PREVALENCE OF OPPORTUNISTIC PARASITIC INFECTIONS IN IMMUNOCOMPROMISED PATIENTS ATTENDING BAYARA GENERAL HOSPITAL, BAUCHI.

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Abstract

One of the major health problems among immunocompromised patients are opportunistic infections due to the deficient immunity. Furthermore, intestinal opportunistic parasitic infections, which are also one of the basic health problems in tropical regions, are common in these patients. Infection by opportunistic pathogens, including various forms of intestinal opportunistic parasites has been the major problem of HIV since the beginning of the epidemic. This work aimed to study the Prevalence of Opportunistic Parasitic Infections in Immunocompromised Patients Attending Bayara General Hospital, Bauchi. Patient stool specimens were examined as fresh wet mounts, formal-ether concentration technique and modified Ziehl-Neelsen staining technique. Data was obtained from 200 study patients selected by convenience sampling method. The overall prevalence of opportunistic parasitic infections was found to be 23(11.5%). Four types of intestinal opportunistic parasites were identified, the most dominant being Cryptospridium parvum 11(5.5%), Isospora belli 9(4.5%), Cyclospora cayetanensis 2(1%) and Microsporidium (Septata intestinalis) 1(0.5%). The study indicated the higher prevalence in patients with <200 CD4+ count. The research also found that socioeconomic conditions such as educational background had significant relationship with the parasitic infections. Use of portable drinking, observance of good sanitation and hygiene were also recorded in the study area. Severe Infections recorded during the study were 234.8 degree, lights infections, 93.9 degrees and moderate infections were only 31.3degrees.

Key word: *HIV/AID, Severe infection, Immuno-compromised, Opportunistic infections, public Health.*

Introduction.

Opportunistic parasites probably play a major role in causing chronic diarrhea accompanied by weight loss in people living with Human Immunodeficiency Syndrome/Acquired immunodeficiency Syndrome (HIV/AIDS) [17]. The incidence and prevalence of infections with a particular enteric parasite in HIV/AIDS patients is likely to depend upon the endemicity of that particular parasite in the community [27]. One of the major debilitating conditions associated with severe immune suppression is diarrhea caused by several intestinal parasites, loose, watery stools, bowel movements, sometimes with unusual colours occurring more than three times in one day is a common problem associated with parasitic infestation [8].

Gastrointestinal infections are very common in patients with HIV infection or AIDS and diarrhea is common clinical presentation of these infections [18and 26]. Reports indicate that diarrhea occurs in 30-60% of AIDS patients in developed countries and in about 90% of AIDS patients in developing countries [12]. The etiologic spectrum of enteric pathogens causing diarrhea includes bacteria, parasites, fungi and viruses [29]. The presence of opportunistic parasites such as *Cryptosporidium parvum, Cyclospora cayetanensis, Isospora belli and Microsporidia* are documented in patients with aids [45].

Parasitic infections are the hallmark of HIV disease especially in the rural and resource poor communities of Nigeria, and these pose serious public health threat as previously reported by several authors who presented varying prevalence rates depending on their geographical locations and nature of their surveys [*8* and 34]. Implicated gastrointestinal protozoan parasites in diarrheal condition includes: *Cryptosporidium parvum, Isospora belli, Microsporidia species, Giardia intestinalis, Entamoeba histolytica*, *Cyclospora* species, others include nematodes such as *Strongyloides stercoralis*, presenting clinical conditions associated with diarrhoea include weight loss, iron deficiency anaemia [11].

There is a dearth of information on the prevalence of gastrointestinal (opportunistic parasitic infections) among HIV-positive patients in Bauchi metropolis. In spite of the daily increasing incidence of gastrointestinal disorders in the metropolis, little or no studies have been carried out to correlate the emerging incidence of these life threatening infestations (with parasitic pathogens) therefore, comprehensive

study is required to determine the prevalence of opportunistic parasitic infections in immune compromised patients attending Bayara General Hospital, Bauchi.
The findings of this work would serve as reference data to health personnel in the community studied, it will also help to provide HIV/AIDs management agencies such as National Agency for the Control of HIV/AIDS, BACATMA and Bauchi state Hospital Management Board to monitor the progress of their project related to HIV/AIDS and also researchers in the same field will find this work useful to their researches.

Materials and methods

The Study Area, Bauchi state is located between latitude 9°3′ and 12°3′ N, and 8°5′ and 11° E, with a total area of 549,200 km^2. The state is dry and hot in the north, while the southern part is milder. The rainfall starts in April to October in the southern part, while in the extreme north rains start from late June to September. The state shares boundaries with seven states namely; Kano and Jigawa to the North, Taraba, and Plateau to the South, Gombe and Yobe to the East and Kaduna to the West.
The Bayara General Hospital is the centre for HIV/AIDS, TB, and leprosy and malaria management under Bauchi State Agency for the Control of Aids, TB, Leprosy, and Malaria **(BACATMA)** with a referral status and also serves as medical centre for the local communities of Bayara and Its environs. The inhabitants of these communities are mostly farmers, students and civil servant with very minimal income per capita. Patients between 5 to 70 years are attending the clinic for HIV Voluntary Testing and Counselling (VTC), Antiretroviral Therapy (ART) as well as others on routine medical check or treatment.

Study Design

The study was a cross sectional study of patients attending Bayara HIV/AIDS referral centre in Bauchi metropolis. The participants who were screened for HIV antibodies to HIV 1 and 2 by abridged enzyme linked immunosorbent assay (ELISA) using commercially available abridged ELISA kits.

Sample Size

The sample size was determined according to the formula of (Thrusfield, 2005) by using 95% level of confidence and expected prevalence was 42.9% from previous study of (Udeh et *al.*,

2016) and desired absolute precision of 5%. A sample size of 200 samples was arrived.
Note: 8 faecal samples were added to avoid sampling error. Therefore, Two hundred samples were collected.

Ethical Consent

Verbal informed consent was elicited from the volunteer participants or their guardians to whom the nature and significance of the study was explained before inclusion in the study. The study was also carried out according to the guidelines of School of Post Graduate Studies, Faculty of Science, Biological science Department, ATBU Bauchi. And the International Guidelines for Human Experimentation in Clinical Research, as well as the ethical board of the hospital.

Sampling Procedure

Stool samples were collected from the aforementioned population living with HIV/AIDS and participation was voluntary, simple random sampling techniques was employed to collect the samples from the participating population and bio-data such as age, gender, educational level, occupation, marital status etcetera, were collected from their hospital records following history taking, oral interview and questionnaire sessions.
A pre-designed structured questionnaire was employed in collecting the socio-demographic characteristics of the subjects such as occupation, marital, educational status, source of drinking water, waste disposal, hands washing before and after meal, washing of vegetables before eating, awareness level on parasitic infection etc.

Stool collection

Fresh faecal samples were collected from participants in sterile open-mouthed universal containers as early as 8:00-10:00am weekly for the period of six month when the patients were attending the Hospital and was analysed within 24h of collection.

Macroscopic examination

Preliminary macroscopic examination of samples were carried out to determine the colour, consistency (water content) as watery, loose, and soft or formed and then categorized as either diarrheic or nondiarrheic. And/or texture as well as presence of blood, mucus, pus and worms in stool, sample.

Saline and iodine wet mount

Stool samples was examined each for the presence of trophozoites, cysts, oocysts, larvae and ova of intestinal parasites using normal saline and lugol s iodine smear. With a wax pencil, patient's number and date were wrote at the left hand end of the slide, a drop of saline was dropped in the centre of the left half of the slide and iodine solution in the centre of the right half of the slide. With an applicator stick, 1gram of the specimen was mixed with the drop of saline. Similarly, 1gram of the stool was mixed with the drop of iodine. The drop of saline and the drop of iodine were a covered with slip. The slide was mounted on the microscope stage and focused with the x10 or low-power objective, the entire cover slip area was examined with the x10 objective systematically backwards and forwards, up and down. When organisms were suspected, the objective and the light were increased by opening the sub-stage diaphragm, the detailed morphology was observed. [3].

Formol-ether concentration technique

The rapid formal-ether concentration technique which involves the removal of large debris as well as the concentration of wide range of parasite with minimum damage to their morphology was used to detect cysts, oocysts and ova. Further concentration and extraction of parasites was carried out using modified zeihl - neelsen technique.

A gram of stool sample was emulsified with 4ml of 10% formal saline in the test tube. The mixture was filtered in to a test tube using a cloth gauge and 3-4ml of diethyl ether was added and mixed vigorously and allowed to stand for two minutes. The mixture was then centrifuged at 1000 revolution per minutes (1000rpm) for 3 minutes. Using a glass rod, the feacal debris from the side of the test tube was loosed and the tube was inverted to pour off the supernatant. The tube was returned to its original upright position and the fluid from the side of the test tube allowed draining to the bottom. The deposits were mixed by tapping the tube with the finger and using a Pasteur pipette. A drop of sediment was applied on microscope slide, covered with a cover slip and examined under the microscope using x10 and x40 objectives [7].

Modified zeihl - neelsen technique

A thin feacal smear was made and left to air dry and fix in methanol for 2-3 minutes. Further fixation in formalin vapour was performed, to reduce infectivity and smear was stain with cold carbonfuchsin for 5-10 minutes, and then differentiated in to

1% hydrocholoric acid-ethernol until color ceases to flood out. It was also rinse in tap-water, counter stained with 0.25% malachite green (or methylene blue) for 30 seconds and rinsed in tap-water. Blotted and drained dried and then examined using the high-power, dry objective and the morphology was confirmed using oil immersion [7].

Parasitic Count/Load (Stoll's Ova counting technique)

The above mentioned technique was used to determine the total Egg per Gram of faeces (EPG) as described by [43]. The technique was carried out by mixing the faecal sample; 3 grams of faeces were weighed with the help of a balance and put in 100 ml graduated beaker. The beaker was then filled with water up to 42 ml marked and the faeces were thoroughly mixed with water by magnetic stirrer. The mixture was then stained with a coffee strainer. The stained mixture was again shaken and 0.15ml of mixture was taken with a 1 ml special pipette and put on a glass slide and covered with a cover slide. Care was taken to avoid bubble formation. The slide was then placed under a microscope and the cysts were identified and counted. The total number of cysts of parasites found in the slide were multiplied by 100 to get the cysts per gram of faeces (EPG).

Identification of Parasite

The organisms observed were identified based on the morphological characteristics using standard keys [55].

Data Analysis

The variation in the study was analysed by using chi-square test [64]. At $p = 0.05$, while available results of the laboratory tests were presented as frequency and percentage.

Results

Occurrence of Opportunistic Parasites Identified in at Bayara General Hospital.

200 feacal samples of people living with HIV/AIDS examined at Bayara hospital, 23(11.5%) were positive for various opportunistic parasite Oocyst/Spores. Four (4) opportunistic parasites were observed which included *Cryptospridium parvum* 11(5.5%), *Isospora belli* 9(4.5*%), Cyclospora cayetanensis* 2(1%) *and* Microsporidium *(Septata intestinalis)* 1(0.5%). The occurrence of identified opportunistic parasites

showed that *Cryptosporidium parvum* had the highest prevalence and microspridium, *Septata intestinalis* present the lowest occurrence.

Table 1: Occurrence of Opportunistic Parasites Identified at Bayara General Hospital Bauchi.

parasites Identified	***No. examined***	***No. Infected***	***Prevalence (%)***
Cryptosporidium parvum		11	5.5
Isospora belli		9	4.5
Cyclospora cayetanencsis		2	1
Microsporidia(Septata intestinalis		1	0.5
TOTAL	**200**	**23**	**11.5**

Prevalence of Opportunistic Parasite Infections According to CD4 Count of the Patients.

Based on the CD4+ count of the patients, the prevalence were found to be higher in the patients with less than <200 CD4+ count of 19(65.5%) out of 23 infections recorded, followed by the patients with 201-400, 401-600 while, patients with >600 CD4+ count presented the lowest infections at 1(1.9%). Patients with <200 CD4S+ count also showed high prevalence of *Cryptospridium parvum* with 9(31%) out of 11 and *Isospora belli* 7(27%), the table also showed that both *Cyclospora cayetanencsis* and *Microsporidia, Septata intestinalis,* were absent in the patients with more than >200 CD4+ count. Difference in CD4+ count was tested using chisquare, P=0.015 was significance and therefore, concluded that the level of opportunistic parasitic infections decrease with the increase of CD4+ count in the study area.

Table 2: Prevalence of Opportunistic parasite Infections According to CD4+ count cells/ml of the Patients at Bayara General Hospital, Bauchi.

CD4+ cell/ml	***No. examined***	***No. infected (%)***	**C. parvum No. (%)**	**I. belli No. (%)**	**C. cayetanensis No. (%)**	**S. intestinalis No. (%)**
<200	29	19(65.5)	9(47.4)	7(36.8)	2(10.5)	1(5.5)
201-400	35	2(5.7)	1(50)	1(50)		

401-600	82	1(1.2)		1(100)		
>600	54	1(1.9)	1(100)			
Total	**200**	**23(11.5)**	**11(5.5)**	**9(4.5)**	**2(1)**	**1(0.5)**

Gender Distribution of Opportunistic Parasitic Infections at Bayara Gen. Hospital, Bauchi.

In terms of Gender of the patients examined as in (table 3) below, the male patients harbored 14(14.9%) out 23 recorded infections which is the higher than that those of the females 9(8.5%). Within the gender also *Cryptosporidium parvum* showed high occurrence in both male and female patients with 6(6.4%) and 5(4.7%) respectively followed by *I. belli* 5(5.3%) and 4(3.8%) with no occurrence of both *Cyclospora cayetanensis* and *Microsporidium(S. intestinalis*). p<0.05 was not significance p=0.45 therefore, Gender did not affect infection with opportunistic parasites in HIV/AIDS patients in the study area.

Table 3: Gender Distribution of Opportunistic Parasitic Infections among HIV/AIDS Patients.

Gender	***No. examined***	***No. (%) infected***	**C. parvum No. (%)**	**I. belli No. (%)**	**C. cayetanensis No. (%)**	**S. intestinalis No. (%)**
Male	94	14(14.9)	6(42.9)	5(35.7)	2(14.3)	1(7.1)
Female	106	9(8.5)	5(55.6)	4(44.4)		
Total	**200**	**23(11.5)**	**11(5.5)**	**9(4.5)**	**2(1)**	**1(0.5)**

Prevalence of Opportunistic Parasitic Infections According to Patient's Source of Drinking Water at Bayara General Hospital, Bauchi.

In terms of the patients drinking water source most of the patients used, packaged water 101(50.5%) and only 1 patient got his drinking water from the stream and showed 1(100%) infections. The least infection was recorded in those using

packaged water 7(6.9%). In testing the difference among the patients using chi square p=0.025 and p<0.05 was therefore significant, meaning that infection with opportunistic parasites in the study area was related with drinking water source of the patients.

Table 4: Prevalence of Opportunistic Parasitic Infections in Relation to Patients Source of Drinking Water in the Study Area.

Source of Drinking water	***No. examined***	***No. (%) Infected***	**C. parvum No. (%)**	**I. belli No. (%)**	**C. cayetanensis No. (%)**	**S. intestinalis No. (%)**
Boreholes	83	8(9.6)	5(62.5)	2(25)	1(12.5)	
Wells	15	7(46.7)	4(57.1)	3(42.9)		
Streams	01	1(100)	1(100)			
Packaged water	101	7(6.9)	3(42.9)	2(28.6)	1(14.3)	1(14.3)
Total	**200**	**23(11.5)**	**11(5.5)**	**9(4.5)**	**2(1)**	**1(0.5)**

Table 5: Prevalence of Opportunistic Parasitic Infections in Relation to Awareness on Opportunistic Parasites Infections.

Awareness on Opportunistic Parasite	***No. examined***	***No. (%) Infected***	**C. parvum No. (%)**	**I. belli No. (%)**	**C. cayetanensis No. (%)**	**S. intestinalis No. (%)**
Yes	166	15(9.0)	8(53.3)	4(26.7)	2(13.3)	1(6.7)
No	34	8(23.5)	3(37.5)	5(62.5)		
Total	**200**	**23(11.5)**	**11(5.5)**	**9(4.5)**	**2(1)**	**1(0.5)**

Table 6: Methods of Waste Disposal and Prevalence of Opportunistic Parasitic Infections.

Methods of Waste Disposal	***No. examined***	***No. (%) Infected***	**C. parvum No. (%)**	**I. belli No. (%)**	**C. cayetanensis No. (%)**	**S. intestinalis No. (%)**
Nearby house	73	14(19.2)	8(57.1)	3(21.4)	2(14.3)	1(7.1)
Disposal site	127	9(7.1)	3(33.3)	6(66.7)		
Total	**200**	**23(11.5)**	**11(5.5)**	**9(4.5)**	**2(1)**	**1(0.5)**

Intensity of Opportunistic Parasitic Infections in the Study Area.

On the intensity of the infections and among the total infections 15(234.8^0) are light infections, 6(93.9^0) are moderate infections while only 2(31.3^0) were severe infections.

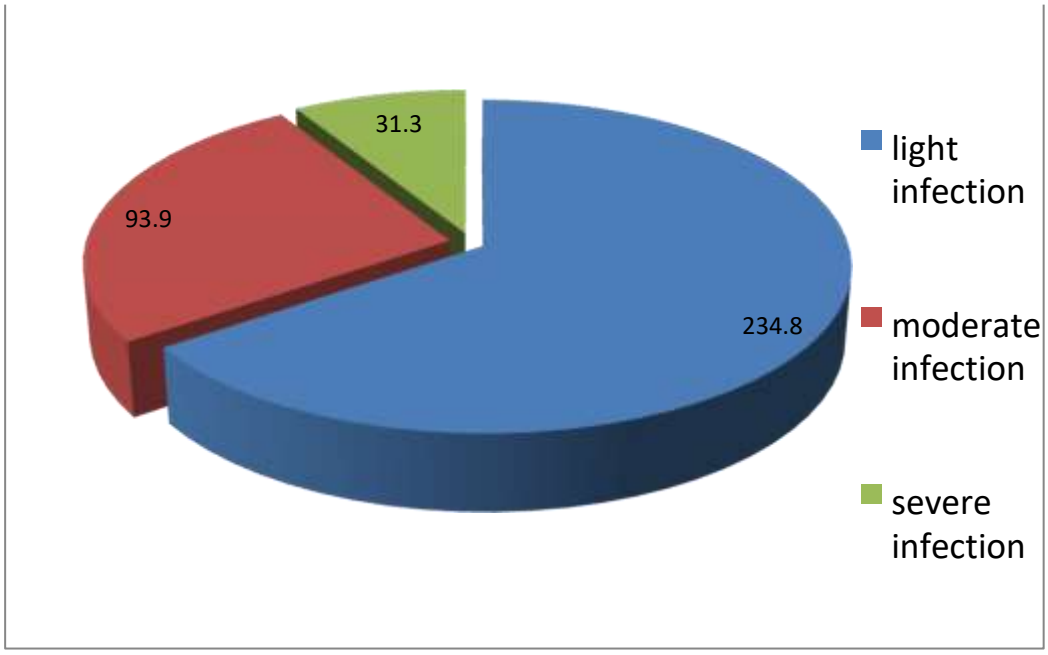

Figure 1: Pie-chart on the Intensity of Opportunistic Parasitic Infections of the Patients.

Discussion

Occurrence of Opportunistic Parasites Identified at Bayara General Hospital Bauchi.

The prevalence of 11.5% (23 out of 200) observed among HIV- infected patients in this study is not in agreement with the (90%; 45 out of 50) presented by [8], and the research agreed with 11.4% reported by an authors in Benin, [3] but lower than that reported by (30) 15.3% in Ethiopia. However, other investigators reported the prevalence of 42.9% in Abeokuta, Nigeria and 84.3% in South Africa [51 and 64]. The difference could be due to sample size traditional practice and or sanitation facilities of difference research location. Looking at the prevalence of individual species identified, *C. Parvum* presented 5.5%, the result was not in line with 21% as reported by [28] in Nigeria but higher than 2.9% reported from the patients in abuja by [51]. The low prevalence recorded in this research could be as a result of strict Voluntary Testing and Counselling (VTC) and Antiretroviral Therapy (ART) programme being observed by the hospital management in the study area.

Prevalence of Opportunistic Parasite Infections According to CD4+ Count of the Patients.

This research also revealed the prevalence of opportunistic parasites to be higher in the patients with less than <200 CD4+ counts 19(65.5%) out of 23 infections recorded while, the patients with more than >200 CD4 count presented the lower infections. Patients with <200 CD4+ counts showed high prevalence of *Cryptosporidium parvum* at the of 9(31%) and *Isospora belli* 7(27%) out of species identified during the study. The research also revealed that both *Cyclospora cayetanencies* and *Microsporidium species* (*septata intestinalis*) were absent in the patients with more than >200 CD4+ counts and statistically was not significant ($p<0.05$), meaning that there was association between increase in opportunistic parasite infections with the CD4 count of the patients, this is in consonant with the findings of [59] which state that the reduction in CD4+ counts by the HIV virus predisposes HIV-infected patients to opportunistic intestinal parasitic infections. According to [22], it was generally found that a CD4+ counts below 200cells/ml predisposes HIV- infected persons to opportunistic infections. The findings of this research was in consonance with previous findings of [33 and 21) which stated that HIV infection leads to loss of CD4+ T cells, which leaves affected individuals more susceptible to opportunistic infections, especially gastrointestinal problems which often present as diarrhoea and weight loss syndrome, which significantly enhanced progression of HIV to AIDS.

Gender Distribution of Opportunistic Parasitic Infections in the Patients Study.

According to this findings/results, male patients harbored 14(14.9%) out 23 which was the highest occurrence as compared to that of the female which presented only 9(8.5%). Within the gender also *Cryptosporidium* showed high occurrence in both male and female patients with 6(6.4%) and 5(4.7%) respectively with no occurrence of both *Cyclospora* and *Microsporridium species* were recorded in female. Using chi square also $p>0.05$. meaning that gender was not associated with opportunistic parasites infection in HIV-patients, this was not in line with the findings of research carried out in Ethiopia which declared that gender significantly affected the prevalence of intestinal parasitic infections among HIV-infected patients [30] also state that the reason for this association between gender and intestinal parasites infections was adduced to more males being exposed than females based on occupational grounds.

Educational status of the patients

Within the educational status, primary education holders present the high infection of 5(11%) out of 62 patients followed by non-formal education holders with 3(9.4%) out of 32 but in terms of individuals prevalence the research showed 7(7.4%) with *C. parvum* in the secondary educational holders and 1(3.1%) in the non-formal educated patients. At this point p-value was significant ($p<0.05$) meaning that the higher educational level of the patients the higher the risk factor in contracting opportunistic parasites in HIV, but this finding was in contrary with researches which presented high prevalence in the less educated groups. [60] Stated that "those that are also likely to have a poor educational background and to a large extent, will face poor hygiene standards. This may explain the observed high prevalence in this group" Therefore, the difference in the findings could be due to the large number of students that were attending the centre for their HIV management as the centre provided hide out to some of the patients as compare with the other hospital within the metropolis.

Prevalence of Opportunistic Parasitic Infections in Relation to Source of Drinking Water.

In terms of the patients drinking water source most of the patients used packaged water 101(50.5%) and only 1 patient got his drinking water from the stream showed 1(100%) infection, the least infection was recorded in those using packaged water 7(6.9%). On the patients daily cleaning of drinking water reservoir, 167 responded positive and only 7(4.2%) show the infections among. 33 responded negatively and

show higher prevalence 16(48.5%). On the awareness on opportunistic parasites infections 166 patients were fully enlighten as such only 15(9%) were infected but 34 patients that were not enlighten with the infection, 8(23.5%) were infected thus constituted the higher prevalence. *Cryptosporidium parvum* was also found to be the most prevalence and p-value (0.025) was found to be significant. Therefore, source of drinking water of the patients was significantly related to the infections with opportunistic parasites.this finding is also in consonant the report which suggested that the increasing incidence of intestinal parasitemia in rural and urban communities are largely due to the lack of safe, portable drinking water, poor hygienic and sanitary conditions [8].

Sanitation and Hygiene Standard and Prevalence of Opportunistic Parasitic Infections.

On the aspect of sanitation and hygiene status of the patients, With respect to washing hand before and after meal of patients 172 responded positively in which only 9(5.2%) were infected. 28 patients were not washing their hands before and after meal 14(30%) were infection.

On the patients washing vegetables before eating 12(7.9%) out of 152 of the patients were infected, 48 patients were not washing vegetables before eating and 11(22.9%) were infected. On methods of waste disposal, 73 of them were dumping their waste nearby house with the prevalence rate of 14(19.2%) while, 127 patients used disposal site for their waste disposal and these patients came up with only 9(7.1%) infections. P-value (<0.05) was significant and the finding was in line with a research presented based on the detection of oocysts in feacal samples and seroprevalence: European countries (0.1-14.1%); North America countries (0.3-4.3%); African countries (2.6-21.3%); Central and South American countries (3.2-31.5%); Asian countries (1.3-13.1%). These results are consequence of sanitation conditions, quality of food and water [13].

Intensity of Opportunistic Parasitic Infections of the Patients in the Studied Area.

On the intensity of the infections, among the patients 15(234.8 degree) were light infections, 6(93.9 degree) were moderate infections while only 2(31.3 degree) were severe infections and this finding agreed with. The prevalence (≤ 5%) of Isosporiasis which has decreased over the past few years, the prevalence of cryptosporidiosis, particularly in Thailand and Malaysia, has also decreased, (13-40%) (25). In the case of *microsporidium* as reported by (40, 9, 23, 53 and 59] that the parasitic infection has the highest prevalence (1.7-33.3%) among related

parasites. This research also contradicted one recent study which found no oocysts of Cryptosporidium spp were detected in patient stools that were on Antiretroviral Therapy (ART) [59 and 48].

Conclusion

The wide distribution of Antiretroviral Therapy (ART) dramatically decreases prevalence of opportunistic intestinal infections, even though opportunistic parasitic infections are still important problems in HIV patients. The overall prevalence of opportunistic parasitic infections was found to be 23(11.5%). Four types of intestinal opportunistic parasites were identified, the most dominant being *Cryptospridium parvum* 11(5.5%), *Isospora belli* 9(4.5%), *Cyclospora cayetanensis* 2(1%) *and Microsporidium (Septata intestinalis)* 1(0.5%). The study indicated the higher prevalence in patients with <200 CD4+ count. The research also found that socioeconomic conditions such as educational background had significant relationship with the parasitic infections. Use of portable drinking, observance of good sanitation and hygiene and effective health education were recorded in the study area. Infections recorded were 234.8 degree lights, 93.9 degrees moderate and only 31.3 degrees severe infections.

Recommendations

Based on the finding of this study the following recommendations are here by suggested.

1. Comprehensive and continuous studies on opportunistic parasites in HIV/AIDS should be put in place so as to be monitoring the level of infections in the patients; this would put them under check and curtail the menace of this life threatening infections.
2. Routine screening for opportunistic parasites should be put in place by the HIV patient's managers; this will reduce the progression of HIV to AIDS.
3. The high risk groups of HIV-patients identified in this research such as; <200 CD4 count cells/ml, male and children should be given special counseling in the cause of HIV/AIDs management.
4. Health education on parasitic infections should cut across all socioeconomic groups including educated individuals instead of considering only people at risk.
5. Portable drinking water and other sanitation facilities should be advocated as a right to all HIV-patients especially by National Aids

Control Agency (NACA) and other concerned bodies so as to curtail the transmission of the infections to HIV-patients.

6. Investigation on how to produce opportunistic parasites vaccine should be intensified so as to eradicate the parasites at all

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