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Prevalence of Parasitic Infections among Students of Evangel University Akaeze, Ebonyi State, Nigeria

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Abstract- Gastrointestinal and urogenital parasites are among the leading cause of parasitic infections in most part of sub-Saharan Africa and is common in States of Nigeria including Ebonyi. The objective of this study, which was done in Evangel University Akaeze, Ebonyi State, southeastern Nigeria, was to identify the burden of parasites among the students' population with emphasis on intestinal and urogenital parasites. Four hundred students participated in the study. Stool samples were collected from 200(56 males and 144 females) and urine samples collected from another 200(24 males and 176 females) and examined microscopically. Analyses of the data obtained showed that of 200, 72(36%) had intestinal parasites, ($p>0.05$). Six different species of the intestinal parasites were prevalent among the study subjects and Ascaris lumbricoides 40(20%) was the most prevalent. Others were Teania spp 12(6%) Entamoeba histolytica 8(4%), Strongyloides stercoralis 4(2%), Fasciola spp 4(2%) and coinfection of Schistosoma mansoni and Teania sp 4(2%), Results of urine samples showed that out of 200, 56 (28%) students were infected by four species of urogenital parasites with Trichomonas vaginalis being the most prevalent 36 (18%), Schistosoma haematobium 8(4.0%), Enterobius vermicularis 4(2%) and Giardia lambilla infected 4(2%). Also 4(2%) of the sampled subjects had coinfection with Enterobius vermicularis and Schistosoma haematobium. The authors suggest that urogenital infection of the subjects by Giardia lamblia may have resulted from their practicing oral-genital sexual activity - anilingus (licking or kissing of the anus to produce sexual stimulation) or fellatio (oral stimulation of penis). Anal intercourse especially by homosexual students is also incriminated. Parasitic infections are still of public health challenge in Nigeria, especially among teenagers and young adults. Intervention by the concerned agencies is encouraged.

Index Terms- Parasites, stool and urine, Ascaris, Schistosoma, Trichomonas, Parasites burden.

I. INTRODUCTION

Human parasites are either unicellular (protozoa or Archezoa) or multicellular (helminths and arthropods) (Castro and Olson, 1996; Manar and Tonsy, 2012; Garcia et al., 2018; Funso-Aina et al., 2020). Parasitic gastrointestinal infection with helminths and/or protozoa can lead to significant morbidity and mortality if not treated appropriately (Center for Disease Control and Prevention (CDCP), 2017; Ahmed, 2023).

A total of 86.2% of a study population in Nigeria (Gyang et al., 2019), which is more than 1.5 billion people, or 24% of the world's population are infected with soil-transmitted helminth (STH) infections and 5.9 million people are at risk of acquiring the STHs (WHO, 2015; WHO fact sheets, 2023; Agrawal et al., 2024). About 50 million people worldwide are infected by the protozoan parasite - Entamoeba histolytica - one of the most significant enteric pathogens worldwide (Shirley et al., 2018; Mohebali et al., 2021). Infection with Schistosoma haematobium parasite is an important factor in the etiology of carcinoma of the bladder (Van Tong et al., 2017). Loads of diseases caused by most foodborne enteric parasites including Entamoeba histolitica and Ascaris lumbricoides resulted in substantial morbidity and mortality among vulnerable populations The menace of parasites and parasitic infections has been a worldwide challenge. In continents, nations, states and communities, parasitic infection is consistent and has ravaged humans and their environment ((Torgerson et al. 2015; Girma and Aemiro, 2022).

In a study on the prevalence of intestinal parasites among students of a tertiary institution in Jos, Nigeria, 43.3% prevalence was recorded, and Ascaris lumbricoides (69.2%) was the most prevalent parasite (Ejinaka et al. 2019). Similarly, Agmas et al., (2021) observed 38.9% prevalence for at least a single species of intestinal parasite in Ethiopia

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among psychiatric patients and Ascaris lumbricoides was the most frequent parasites detected.

Al-Hindi et al. (2019) reported overall prevalence of 20.6% intestinal parasitic infection among university female students in Gaza, Palestine, and found Entamoeba histolytica/dispar to be more prevalent (7.5%) than other parasites. Omorodion et al. (2012) recorded 12.5% and 23.74 % occurrences respectively, of intestinal parasites, for tertiary institution students and pregnant women in southsouth, Nigeria. The percentage prevalence increased as Amoo et al. (2018) recorded 36.4% prevalence of intestinal parasites among people living with HIV in Abeokuta, Nigeria. According to Ijeoma et al. (2018), percentage prevalence of trichomoniasis among Adults in Oru-East Local Government Area, Imo State, Nigeria was 40.5%, which was higher than 24.7% observed by Anosike et al. (1993) among students of a higher institution in Nigeria. They further observed that infection increased progressively with increase in the number of sexual partners. In a study of urinary Schistosomiasis in Ebonyi State, Nigeria from 2006 to 2017, Chiama et al. (2019) reported 26.02% total prevalence of urinary schistosomiasis and further reported prevalence of 34.57% in Ebonyi North, Nigeria. Meanwhile, the rate of infection increased to 41% as reported by Afiukwa et al. (2019) on the transmission dynamics of urogenital schistosomiasis in the rural community of Ebonyi State, Southeastern Nigeria.

However, no published study of such exists in Okpoto community which is the take off Campus of Evangel University Akaeze, Ebonyi State. The present study explored the burden of intestinal and urogenital parasites among inhabitants of Okpoto community, using students of Evangel University Akaeze as case study.

II. MATERIALS AND METHODS

Study Area

This study took place at Evangel University Akaeze, presently at its take off Campus in Okpoto community, Ebonyi State, Nigeria. Okpoto is in Ishielu Local Government Area of Ebonyi State, one of the States in the southeastern geopolitical zone (Fig. 1). The geopolitical coordinate of Ishielu is 7°45′ and 7°50′E 6°3′ and 6°35′N. The indigenes of this area are predominantly farmers. Their major food crops include cereals, stem and root tubers, vegetables, and fruits, grown around streams and ponds that surround the University. There is still abundance of open/bush defecation practice among rural dwellers, who lived in scattered settlements close to the University. Raw foods items for students' consumption were bought from their local markets within the town. On campus, boreholes were the main source of water. There were flush latrines and piped sewerage system. Cafeteria was the central eating point for students and food were prepared by caterers.

Research Design

The study was a descriptive study done to evaluate the burden of parasites among undergraduate students.

Health Service

University Health center and one health center in Okpoto community were the health service system available for the students.

Study Population

Undergraduate students of the University who gave their consent were enrolled.

Sampling Method and Sample Size

Multi- stage sampling method was adopted. Four hundred students within the age of 15 and 30years, who consented, were enrolled, thus adopting the WHO guideline on survey of prevalence or intensity of infection (WHO, 1991).

Ethical Clearance:

Ethical clearance was sourced and obtained from Research Ethics Committee of Evangel University and from Ebonyi State Ministry of Health.

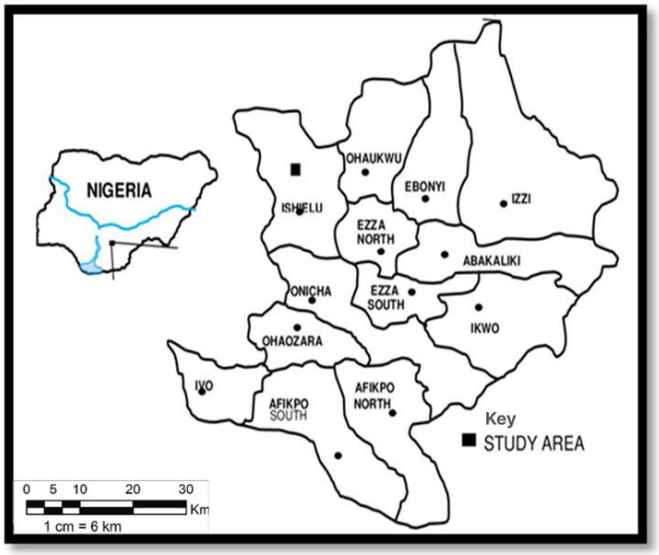

Figure 1: Map of Nigeria showing position of Ebonyi State and the Study Area.

Source: https://www.researchgate.net/figure/Map-of-Ebonyi-State-showing-the-study-area_fig1_329232109

Data/ Sample Collection

The 400 students were divided into two groups of 200 each, for collection of stool and urine samples.

Collection of Urine Samples: Sterile sample containers were distributed to the study population, in which 10 mls clean catch, mid-stream urine samples were collected from 200 number of the study population following initial instructions and illustrations (WHO, 1991; Ossia, 2014).

Collection of Stool Samples: Each of the remaining 200 students was each, given a sterile sample container and two applicator sticks, and asked to pass the stool on a clean sheet

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of paper and use the applicator stick to transfer little portion into the container. The samples were each, labeled with each student's name, sex, the time, and date of specimen collection, for easy identification.

Macroscopic Examination of the Specimens: Stool and urine samples were first examined macroscopically to determine the consistency, presence of mucous, pus, adult worms or worm segments, and blood. The findings were recorded appropriately. Some samples not examined immediately were preserved in 10% normal saline.

Microscopic Examination of Urine Samples: Approximately 10 mls of well-mixed urine was centrifuged at 3000 revolution per minutes for 3 minutes. The supernatant was discarded, and a drop of the sediment placed on a slide, covered with a coverslip, and examined microscopically using compound Microscope with magnification of x10 objective (low power) and then x40 (high power) objective. In addition, sedimentation technique was done for detection of Schistosoma spp. The urine sample was poured into a conical urine flask and allowed to stand for 1 hour to sediment. The supernatant was decanted, and sediments transferred into a centrifuge tube and centrifuged at 1000 revolution per minutes for 15 minutes. The deposit was examined under the compound Microscope using x10 objective. The intensity of S. haematobium infection was expressed as: light (<50 eggs/10 mls of urine) and heavy (≥50 eggs/10 mls of urine) (WHO, 2002). For quality control, randomly selected deposits were re-examined by a medical laboratory technologist.

Microscopic Examination of Stool Samples:
Four grams of each faecal sample was measured out using an Ohaus Havard trip balance (Florham Park USA) calibrated in 0.1gram. Concentrated saturated sodium chloride floatation and formol-ether concentration techniques were used for faecal analysis. The total number of eggs was counted under X40 magnification of a compound microscope. Stool samples were processed within 8 hours of collection and examined microscopically within one hour of preparation to avoid over clearance of hookworm ova (Okoye, 2009)
Statistical Analysis
Data were analysed using Statistical Package for Social Sciences software, version 19.0.

III. RESULTS

Table 1 shows the overall sample population size of the 400 students. It shows that intestinal and urogenital parasites were examined. The table further shows that twenty percent (20%) of the total population were males while 80% were female. The number of the female subjects were more than the males.

Table 2 shows the grouping of the sampled population according to their age for the investigation of the intestinal and urogenital parasites. The age groups ranged from 15 – 20, 21 – 25 and 26 – 30 years. The table also shows that more than 50% of the studied population fell within ages 15 – 20 years age range. It further shows that none of the sampled population was aged 26 – 30 years age range.

The overall results showed that 128 out of 400(32%) students examined, each had infection with either one or more intestinal or urogenital parasites respectively. Seventy-two (72) out of 200(36%) were infected with intestinal parasites and 56 of 200(28%) had infection with urogenital parasites (Table 3)

Table 1. Grouping of sampled students according to gender

Parameters Sample population.

Parameters Sex	Sample population	
Male	Female	
Intestinal parasites		200
56	144	
Urogenital parasites		200
24	176	
Total	400	
80(20%)	320(80%)	

Table 2. Grouping of sampled students according to age range, number within each age range and number infected by either intestinal or urogenital parasites.

Variables Number (%)		Parameters
Age	Intestinal parasites	Urogenital parasite
15 – 20	148 (74)	140 (70)
	288 (72)	
21 – 25	52 (26)	60 (30)
	112 (28)	
26 – 30	0 (0)	0 (0)
0 (0)		
Total 400 (100)		

Table 3. Overall results of prevalence of intestinal and urogenital parasites among the sampled students

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Specimen samples Parameters	Number (%)	
Intestinal parasites	Urogenital parasite	
No. Examined	200	200
No. Positive	72 (36%)	56(28%) 128 (32)
No. Negative	128 (64%)	144(72% 272 (68)
Total	200	200 400

Results of Stool Samples

Six different species of intestinal parasites, which were Ascaris lumbricoides (20%), Teania spp (6%) Entamoeba histolytica (4%), Strongyloides stercoralis (2%), Fasciola spp (2%) and coinfection of Schistosoma mansoni and Teania sp (2%), were prevalent among the study subjects. (Table 4). The table shows that 72 (ie 36%) out of 200 sampled students were infected. It shows that infection with Ascaris lumbricoides was the highest 40(20%) among all. The table further showed that 4(2%) of the sampled students had coinfections with Schistosoma mansoni and Taenia species.

Figure 2 presents the results according to gender. It shows that female students were more infected than the males ($p>0.05$) by all the six intestinal parasites observed. It shows that 64 of 144(44.4%) females were infected against 8 of 56(14.3%) for males. Of the 64 females, 32(22.2%) had Ascaris lumbricoide infection, 12(8.3%) had Taenia spp., and 8(5.6%) had Entamoeba histolytica infection. Srongyloides stercoralis and Fasciola species infected 4(2.8%) each, respectively. The 8(14.3%) males were all infected by Ascaris lumbricoides only. There was also coinfection of Schistosoma mansoni and Taenia spp., observed among 4(2.8%) female subject. ($p>0.05$), p-value = 0.562.

Thirty six(ie 24.3%) out of 148 subject within ages 15- 20 years age range were infected. Twelve (12) (8.1%) were infected with Taenia spp., 12(8.1%) had Ascaris lumbricoides, 4(2.7%) had Strongyloides stercoralis and 4(2.7%) were infected with Fasciola spp. Also 4(2.7%) had coinfection with Schistosoma mansoni and Taenia spp. Also 36 of 52(69.2%) of those within ages 21-25 years age range were equally infected, but with only two species of the parasites: Ascaris lumbricoides 28(53.8%) and Entermoeba histolytica 8(15.4%) (Figure 3) ($p<0.05$), p-value= 0.002.

Table 4. Species and frequency of intestinal parasites prevalent among students of Evangel University Akaeze, Ebonyi State.

Parasite species.	Frequency	Percentage (n=200)
Single Infection		
Taenia species	12	6
Ascaris lumbricoide	40	20
Entamoeba histolytica	8	4
Strongyloides stercoralis	4	2
Fasciola spp (larva)	4	2
Co-infection		
Schistosomia mansoni and Taenia species	4	2
Total	72	36
NG	128	64
TOTAL	200	100

of sampled students, NG: No Growth

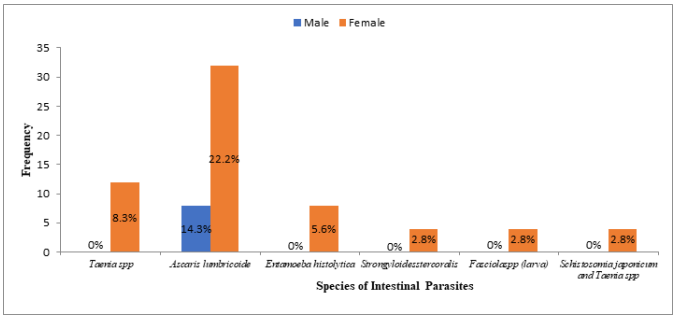

Figure 2: Prevalence of intestinal parasites according to gender of sampled students

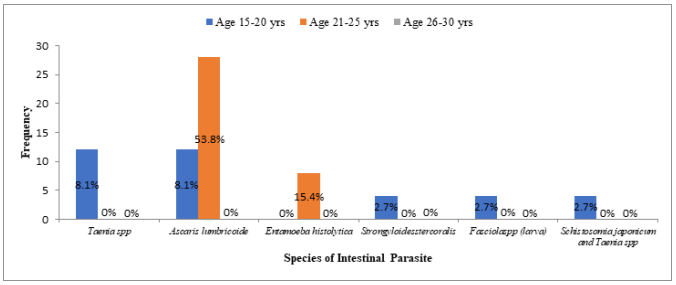

Figure 3: Prevalence of intestinal parasites according to age group of sampled students

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IV. RESULTS OF URINE SAMPLES

The data generated from the urine samples showed that four different species of parasites were observed, which were Trichomonas vaginalis, Schistosoma haematobium, Enterobius vermicularis and Giardia lamblia (Table 5). The table shows that, 56 out of 200(28%) students were infected by these parasites at different frequencies, 36(18%) subjects were infection with Trichomonas vaginalis, 8(4.0%) had Schistosoma haematobium and 4(2%) each, had Enterobius vermicularis and Giardia lamblia respectively. Also 4(2%) of the sampled subjects had co-infection with Enterobius vermicularis and Schistosoma haematobium. Trichomonas vaginalis 36(18%) was the highest prevalent.

Figure 4 shows that 56 of 176(31.8%) female sampled students had infection with all the 4 species of parasites observed from urine samples. Trichomonas vaginalis infection rate was 36(20.5%), Schistosoma haematobium was 8(4.5%), Enterobius vermicularis and Giardia lamblia were 4(2.3%) each, respectively. Enterobius vermicularis and Schistosoma haematobium coinfected 4 female students. None of the male sampled students was infected. The highest total percentage prevalence was 18.0% and the lowest was 2.0%. (p>0.05), p-value = 0.496.

A total of 48 out of 140(34.3%) of those within ages 15-20 were infected by all the parasites observed. Trichomonas vaginalis was prevalent in 32(22.9%). This was followed by Schistosoma haematobium, which was prevalent in 8(5.7%). Enterobius vermicularis and Giardia infected four students, each 4(2.3%). For those within ages 21-25, Trichomonas vaginalis occurred in 4 out of 60(6.7%) students and co-infection of Enterobius vermicularis and Schistosoma haematobium occurred in 4(6.7%) too, (Figure 5) (p0.05), p-value=0.389.

The Burden of Intestinal and Urogenital Parasites among the Students

The percentage occurrence of both intestinal and urogenital parasites among the sampled students was compared, and results presented in Table 6. The Table showed that intestinal parasites infected 72 (36%) out of 200 students sampled, whereas urogenital parasites were observed in 56 (28%) out of the second 200 students sampled. The parasite loads of intestinal parasites were more on the students than urogenital parasites.

When the results were compared among the gender, it showed that 8 (14.3%) out of 56 males were infected by intestinal parasites while 64 (44.4%) out of 144 females students examined had intestinal parasite. The results further showed that, while 56 (31.8%) out of 176 females were infected with urogenital parasites, such infection was not recorded among the 24(0%) males (Table 6).

Table 5. Species and frequency of Urogenital parasites prevalent among students at Evangel University Akaeze, Ebonyi State.

Parasite species.	
Frequency	Percentage (%)
(n=200)	
Single Infection	
Enterobius vermicularis	
4	2
Schistosoma haematobium	
8	4
Trichomonas vaginalis	
36	18
Giardia lambilla	
4	2
Co-infection	
Enterobius vermicularis aand Schistosoma haematobium	
4	2
Total	56
28	
NG	144 72
TOTAL	200 100

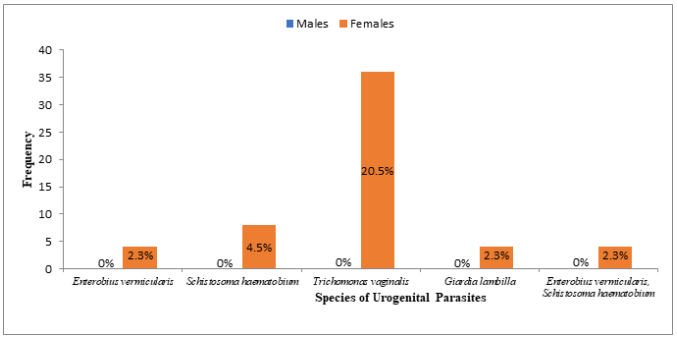

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Figure 4: Prevalence of urogenital parasites according to gender of sampled students

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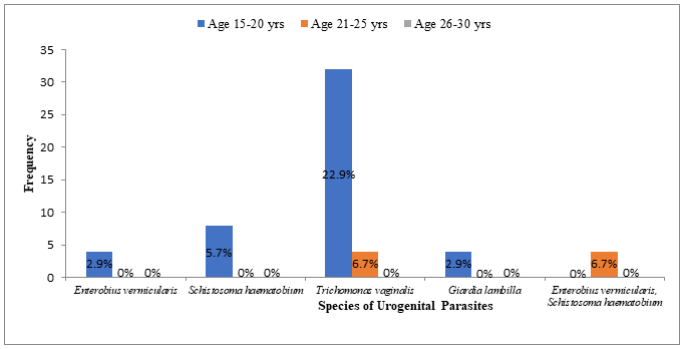

Figure 5: Prevalence of urogenital parasites according to age groups of sampled students

Further comparison of the results according to age groups of the sampled students showed that 36 out of 148(24.3%) sampled students within 15-20 years age group were infected by intestinal parasites while 48 out of 140(34.3%) students in the same age range were infected by urogenital parasites. Among the 21-25 years age group, intestinal parasites were found in 36 out of 52(69.2%) examined whereas 8 out of 60(13.3%) students of the same age range were infected by urogenital parasites (Table 7).

Table 6. Comparison of the results of prevalence of intestinal and urogenital parasites according to gender of sampled students

Sex (n)	Intestinal Parasite group (n=200)		Total	Sex(n)	Urogenital Parasites group (n=200)		Total
	Positive	Negative			Positive	Negative	
Male(n=56)	8(14.3%)	48(85.7%)	56(28%)	Male (n=24)	0(0%)	24(100%)	24(12%)
Female (n=144)	64(44.4%)	80(56.6)	144(72%)	Female (n=176)	56(31.8%)	20(68.1%)	176(88%)
Total	**72(36%)**	**128(64%)**	**200(100%)**		56(28%)	44(72%)	200(100%)

n: No of males/females examined p>0.05 (p-value = 0.562.) p>0.05 (p-value = 0.496).

Table 7. Comparison of the results of prevalence of intestinal and urogenital parasites according to age groups of sampled students.

Age (n)	Intestinal Parasite group (n=200)		Total	Age	Urogenital Parasites group (n=200)		Total
	Positive	Negative			Positive	Negative	
15-20 (n=148)	36(24.3%)	112(84%)	148(74%)	15-20(n=140)	48(34.3%)	92(65.7%)	140(70%)
21–25(n=52)	36(69.2%)	16(30.8	52 (26%)	21-25(n=60)	8(13.3%)	52(86.7%)	60(30%)
26-30 (n=0)	0 (0)	0 (0)	0 (0)	26-30(n=0)	0(0%)	0(0%)	0(0%)
(36%)	**128(64%)**	**200(100%)**		**56(28%)**	**144(72%)**	**200(100%)**	

n: No of males/females examined, P<0.05 (p-value=.002.) p>0.05 (p-value=.389).

V. DISCUSSION

It still toed the opinion of Anosike et al., (2004), Ijeoma et al., (2018) and Gyang et al., 2019 that parasitic infections are of great health problem in Nigeria. The 36% total occurrence of intestinal parasitic infection recorded in this study agreed with 36.4% reported by Amoo et al., (2018) among people living with HIV in Abeokuta, Nigeria. This is perfectly in tandem because, 28% total occurrence of urogenital parasitic infection (Table. 5) was reported among the study population. Schistosoma haematobium was one of the urogenital parasites observed. Evidence from studies shows that urogenital schistosomiasis does increase a person's risk of becoming infected with HIV (Mbabazi et al, 2011).

The 36% total prevalence was a reduction over 42.4% by Anosike et al., (2004) among nomadic Fulanis of South-eastern Nigeria, 43.3% recorded by Ejinaka et al., (2019) among students of a tertiary institution in Jos, Nigeria, 47.9% recorded by Menjetta et al., (2019) from university student's clinic in Ethiopia, and 52.5% by Odo et al., (2016) among School children in UzoUwani Local Governemnt Area of Enugu State. Although there were fluctuations in the trend of infections based on the results, but it showed progressive reduction in prevalence from 52.5% by Odo et al. in 2016 to 36% in the present study. The authors attributed this to improvement in maintenance of both environmental and personal hygiene as Nation develops, as well as decrease in the rate of use of human feces as manure. The reduction in intestinal parasitic infection between the nomadic Fulanis of south-eastern Nigeria (42%) and students of a tertiary institution in Jos (43.3%) may be due to increase in awareness creations by public health institutions against community environmental cleanliness, lodging overcrowding and basic personal hygiene. In addition, since parasites usually enter the body through the mouth or skin, mode of transmission of the parasites is a factor. The lifestyle of the nomadic do normally expose them more to vector transmitted parasites than intestinal parasites (Anosike et al., 2004). As students are normally voracious eaters, they are exposed more to intestinal parasites.

The 36% total prevalence observed in the present study was however higher than 24.8% recorded by Michael et al. (2017) among school children in Port Harcourt, Nigeria, 25.4% reported by Gizaw et al. (2019) among under five children in rural Dembiya, Ethiopia and 27.66% by Abah and Arene (2015) among primary schoool children in Rivers, Nigeria. The differences in prevalence rate observed by the different authors in relation to the present study may be due to differences in sample population sizes, study locations and level of education on personal and hand hygiene by the subjects.

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In this study, female subjects had more infection 64 of 144(44.4%) with intestinal parasites than the males 8 of 56(14.3%) (p>.05, p-value = .562). It agreed with Ejinaka et al., (2019) who recorded that female student had more parasitic infection than males 19 of 37(51.4%). The results was rather contrary with the report of Hailegebriel et al (2017) and Anosike et al (2004) who observed that Males had more infection than females 120 of 359(33.4) and 79 of 167(47.3%) respectively. The inconsistency in the rate of infection on gender, as reported by these different authors may depend on the rate of individual's exposure to parasites before the study and level of immune system, because sexual dimorphism in response to parasites is mediated primarily by the immune system of the host ((Escobedo et al., 2010).

In this study, age group 21-25(n=52) years age range was more infected by intestinal parasites 36 of 52 (69.2%) than others (p<.05) p-value=.002, (Table 7). This findings disagree with the report of Odo et al., (2016) who opined that children between the ages of 5 - 7 had the highest prevalence (19.0%) and Anosike et al. (2004) who further observed and reported that adults of ages 36-40 were more infected (60.0%). The variation still depended on individual's level of immune system.

The 28% total prevalence of urogenital parasites observed in this study is high. Urogenital parasitic infection is life-threatening diseases and remain a major public health problem in Nigeria, especially in Ebonyi State, where Okpoto community is located. The parasites observed were Schistosoma haematobium (4.0%), Trichomonas vaginalis (18%), Enterobius vermicularis (2%) and Giardia lambilla (2%). There was also 2% coinfection of S.haematobium and E. vermicularis. It was observed that prevalence of these parasites varied among the gender as well as the age groups of the students.

The 18% prevalence of Trichomonas vaginalis and 4% of Schistosoma haematobium is not good. It is an indication of high prevalent of urogenital parasitic infection among the students. The 18% prevalence for Trichomonas vaginalis, could be attributed to the fact that the students lacked basic knowledge of sex education and indulge in indiscriminate sex activities especially with more than one sex partner and without protective coat (condom), thus distributing the parasite among themselves (Ijeoma et al., (2018); Anosike et al., 1993).

The 18% prevalence of trichomoniasis here in Evangel University (Okpoto) was in line with 17.7%, 18.67%, 18.7%, reported by Omorodion (2018) in Akwa-Ibom, in Abia and in Lagos respectively when he reviewed the trend of trichomoniasis in Nigeria. It was however less than 24.7% and 40.5%, by Anosike et al., (1993) and Ijeoma et al., (2018) both in Imo state, and higher than 12.5% and 2% recorded by John et al., (2017) and Isaac et al., (2019) in Ogun state and Edo State respectively, both in Nigeria. All pointed out that Trichomonas vaginalis was prevalent among university students. The variation could be due to differences in sample population size, level of personal hygiene and differences in age range of sample population. Records show that the infection occur more in young adults who are more sexually active than older ones (Ijeoma et al., 2018; Senchi et al., 2017). Highest percentage prevalence of 22.9% of trichomoniasis was recorded among those aged 15 -20 years old, and 6.7% among those aged 21 – 25 years age group. Ijeoma et al., (2018) reported 64.15% among adults within 29-39 years age range in Imo State, Nigeria. Though the percentage prevalence reported by Ijeoma et al., (2018) was higher and among varying but close age ranges, but it still corresponded with the teenage ages and young adults where sexual activity is very active. In this study, female subjects were more infected (20.5%) by T. vaginalis than the males (0%). This observation agreed with Ijeoma et al (2018) who reported higher prevalence in women (52.02 %) against men (29.0%) in her study among adults in Oru-East, Imo State. The differences was attributed to the fact that trichomoniasis in men tends to be less clinically apparent and of shorter duration. In addition, multiple studies have found that T vaginalis infection is less prevalent in men than in women (Joyner et al., 2000; Schwebke and Hook, 2003).

The 4% infection of Schistosoma haematobium in the present study was lower than 22.7% and 41% reported by Atalabi et al., (2016) in Katsina and Afiukwa et al. (2019) in rural community of Ebonyi State. The higher prevalence in Katsina and rural community of Ebonyi State respectively, may be due to frequent use/contact with open/flowing shallow water by the study populations, driven by their age range and socioeconomic background. Ocurrence of S. haematobium is associated with exposure to stream water in areas where potable water is scarce. In the present study, the subjects go to the shallow stream close to the Campus occasionally only to wash their clothes, while those in Katsina were exposed to shallow water more frequent due to lack of portable water: for domestic use, recreational activities such as swimming, fishing and irrigation (Atalabi et al., 2016). However, they all pointed out that urogenital parasitic infection with Schistosoma haematobium still thrive in communities and States of Nigeria and therefore calls for urgent public health intervention, because infection with Schistosoma haematobium parasite is an important factor in the etiology of carcinoma of the bladder (Van Tong et al., 2017).

In the present study, results showed that 4(2.3%) out of the 176 female subjects had coinfection with Schistosoma haematobium and Enterobius vermicularis parasites. Coinfection is the simultaneous infection of a host by multiple pathogen species. It means that the person has two separate

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infections going on at the same time (McArdle et al. 2018). A 2.3% coinfection occurrence of S. haematobium and E. vermicularis among the subjects agreed with the earlier statement that -, occurrence of E. vermicularis eggs in urine sample has relationship with urinary tract infection (Choudhury et al., 2017; Khurana et al., 2018). Therefore, occurrence of Schistosoma haematobium and Trichomonas vaginalis earlier stated was a clear indication that the subjects had urinary tract infection. Hence the cause for the E. vermicularis infection. Paucity of literatures exists on coinfection of Schistosoma haematobium and E. vermicularis. So the authors lack material to compare the present observation.

Nevertheless, the researcher observed that this kind of combinations of coinfections matter the most for the health of the subjects. This is beacause, S. haematobium was declared as Group 1 (extensively proven) carcinogens by the WHO International Agency for Research on Cancer (IARC) Working Group on the Evaluation of Carcinogenic Risks to Humans in 2009 (Van Tong et al., 2017). Chronic inflammation, a common feature of S. haematobium infection, is known to generate microenvironment conducive to the initiation of lesions in the vulva and perianal areas and ultimately cervical cancer. All these added to the impacts of E. vermicularis which include varying intensities of itching and scratching the area around the anus, can complicate to hair follicle inflammation (Cook and Zumla, 2009; Burkhart and Burkhart, 2005). This implied that someone who has S. haematobium and E. vermicularis coinfection is bound to experience these impacts. It will be very devastating. Therefore, there is need for urgent public health intervention and awareness creation to enlighten the students on health and sex education.

In this study, 2% prevalence of Enterobius vermicularis was recorded among female students within 15-20years age group. In humans, presence of E. vermicularis ova in female genital tract occur rarely (Khurana et al., 2018).

The present study is one of the rare cases where Enterobuis vermicularis ova was observed in urine samples of infected students. A 2% prevalence of Enterobius vermicularis recorded among the female students may have resulted from urinary tract infection with T. vaginalis and S. haematobium, also reported by Khurana et al. (2018). It may have equally resulted from the students eating improperly washed fruits and vegetables contaminated with geohelminth parasites including Enterobius vermicularis (Elom et al. 2012). The low prevalence infection of Enterobuis vermicularis observed in this study was attributed to age range of the sampled students. Adolescents and young adults of between 15-20 years were assumed more conscious of personal and environmental hygiene. The occurrence of E. vermicularis ova only among the female subjects in this study is in line with the observation of Khurana et al. (2018) that rectovaginal/urinary tract contamination is anatomically more probable in female gender.

A 20% prevalence of Ascaris. lumbricoides recorded in this study was high. It indicated high load of parasites among the students. It was attributed to unsanitary environment probably contaminated by eggs of Ascaris lumbricoides. Occurrence of A. lumbricoides at 20% in the present study was similar to 20.0% observed by Alo et al. (2013) from the Fingers of School Children in Ohaozara, Ebonyi State. It was less than 46% recorded by Owaka et al. (2016) from Survey of Intestinal Helminth Infection amongst School Children in Rural Communities of Ebonyi State and 79% reported by Ugbogu and Asogu (2013) among schoolchildren in Unwana Community Afikpo, Ebonyi State, respectively. The 20% prevalence was however higher than 8% recorded by Ani and Akamnonu (2009) among Primary School Children in Ntezi Area of Ebonyi State, Nigeria. Though there were variations in the percentage occurrences, they all pointed at confirmation that A. lumbricoides infection was prevalent among the sampled students. It equally confirmed unsanitary environment, because these students may have been infected through eating contaminated food and improperly washed fruits and vegetables contaminated by these parasites.
In this study, 6% (12n) infection with Taenia sp. was recorded. The source of infection may be linked to the unclean condition of their water and food sources, which may possibly be contaminated by Taenia eggs/segments. Borehole and well water appear to be the major sources of water in Okpoto community including Evangel University, for both drinking and domestic uses. The students may have been infected by the Taenia sp. through this contaminated water, food and fruits (Odikamnoro et al. 2016; Nwidembia et al. 2016). It confirmed that both personal and environmental sanitation of the students need to be improved upon, and public health intervention is needed to improve on the environmental quality.

The present study recorded 4% occurrence of Entermoeba histolytica among the sampled population. It was lower than 55% reported by Ugbogu and Asogu (2013) amongst School Children in Unwana Community, Afikpo, Ebonyi State, 5.1% recorded by Anosike et al. (2004) among nomadic fulanis of southeastern Nigeria. It was equally lower than 10.5% reported by Odo et al (2016) among School Children in UzoUwani Local Governemnt Area of Enugu State. It is an indication of prevalent of Entamoeba histolytica among the sampled students. Entamoeba histolytica is one of the most significant enteric pathogens worldwide (Shirley et al. 2018), which infection is promoted by poor sanitary condition. It is contacted through drinking contaminated water, eating contaminated foods, especially fecal contaminated food, association with food handlers whose hands are contaminated and oral-anal sexual practices (Davis, 2019). It was earlier stated that there is still abundance of open/bush defecation

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practice among rural dwellers, who lived in scattered settlements close to Evangel University. They cultivate on the same farm, and raw foods items for students' consumption are bought from their local markets. The subjects may have contacted the parasite by eating foods and vegetables inadequately washed and unhygienically prepared by the caterers. However, the 4% prevalence recorded in this study is a good, improved reduction over the past years, may be due to improvement on awareness creation and enlightenment programmes on importance of personal and environmental cleanliness.

In this study, 2% prevalence of Faciola species (larva) was recorded among the sampled students. Fascioliasis is caused by two species (Fasciola hepatica and F. gigantica) of parasitic flatworms or trematodes that mainly affect the liver. It belongs to the group of foodborne trematode infections and is a zoonosis, meaning an animal infection that may be transmitted to humans. They are leaf-shaped worms, large enough to be visible to the naked eye. The disease they both cause is similar. This was linked to students' consumption of improperly washed vegetables especially salad vegetables (lettuce, cabbage) sold in the indigenous market of Okpoto, on which Faciola laevae may have attached (https:/www.who.int/foodborne_trematode_infections/fascioliasis/en/; WHO, 2014) .The present study also recorded 2% ocurrence of Strongyloides stercoralis among the sample students. A 2% prevalence of Strongyloides stercoralis observed in the present study was lower than 4.2% respectively reported by Anosike et al. (2004) among nomadic fulanis of southeastern Nigeria and Auta et al., (2013) among Primary School Children in Gwagwada Kaduna, northwestern Nigeria. The low percentage prevalence recorded in this study show a reduction in prevalence rate, hence improvement in sanitation and method of human waste disposal. It was also attributed to the knowledge, by the subjects, of the danger of walking barefooted and so avoided the habit strictly.

Giardia lamblia is a protozoan intestinal parasite also known as Giardia intestinalis and G. duodenalis. In the present study, 4(2.3%) out of 176 female students sampled for urogenital parasites, had Giardia lamblia infection (Fig. 4). To the best of the authors' knowledge, there was no single literature that has reported occurrence of Giardia cyst or trophozoite in urine samples before the present study. Consequently, paucity of literature exists on occurrence of Giardia lamblia in urine samples. So the authors lack material to compare the present observation.

The authors suggest that urogenital infection of the subjects by Giardia lamblia may have resulted from their practicing oral-genital sexual activity - anilingus (licking or kissing of the anus to produce sexual stimulation) or fellatio (oral stimulation of penis). Anal intercourse especially by homosexual students is also incriminated. Already reported in this study was that 36 of the 176(20.5%) females student had infection with Trichomonas vaginalis and T. vaginalis infection is usually associated with active sexual behaviour. Such sexual behaviour goes with sexual plays, as mentioned above, and can most likely introduce intestinal protozoa into the vaginal orifice. Among a population where personal hygiene is low as observe among the students, intestinal protozoa parasites introduced into vaginal orifice can be collected in urine samples.

Public health importance of purified food, clean social and physical environment cannot be overemphasized. Further studies are recommended to determine whether anilingus or fellatio and other sexual play were responsible for the presence of Giardia lamblia in urine sample of the students. In addition, ascertain whether students at the University practice homosexuality.

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