures and other academic engagements. This scenario traversed from the basic schools to tertiary institutions. Ownership of SPs has social, economic, psychological and educational consequences especially on students (Cecconi, 2007). With all the achievements and benefits of the SPs today, it is easy to overlook the health hazards posed to its many users (Jagadeesan et al., 2013). The interest in the infection potential of phones can be traced back to the late 1900s (White, 1980). However, most of the pathogens isolated from phones are usually microbes such as bacteria, fungi and viruses especially in humid and warm environments (Coanzantis et al., 1978; Killic et al., 2009). In recent times, studies on bacterial contamination of SPs abound (Akinyemi et al., 2009; Jagadeesan et al., 2013). Ekrakene and Igeleke, (2007) reported that mobile phones can harbour more microorganisms than the lavatory seat, sole of shoes or door handles so they are dirtier than people may think. The constant handling of SPs makes them ideal devices for the spread and colonization of pathogens and nosocomial infections (Karabay et al., 2007; Fatma et al., 2009). The human Fingertips (FTs) are the greatest culprit when it comes to putting pathogens on SPs (Carter, 2002). It has been an old cry that human FTs usually harbour pathogens as part of normal microflora as well as those acquired from the environment (Mackintosh and Hoffman, 1984). Whatever model of SPs are used today, they are all hand-held devices operated with the FTs especially the tips of the thumb and index fingers (Akinyemi et al., 2009).

Gastrointestinal Parasites (GIPs) are protozoa or helminthes that live within the intestines of humans and animals. They are feacal, orally transmitted and derive food, shelter and protection from their hosts intestine. They do not need an intermediate host so are transmitted directly by ingestion of their infective stages such as cysts and eggs which are found in the environment. Various modes of the transmission of GIPs exist but most can be transmitted directly by ingesting feacally contaminated food or drinks containing parasitic stages or indirectly by flies, soil, hands, inanimate objects and several other fomites (Kusumrungum et al., 2003; Kramer, 2006). The widespread occurrence of GIPs is largely due to lack of personal hygiene and environmental conditions such as open defeacation (Ezeagwuna et al., 2010; Okwa et al., 2018).

There is scanty information regarding GIPs contamination of SPs in Nigeria. The dearth of information necessitates this research in order to bridge the information gap. Ucheagwu (2015) carried out surface sampling of the hands of mobile phone users in order to identify the possible sources of contamination in Samaru, Zaria, Nigeria. In the study, mobile phones with keypads and buttons were sampled and not SPs with touch screens. Hitherto, there was no baseline data on the prevalence of GIPs on mobile phones with key pads/buttons or touch screens. The aim of this present survey is to identify and determine the prevalence of eggs and cysts of GIPs from SPs and compare with the corresponding FTs of the student users. The study also investigated the risk factors which predisposes students' SPs to infestation with GIPs. This study is one of a kind among Nigerian students and aims to bridge the information gap.

METHODOLOGY

Study Area

Lagos state is one of the thirty-six (36) states of Nigeria and the commercial nerve centre of the country. The state was the former capital of Nigeria, the fifth largest economy in Africa and is located in the south western geopolitical zone of the country. Lagos State University (LASU), is owned by the Lagos State Government of Nigeria and the main campus is situated in Ojo local government area of the state, along the Badagry express way (Figure 1). LASU is a multi-campus, collegiate tertiary institution with eleven (11) faculties that caters for a population of over 40,000 full time and part time students at the undergraduate and postgraduate levels.

Study Population Sampling and Inclusion Criteria

A total number of five hundred (500) students were enrolled in the study which was carried out between July to December, 2019. The determination of the minimum number of students' participants recruited into the sample population was estimated by using a standard sample size formula for prevalence studies by Kish (1965) as follows:

$$N = \frac{ZX^2 P(1-P)}{D2}$$

Where *N* is sample size, Z is the standard normal deviate statistical value of 1.96 at confidence level of 95%. *P* is considered the assumed prevalence at 9% at 95% confidence interval and *D* is a 5% relative precision or absolute error between estimated and true prevalences.

One hundred (100) students each were randomly selected from five faculties (Science, Arts, Law, Education and Social Sciences). The different faculties were selected because it aided the random selection of students from different academic background into the study. Students in their first year (100 level) were not available during the study so the inclusion criteria were students from 200 to 400 levels which facilitated age diversity.

A systematic random sampling technique procedure was used in the selection of the students which included ownership of SPs, informed and verbal consents, availability and willingness to participate in the study. The fish-bowl technique of Jacob and Nuuyoma (2019) was adopted to select participants from each faculty randomly, by putting their identification numbers in the bowl and drawing them out one by one until the preferred representative sample per faculty was reached. The procedure continued until 100 students from each of these five faculties were selected to partake in the study consisting of fifty (50) male students and fifty (50) female students without any gender bias. Overall, a total of 250 male students (50%) and 250 female students (50%) participated in the study.

Preparation and Administration of Questionnaires

The research instruments were structured questionnaires which were made confidential and anonymous and contained the objectives of the study. Twenty questionnaires were first pretested and validated by carrying out a pilot study on 20 students. This enabled the questions to be adjusted, refined and authenticated. The questionnaire was designed to provide information on the students (respondents) data such as sex, age, marital status, level of study and brand of SPs. The questionnaire also elicited information on the risk factors predisposing SPs to parasitic contamination such as use of SPs in toilets, hand-washing practices especially after using the toilets, SPs cleaning practices, sharing of SPs and preferred FTs used when operating SPs. For the risk's factors, the respondents were permitted to indicate more than one option as applicable. The actual administration of the questionnaires to the students was carried out at the sampling areas in the five aforementioned faculties. The questionnaires were given serial numbers (Q1-Q500) and it took a maximum average of 15 minutes to fill each questionnaire.

Field Sampling Techniques

The following materials and reagents were carried to the sampling areas. Sterile swabs made of light cotton material, sterile cotton buds, sterile capped bottles and 10 ml formalin. Normal saline of 4.22% was prepared and sterilized with autoclaved at 2% for 12 minutes. It was cooled and stored at room temperature and carried along to the sampling area. The sterile swab was rolled over the screens of each SPs in succession, after which 10 ml formalin was added as preservative in each swab placed in a sterile capped bottle. The FTs of the students were swabbed using sterile cotton buds soaked in the normal saline. The samples were inserted into 5 mls sterile capped bottles containing 2 mls of 4.22% normal saline.

The FTs swabbed were the ones specified or preferred for operating of the SPs of the student users. Each sample bottle had a serial number that was assigned to the user's questionnaire (SP1 – SP500) and (FT1 – FT500). Overall, a total of 1000 samples of 500 SPs swabs and 500 corresponding FTs swabs were collected. The samples collected were taken to the parasitological laboratory of the Department of Zoology and Environmental Biology, Lagos State University, for microscopy.

Laboratory Examination

Laboratory examination was guided by the World Health Organization manual of Basic Laboratory Techniques (WHO, 2003). In the laboratory, each swab was repeatedly pressed mechanically against the internal walls of the bottles to dislodge any adhering cysts and eggs in the liquid preservative. The bottles were shaken and the contents were allowed to settle by gravity for 24 hours and the supernatant fluid was poured off leaving a sizable 10 ml sediment, which was transferred into 15 ml centrifuge tubes. The samples were spinned using an ultracentrifuge with fixed angle rotor at 2,500 revolutions per minute for 10 minutes. The supernatant fluid was poured off leaving the sediments which were collected with sterile applicator sticks and mixed. A drop of each sediment was mounted on microscope clean grease free slides using Pasteur pipettes and left to dry for 15 minutes. Five percent (5%) lugols iodine was prepared by dissolving 10 grams of potassium iodine and 5 grams of iodine crystal in 100 ml of distilled water. After drying the samples, a drop of lugols iodine was applied to each sample using sterile syringes and placed on racks to dry for 10 minutes before microscopic examination. Lugol's iodine was added to aid viewing under a microscope. A B-bran binocular compound microscope was used for examination at x 40 and x100 magnifications.

Identification of Parasites Ova (Eggs) and Cysts

Identification of parasite stages was aided by the use of an Atlas of Medical Parasitology (Zaman, 1972, reviewed by Hay,1992) and WHO (1991) Basic Laboratory Methods in Medical Parasitology. Only viable cysts and ova were identified.

Entamoeba histolytica cyst was identified by a four (4) nuclei ovoid cyst of about 8- 12 µm containing rod shaped chromatoid bars. *Entamoeba coli* cyst was distinguished with eight (8) visible nuclei cyst of about 10-17 µm with no chromatoid bars. The ova of *Ascaris lumbricoides* (50 - 60 µm) was identified by a brownish yellow coloured, embryonated, unsegmented, oval shaped body with characteristics warty or mammilated appearance and thick shell of three layers.

The ova of *Necator americanus* (hookworm) was characterized by roundish, thin, transparent hyaline shells with blastomeres of between 2-8 cells (60 µm by 40 µm). *Trichuris trichiura* ova was characterized by a golden brown colour with barrel or lemon shaped appearance having bipolar protuberances or opercular plugs at each end (50 by 25 µm). *Strongyloides stercoralis* was differentiated by an oval-thin shelled egg (50-58 µm) containing a larva or by an already hatched rhabditiform larvae as both stages may be passed into the environment. A short buccal cavity distinguishes *S. stercoralis* rhabditiform form that of hookworm rhabditiform larvae.

Data Analysis

The parasite prevalences, parasite types, infestation status and loads of SPs and FTs were calculated using Microsoft excel and expressed as percentages (%) and represented in tables and figures. Other parameters compared were gender differences in prevalence rates and the students' infested SPs with their FTs. The questionnaires were manually sorted out and Information was extracted on the demographic profile and risk factors. Data were analyzed by Microsoft excel and represented in tables and figures. Chi square test (χ^2) was used to determine statistical relationships in prevalence of GIPs with respect to gender and to compare proportions and associations between variables. Levels of significance was estimated at 5% with 95% confidence interval (C.I). Probability (P value) was determined by $P< 0.05$ as significant and $P> .05$ as not significant. Multiple logistic regression analysis was used to determine the predisposing risk factors and represented in figure.

RESULTS

Demographic Profile of the Selected Students

As systematically selected, 500 students participated in the study with 250 (50%) male students and 250 (50%) female students. Among these total population, 472 (94.4%) of the students were in the age range 18- 24 years. A total of 310 (62%) of the students were in 400 level, 90(18%) in 300 level, while 100 (20%) were in 200 level. The commonest SP used among the students was Techno which was 150 (30%) of all the SPs sampled. A total of 25 (10%) of the female students were married. Table 1 shows the demographic profile of the students.

Overall Prevalence of Infectious Status of Smart-Phones and Fingertips

Among the 500 SPs, 290 (58%) were infested with parasitic stages. Among these 290, 130(44.8%) had male users and 160 (55.2%) had female users. A total of 350 (70%) FTs were infested with parasitic stages. A total of 170 (48.5%) female FTs were infested while 180 (51.4%) of male FTs were infested. The female students had more infested SPs while the male students had more infested FTs. However, there were no gender significant difference at 5% ($P>0.05$).

Figure 2 shows the infestation status of the SPs and FTs of the students (male and female).

Comparison of the Parasitic Load on Smart-Phones and Fingertips

The infested FTs 350 (70%) harboured more parasite

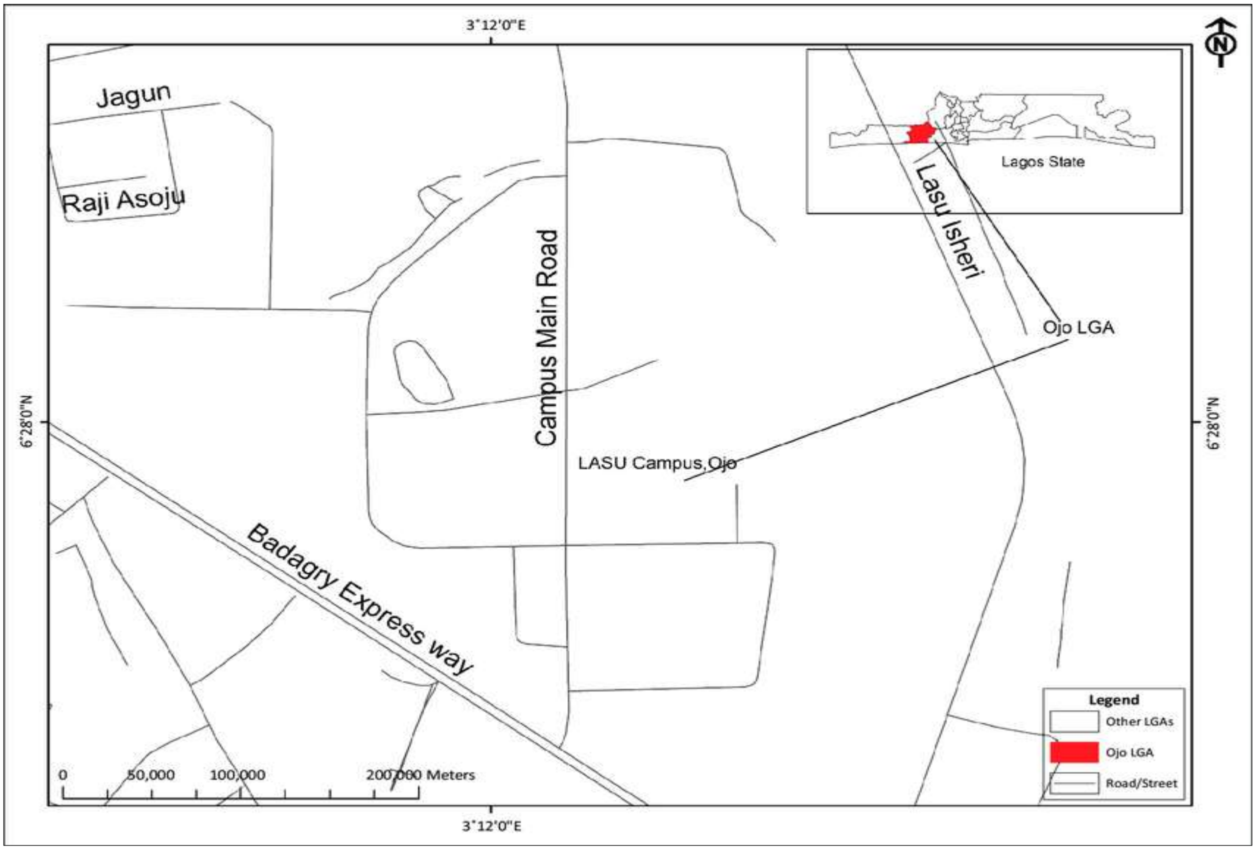

Figure 1. Map showing the location of the Lagos State University, Main campus within Lagos. Source: Lagos Bureau of Statistics (2016).

Table 1. The demographic profile of the study population.

Parameters	Male (%) (N= 250)	Female (%) (N= 250)	Total (%) (N= 500)
Age Ranges			
18-24	227 (90.8)	245 (98%)	472 (94.4)
25 and above	23 (9.2)	15 (6%)	38 (7.6)
Levels of Study			
400 level	140 (56)	170 (68)	310 (62%)
300 level	40 (16)	50 (20%)	90 (18%)
200 level	70 (28)	30 (12%)	100 (20%)
Types of SP			
Techno	60 (24%)	90 (36%)	150 (30%)
Infinix	88 (35.2%)	30 (12%)	118 (23.6)
Samsung	50 (20%)	46 (18.4)	96 (19.2)
Itel	40 (16)	48 (19.2)	88 (17.6)
Others	12 (4.8%)	36 (14.4)	48 (9.6)
Marital Status			
Single	250 (100%)	225 (90%)	475(95%)
Married	0 (0)	25 (10%)	25(5%)

stages that the infested SPs 290 (58%) as shown in Table 2. All the students with infested SPs also had infested FTs. On the contrary, there were 60 (12 %) of the student population whose FTs were infested

Table 2. The Parasitic load of Identified cyst and ova recovered on SPs and FTs.

Parasites stages Identified	Load on SPs N (%)	Load on FTs N (%)
Entamoeba coli	110 (37.9)	110 (31.4)
Entamoeba histolytica	60 (20.6)	70 (20)
Giardia lamblia	20 (6.89)	40 (11.4)
Ascaris lumbricoides	50 (17.2)	60 (17.1)
Trichuris trichiura	20 (6.89)	20 (5.71)
Necator americanus	20 (6.89)	30 (8.57)
Strongyloides stercoralis	10 (3.44)	20 (5.71)
Total	290 (58%)	350 (70)

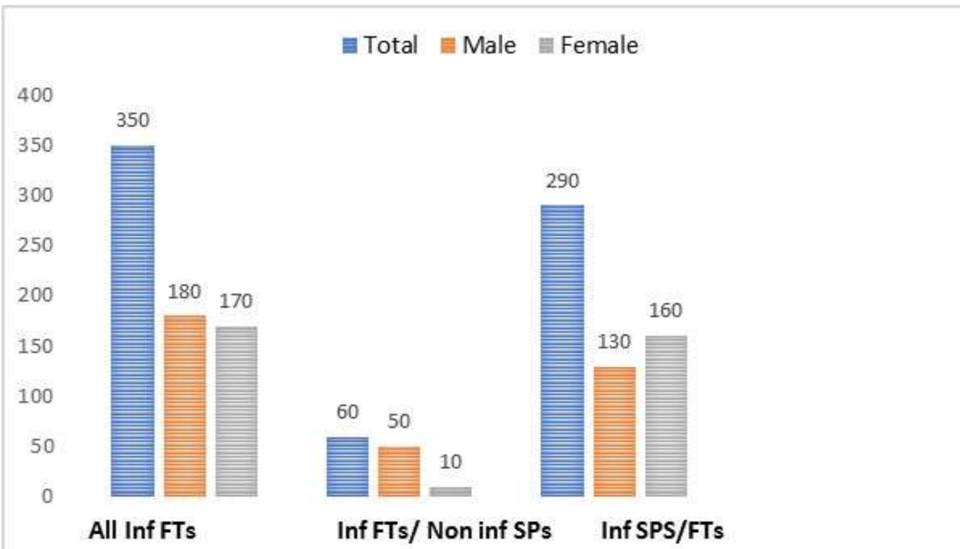

Figure 2. Number of Students (Male and Female) with: (1) All infested FTs (2) Infested FTs and Non infested SPs (3) Both infested FTs and infested SPs

but their SPs were not. A total of 50 (83.3%) out of these 60 were male students while 10 (16.6%) were female students. Figure 2 shows the comparison of students (male and female) with infested FTs, with infested FTs but non-infested SPs and with both infested SPs and FTs.

Parasites Identification and Load on the Students Smart-Phones

The cysts of the protozoa identified and recovered on the SPs were *Entamoeba coli* cyst (a commensal) which was 110 (37.9 %), followed by *Entamoeba histolytica* cyst 60 (20.6%) and *Giardia lamblia* cyst 20 (6.89%). The ova of helminths such as *Ascaris lumbricoides* was 50 (17.2%), *Trichuris trichiura* 20 (6.8%), *Necator americanus* 20(6.89%) while the least recovered helminth stage was *Strongyloides stercoralis* larva 10(3.44%). The ova of *S. stercoralis* were not detected. Therefore, on the SPs, the most abundant protozoa cyst recovered was *E. coli* cyst at 37.9%, followed by *E. histolytica* at 20.6% while *G. lamblia* cyst was the least at 6.89%. *A. lumbricoides* ova were the most abundant helminth ova recovered at 17.2%. Table 2 shows the parasites cysts and ova recovered and identified on the SPs of the students.

Parasites Identification and Load on the Students Fingertips

Similar protozoa stages were recovered and identified on the FTs such as cyst of *Entamoeba coli* 110 (31.4 %), *Entamoeba histolytica* cyst 70(20%) and *Giardia lamblia* cyst 40 (11.4%). The ova of helminths such as *Ascaris lumbricoides* was 60 (17.1%), *Trichuris trichiura,* 20(5.71%), *Necator americanus* 30 (8.5%) while the larvae of *Strongyloides stercoralis* was the least recovered 20 (5.71%). The ova of *S. stercoralis* were not detected. Of the 350 infested FTs, a total of 170(48.5%) of the right index FTs, 140 (40%) of right thumbs FTs and 40 (11.4 %) of left thumbs FTs were infested with parasite stages (Figure 4). Therefore on the FTs, the most abundant protozoa cyst recovered was *Entamoeba coli* at 31.4% followed by cyst of *Entamoeba histolytica* at 20% while *G.lamblia* was the least at 11.4%. The most abundant helminth ova recovered was that *of A.lumbricoides* at 17.1%. Table 2 shows the parasites cyst and ova recovered and identified on the FTs of the students

Determination of Risk Factors Predisposing Smart-Phones to Infestation

There was no relationship between type of SPs and prevalence of infestation. Only 20 (0.04%) of the total student population (500) indicated that they washed their hands before operating their SPs. The result of the multiple logistic regression analysis indicated that of lack of cleaning SPs was a significant risk factor for those with infected SPs (P< 0.05) at 95%. There was no significant predictor or association between use of SPs in toilets, sharing of SPs and infected SPs. Among the 290 (58%) with infested SPs, 190(65.5%) of the student users indicated that they used their SPs in toilets, 180(62%) indicated that they shared their SPs and about 60 (20.6%) claimed they cleaned their SPs regularly. The proportion of students with non-infested SPs was 210 (42%), of which 150(71.4 %) claimed that they used their SPs in toilets. A total of 140 (66.6 %) of this same population claimed that they shared their SPs while 126(60%) indicated that they cleaned their SPs regularly. In comparison, the percentage of students whose SPs were infested (58%) and used their SPs in the toilets (65.5%) or shared SPs (62%) was lower than the percentage of students whose SPs were not infested (42%) but used their SPs in toilets (71.4%) or shared SPs (66.6%). However, there was no significant statistical difference at 5% (P> 0.05). But the percentage of students with non- infested SPs who cleaned their SPs regularly (60%) was significantly higher than the percentage of students with infested SPs who claimed they cleaned their SPs regularly (20.6%). Figure 3 shows the percentage of students with infected SPs and non- infested SPs and the predisposing risk factors.

Determination of the Preferred Fingertips for Operating Smartphones

Among students with infested FTs, the right index FTs 170 (48.5%) was the most preferred when compared with the FTs of the right thumbs 140 (40%) and the left thumbs 40 (11.4%). Among students with non-infested FTs 150 (30%), 80(55.3%) preferred the use of their right index FTs for operating their SPs but 54 (36%) preferred their right thumbs FTs while 16 (10.6 %) preferred their left thumbs FTs. However, there was no significant statistical difference at 5% (P> 0.05) in preferred FTs among students with infested FTs and non-infested FTs. The right index FTs was most preferred in operating SPs among students with infested FTs and well as those with non-infested FTs. Figure 4 shows the percentages of preferred FTs among students with infested FTs and students with non-infested FTs.

DISCUSSION

Gastrointestinal Parasites (GIPs) infections has been significantly reduced in developed countries by improving sanitation and other hygienic measures including hand- washing and adopting proper hand hygiene practices (Bartram and Cairncross, 2010). SPs as mobile hand held, indispensable devices in human daily life aspects requires extensive finger contact and this is problematic regarding the dispersal of pathogens (Akinyemi et al., 2009). The dramatic increase in the usage of SPs today and especially among Nigerian students enhances the transmission of GIPs whose disseminating stages such as cyst and eggs are found in the environment (Omar et al., 2014; Okwa et al., 2018).

GIPs are feacally transmitted and so can survive on hands and surfaces for hours at a time, especially in warmer temperatures away from sunlight. These organisms are easily transferred by touch to door handles, food and mobile phones. From there, the

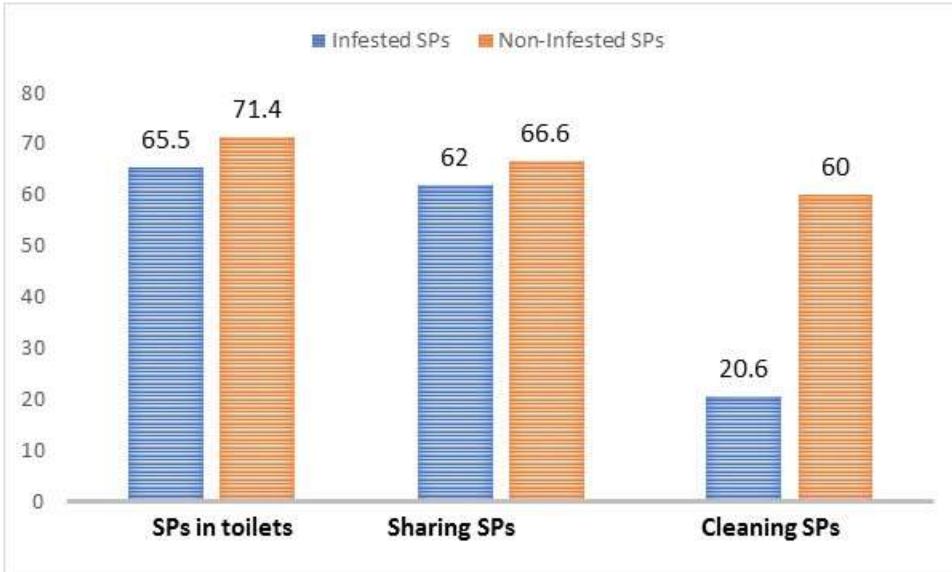

Figure 3. The percentages of students with infested SPs and Non infested SPs and the risk factors.
(1) Using SPs in toilets (2) Sharing SPs (3) Cleaning SPs

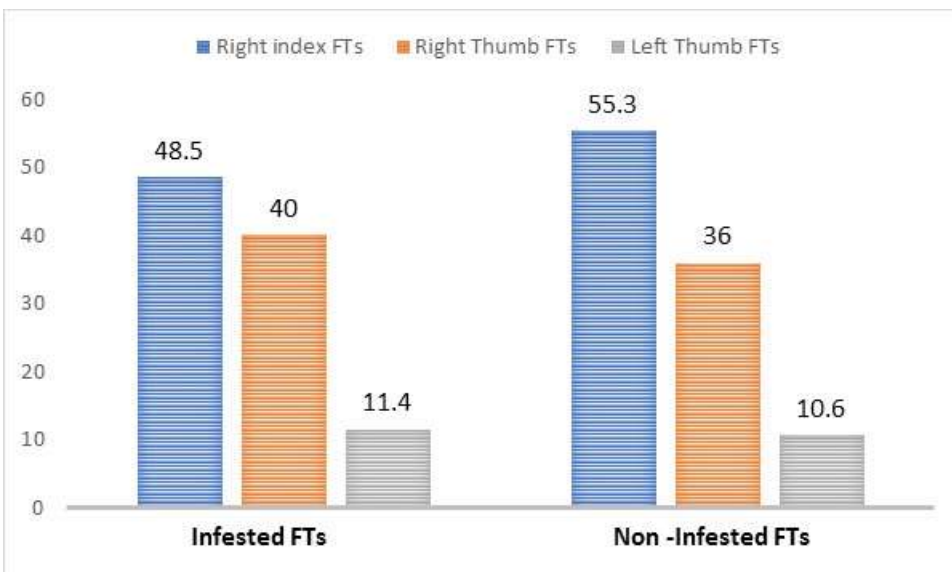

Figure 4. The percentages of preferred FTs among students with infested FTs and non-infested FTs.

parasites may be picked up by people (LSHTM News, 2011; Sheriff, 2020). SPs may come in contact with different sources such as contaminated human skin, handbags, soil, dust, soiled hands and fingers, pockets, food, tables, remote controls, keys. Currency notes (Okwa and Bello, 2016), door handles, door knobs (Sanni, 1997; Sheriff, 2020), soles of shoes (Nock and Tanko, 2000), computer mouse and keyboards (Ndams and Jimoh 2006; Ajenifuja and Ajibade, 2012) and many other inanimate objects may serve as fomites (Kramer, 2006). However, the adherence of GIPs to the fingertips (FTs) is salient to the contamination of SPs and ultimate transmission of the GIPs to the users. Dyek (2001) and Ademola (2012) reported the occurrence of parasitic stages of GIPs under the FTs of primary school children in two different surveys in Zaria, Kaduna State, Nigeria. This study has shown that infested FTs contaminates the user's SPs and are culpable in the transmission of GIPs. The right index FTs appeared most culpable in SPs contamination being most preferred for operating SPs. A strong association between the prevalence of parasites on SPs and FTs of the same students was observed in this study. In Ucheagwu (2015) study, more parasite stages were found on the hands of the users than on their mobile phones in Samaru market in Zaria, Kaduna State, Nigeria and this is in line with this present study. In this present study, female students usually keep their SPs in their handbags which they carry with them into the toilets while the male students usually keep their SPs in their pockets. This could be responsible for the slightly higher prevalence among female students (55.2%) compared to the male students (44.8%) recruited into this study. It was observed in this study that exposure to infested SPs which are shared and not usually cleaned can serve as vehicles of disease transmission and this is a looming threat to public health as reported by Abdullahi and Abdulazez (2000) in their study. Ademola (2012) carried out a study in Zaria, Nigeria and reported that shared mobile phones had more parasitic stages than unshared ones. Ucheagwu (2015) also reported in her study that low educational level, sharing of phones, using phones in markets and lack of hand-washing were risk factors in the transmission of GIPs in Samaru market.

LSHTM News (2011) reported that people who did not wash their hands with soap especially after using the toilets had a higher prevalence of pathogens on their hands and SPs. In their study, the largest proportion of contaminated phones was in Birmingham (41%) while Londoners were caught with the highest proportion of *E. coli* present on their hands (28%). Ucheagwu (2015), investigations into the diversity of GIPs stages found on hands and mobile phones with keypads and buttons, in Northern Nigeria detected some similar organisms as found in this study such as cysts of *Entamoeba coli* (a commensal) *E. histolytica,* and ova of A. *lumbricoides T. trichirua, S. stercoralis* and hookworms.

In this study, we did not observe the oocyst of *Cryptosporidium parvum,* Coccidia, *Cyclospora cayatanensis, Isospora*, and eggs of *Taenia, Fasciola* and *Toxocara* as reported in Ucheagwu (2015) investigations. This could be because of the differences between the study area, geopolitical zone and study populations. The keypads and buttons of mobile phones sampled in Ucheagwu's study are most frequently in contact with the tips of FTs than the screen. However, only SPs with touch screens having no keypads or buttons were sampled in this present study and the differences in phone types and sampling methods affect GIPs detection.

This research has contributed in bridging the dearth of information and scanty data regarding the degree to which SPs and the hands of their users are contaminated with GIPs in Nigeria. According to Ucheagwu (2015), the information of GIPs on SPs and FTs are highly desirable in environmental parasitology and disease epidemiology. This will expose the health risks associated with having contact with mobile phones; create needed awareness on the importance of hand washing as a powerful public health intervention tool in the control of parasitic infections.

CONCLUSION AND RECCOMENDATIONS

There is a great need for constant personal hygiene, regular hand-washing and basic sanitation and the recognition of the human's hands in the transmission of GIPs. These same practices have also been being made of utmost importance in the battle against the COVID-19 pandemic. The World Health Organization (WHO) recognizes that hand-washing is the most effective and inexpensive way to prevent transmission of pathogens (WHO, 2020). Cleans hands should be used in operating SPs and the regular cleaning of SPs is also essential especially when it has been exposed to dirty surfaces and unhygienic environments (Civic, 2020). No doubt, hand-washing and SPs cleaning practices will continue to prevent the transmission of a myriad of pathogenic organisms (Abruqua and Lambon, 2014). Public enlightenment should be continued and sustained on hand-washing and hand sanitizing practices especially among students in the post COVID world. The sharing and use of SPs in toilets should be discouraged as these are risk factors to their subsequent contamination.

According to LSHTM News (2011), Global Hand-washing Day – which is held on October 15 every year - aims to transform the action of washing hands with soap into an automatic behaviour, deeply set in our daily lives. Initiatives and events to promote the practice in homes, schools, workplaces and communities are held worldwide. This is also an important approach to be adopted in the control of GIPS and diverse kinds of pathogens.

ETHICAL CONSIDERATION

The authors were guided by the ethical principles that are based on human rights and protection of respondents during this survey such as voluntary participation, respect of persons, Informed consent and approval which were obtained from students who participated in the study. Confidentiality and anonymity of information was strictly ensured.

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