**FACTORS ASSOCIATED WITH INTESTINAL PARASITIC INFECTIONS IN PARTS OF SOUTH EAST NIGERIA AMONG HIV INFECTED INDIVIDUALS**

**Abstract**

HIV-positive individuals are especially vulnerable to enteric parasitic infections and are at greater risk when infected with enteric parasite. It is a common occurrence within the population constituting a public health challenge. Behavioral and social demographic factors have made Africans to harbor the greatest burden of enteric parasite. Therefore, this study is aimed at assessing the behavioral and social demographic factors associated with parasitic infections in parts of South East Nigeria among HIV infected individuals. A cross sectional study was conducted among 535 patients from various governments tertiary health institutions with HIV referral and centre for HIV/AIDS management under President’s Emergency Plan for AIDS Relief (PEPFAR) in South East Nigeria (Abia, Anambra, Ebonyi, Enugu and Imo) from September 2018 to December 2023. These included FMC-Umuahia, NAUTH-Nnewi, FMC-Abakaliki UNTH-Enugu and FMC-Owerri. The stool and blood samples of 535 participants were examined using standard methods for parasitology and haematology according to World Health Organisdation (WHO). The prevalence of intestinal parasites was determined to be 43.2% (231) after screening 535 stool samples. *Ascaris lumbricoides* followed by hookworm emerged as the most prevalent parasites 77(33.3%) and 69 (29.9%) respectively while *S. japonicum, T.trichuria, and E. vermicularis,* each had a low prevalence of 0.9% (2 cases). Farmers followed by artisans were having more prevalence rate while professional was the least. Age group (41-50) followed by (31-40) years had the highest rate while (81-90) years had the least. Rural dwelling, poor sources of water (stream), open/field system of toilet facilities and residential status (overcrowding) pose high risk of parasitic infestation amongst the study group. High intensity of parasitic infestation had serious adverse effect on the CD4+ count and haemoglobin level of the infected individuals.

**Key CD4 count,Education, toilet type, sex, occupation**

**Introduction**

Enteric parasitic infection among HIV infected individuals could be very fatal and is attributed as a major cause of death among HIV individuals (Udeh *et al*., 2019) following complications due to loss of blood , vital nutrients, severe diarrhea, poor nutrition and loss of appetite (Fauziah *et al.,* 2022). There are a lot of factors that could be associated with enteric parasitic infections among HIV individuals. This includes

Poor hygienic practice: Poor hand washing especially after using the toilet and before eating of food, fruits and vegetables could cause the ingestion of these enteric parasites (Gemechu *et al*., 2023).

Unavailability of clean and safe drinking water and for other domestic activites could lead to infection by these parasite as most of them are ingested through contaminated water consumption (Atabati *et al*., 2020)

Low CD4+ cells: a reduction in the number of CD4+ cells below 200 cells/µl exposes the HIV infected individual to opportunistic pathogens such as enteric parasites (Almaw *et al*., 2024).

Poor sewage disposal: improper sewage disposal practices such as open defecation in farms and field, leaking sewage that is washed into water bodies leading to contaminations. And these waters are used for domestic purposes and to water the vegetables in the garden. This practice will increase the risk of ingestion of these enteric parasites through fecal –oral route (Ali *et al*., 2023)

Poor nutrition: This can weaken the immune system exposing the individuals to opportunistic infection and anaemia (Morales *et al*., 2023)., Siagian, (2023), Danish *et al.,* (2021)

Low level of education and occupation has been linked to as a predisposing factor to intestinal parasitic infection (Forson *et al*., 2018). Therefore, the aim of this work is to evaluate the factors associated with intestinal (enteric) parasitic infections in parts of South East Nigeria among HIV infected individuals.

**Materials and method**

**Study area**

This is a cross sectional study carried out in tertiary health in South East Nigeria with a referral status and center for HIV/AIDS. They are University of Nigeria Teaching Hospital (UNTH), Enugu, Federal Medical Center (FMC) -Abakaliki, Nnamdi Azikiwe University Teaching Hospital (NAUTH)- Nnewi, Federal Medical Center (FMC) - Umuahia and Federal Medical Center (FMC) - Owerri.

**Socio-demographic data**

A pre tested well-structured questionnaire was used to collect the socio-demographic data of the individuals.

**Sample collection and processing**

Freshly voided fecal sample was submitted by the participant and 5ml of venous blood in EDTA bottle collected from each participant and is properly labeled with patient identification number. It was then transported to the laboratory for processing.

Macroscopic examination of the stool sample was done in search of adult larva of enteric parasites. Consistency and colour of the stool was also noted. Microscopic examination of the stool sample was done using wet mount, concentration methods (formol ether concentration and brine floatation method), fecal culture techniques, Gram-chromotrope staining technique for Microrsporida, modified Ziehl Neelsen staining technique as described by Abayneh, 20243.

Flow cytometer was used to analyze the CD4+ T- lymphocyte estimation as described by Flynn and Gorry 5,and Haemoglobin estimation using autoanalyzer (Zybio full automation).

Ethical clearance was obtained from the Ethics Committee of University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu state, Nigeria

Data obtained was analysed using the Chi-square ( X2) , ANOVA and odd ratio analysis using the statistical software INSTAT and SPSS version 22.0. Statistical significance was set at 95% level of significance.

Table 1 presents the distribution of various parasites isolated from HIV/AIDS patients according to sex. The total number of patients surveyed is 231, with a higher percentage of females 160 (69.3%) than males 71 (30.7%). The most prevalent parasites among the patients are *Ascaris lumbricoides* 77 (33.3%) and Hookworm 69 (29.9%), with both being more common in females than in males. Other parasites such as *Entamoeba histolytica*, *Strongyloides stercoralis*, and *Giardia lamblia* showed varied distributions but are less common. The p-value of 0.34 indicates that there is no statistically significant difference in the distribution of parasites between male and female patients (p >0.05).

**TABLE 1:– GENERAL DISTRIBUTION OF PARASITES ISOLATED FROM HIV/AIDS PATIENTS ACCORDING TO SEX**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parasites** | **Male (%)** | **Female (%)** | **Total (%)** |
| Hookworm | 19 (26.8) | 50 (31.3) | 69 (29.9) |
| *Ascaris lumbricoides* | 18 (25.4) | 59 (36.9) | 77 (33.3) |
| *Entamoeba histolytica* | 8 (11.3) | 11 (6.9) | 19 (8.2) |
| *Strongyloides stercoralis* | 5 (7.0) | 12 (7.5) | 17 (7.4) |
| *Giardia lamblia* | 10 (14.1) | 14 (8.8) | 24 (10.4) |
| *Microsporida* spp | 1 (1.4) | 5 (3.1) | 6 (2.6) |
| *Cryptosporidium parvum* | 3 (4.2) | 5 (3.1) | 8 (3.5) |
| *Schistosoma japonicum* | 1 (1.4) | 1 (0.6) | 2 (0.9) |
| *Isospora belli* | 4 (5.6) | 1 (0.6) | 5 (2.2) |
| *Trichuris trichuria* | 1 (1.4) | 1 (0.6) | 2 (0.9) |
| *Enterobius vermicularis* | 1 (1.4) | 1 (0.6) | 2 (0.9) |
| ***Total*** | 71 (30.7) | 160 (69.3) | 231 (100) |

***p-value=0.34(student t-test)***

Fig 1: Provides a detailed breakdown of the distribution of parasites isolated from HIV/AIDS patients in different states in South East Nigeria by gender. Across the states shows that females are more infected than males. In Abia state male 20(8.66%) ,40(17.32%) female; Anambra male 16(6.93%), female 30(12.99%); Ebonyi male 12(5.19%), 30(12.99%) female; Enugu male 11(4.76%), female 24(10.39%) and Imo male 12(5.19%), female 36(15.58%). Abia state recorded the highest number of infected females followed by Imo state and the least is Enugu State. The highest state with male infection was Abia followed by Anambra and the least was Enugu state.

Fig 1: **DISTRIBUTION OF PARASITES ISOLATED FROM HIV/AIDS PATIENTS IN SOUTH EAST NIGERIA ACCORDING TO SEX**

Fig 2 and 3 shows the distribution of HIV/AIDS patients with parasitic infections across different occupations and habitations and table 2 by age groups. In terms of occupation, the farming group has the highest percentages 107 (73.4%) in the age ranges of 31-40 (31%), 41-50 (29%), and 51-60 (10%). For habitation, the rural group has the highest infection rates 136 (58.9%), particularly in the age ranges of 31-40 (36%), 41-50 (31%), and 21-30 (12%). The p-values for both occupation (0.0047) and habitation (0.0042) indicate statistically significant differences in the distribution of parasitic infections among the various groups (p<0.05).

**Fig 2 : DISTRIBUTION OF PARASITES ISOLATED FROM HIV/AIDS PATIENTS IN SOUTH EAST NIGERIA ACCORDING TO OCCUPATION**

**Fig 3: DISTRIBUTION OF PARASITES ISOLATED FROM HIV/AIDS PATIENTS IN SOUTH EAST NIGERIA ACCORDING TO HABITATION**

**TABLE 2 – GENERAL DISTRIBUTION OF HIV/AIDS PATIENTS WITH PARASITIC INFECTION ACCORDING TO OCCUPATION AND HABITATION**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Age group** | **0-10**  **(%)** | | **11-20**  **(%)** | | | **21-30 (%)** | | | **31-40 (%)** | | | **41-50**  **(%)** | | | **51-60**  **(%)** | | | **61-70**  **(%)** | | | **71-80 (%)** | | | **81-90 (%)** | | |
| **Occupation** |  |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |
| Farming | 2(2.4) | 0 (0) | | | 7(8.3) | | | 31(36.) | | | 29(34.) | | | 10(11.9) | | | 5 (6) | | | 0 (0) | | | 0 (0) | | |
| * Schooling | 1(3.8) | 9(34.6) | | | 7(26.) | | | 8 (30.8) | | | 1(3.8) | | | 0 (0) | | | 0 (0) | | | 0 (0) | | | 0 (0) | | |
| * Artisan | 0 (0) | 1(2.9) | | | 5(14.) | | | 10(28.) | | | 11(31.) | | | 4 (11.4) | | | 4(11.) | | | 0 (0) | | | 0 (0) | | |
| * Trading | 0 (0) | 0 (0) | | | 1(3.6) | | | 9 (32.1) | | | 12(42.) | | | 5 (17.9) | | | 1(3.6) | | | 0 (0) | | | 0 (0) | | |
| * Professional | 0 (0) | 0 (0) | | | 0 (0) | | | 3 (27.3) | | | 4 (36.4) | | | 3 (27.3) | | | 1(9.1) | | | 0 (0) | | | 0 (0) | | |
|  | ***Pvalue=0.0047*** | | |
|  |  | | |
| **Habitation** |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |
| * Urban | 0 (0) | | | 0 (0) | | | 1(3.6) | | | 10(35.) | | | 11(39.) | | | 5 (17.9) | | | 1(3.6) | | | 0 (0) | | | 0 (0) | | |
| * Semi-urban | 0 (0) | | | 2(4.1) | | | 7(14.) | | | 15(30.) | | | 15(30.) | | | 8 (16.3) | | | 2(4.1) | | | 0 (0) | | | 0 (0) | | |
| * Rural | 2(1.9) | | | 8(7.5) | | | 12(1) | | | 36 (34) | | | 31(29.) | | | 9(8.5) | | | 8(7.5) | | | 0 (0) | | | 0 (0) | | |
|  | ***pvalue=0.0042*** | | |

Table 3. Show the distribution of parasitic egg burdens across different CD4 count ranges for HIV/AIDS patients. The data is organized into CD4 count brackets ranging from 0-200 to 1101-1200, with the corresponding percentages indicating the proportion of patients with specific egg burdens within these ranges. Patients with lower CD4 counts (100-500) exhibit higher percentages of egg burdens, suggesting that a weaker immune system is correlated with a higher load of parasitic eggs. For instance, patients in the 801-900 CD4 count range have a 66.7% egg burden, which significantly increases to 100% in the 1001-1100 range, indicating severe parasitic infections as the immune system further weakens.

Conversely, as CD4 counts increase, the percentage of parasitic egg burden generally decreases, indicating better immune responses capable of controlling parasitic infections. The highest CD4 count ranges (2600-4000) show minimal to no egg burden. The statistical analysis confirms the significance of these observations with a p-value of 0.0005 in the ANOVA test, strongly suggesting that differences in parasitic egg burdens across CD4 counts is statistically significant (p<0.05).

**TABLE 3: PARASITIC EGG BURDEN DISTRIBUTION BY CD4 COUNT**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CD4 Count** | **0-200**  **(%)** | **210 300**  **(%)** | **301-400**  **(%)** | **401-500**  **(%)** | **501-600**  **(%)** | **601-700**  **(%)** | **701-800**  **(%)** | **801-900**  **(%)** | **901-1000**  **(%)** | **1001-1100**  **(%)** | **1101-1200**  **(%)** |
| 100-500 | 2 (3.4) | 3 (6.1) | 6 (15.8) | 4 (21.1) | 3 (15) | 5 (23.8) | 3 (33.3) | 2(66.7) | 2(33.3) | 1(100) | 3 (50) |
| 600 1000 | 3 (5.1) | 3 (6.1) | 11(28.9) | 5 (26.3) | 1 (5) | 4 (19) | 0 (0) | 0 (0) | 1(16.7) | 0 (0) | 1(16.7) |
| 1100-1500 | 13 (22) | 22(44) | 9 (23.7) | 4 (21.1) | 7 (35) | 7 (33.3) | 2 (22.2) | 1(33.3) | 2(33.3) | 0 (0) | 1(16.7) |
| 1600-2000 | 17(28) | 8(16.3) | 9 (23.7) | 5 (26.3) | 6 (30) | 3 (14.3) | 3 (33.3) | 0 (0) | 0 (0) | 0 (0) | 1(16.7) |
| 2100-2500 | 14(23.7) | 12(24.) | 2 (5.3) | 1 (5.3) | 3 (15) | 2 (9.5) | 1 (11.1) | 0 (0) | 1(16.7) | 0 (0) | 0 (0) |
| 2600-3000 | 6 (10.2) | 1 (2) | 1 (2.6) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| 3100-3500 | 3 (5.1) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| 3600-4000 | 1 (1.7) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| **Total** | **59 (100)** | **49 (100)** | **38 (100)** | **19 (100)** | **20 (100)** | **21 (100)** | **9 (100)** | **3 (100)** | **6 (100)** | **1(100)** | **6 (100)** |

***p-value=0.0005(ANOVA)***

Table 4: Explores the distribution of parasitic egg burdens among HIV/AIDS patients relative to varying levels of hemoglobin (Hb), a critical measure of blood health, across several defined ranges from 3 to over 20.9 g/dL. The table categorizes patients into Hb level groups and correlates these with the intensity of their parasitic egg burdens, expressed in percentages within specific egg burden ranges (100-4000). A notable trend observed is the concentration of higher egg burdens within intermediate Hb levels, particularly in the 9-11.9% and 12-14.9% Hb ranges, where parasitic egg burdens are most prevalent. For instance, patients with Hb levels between 9-11.9% and 12-14.9% display significant percentages of egg burdens.

As Hb levels increase, moving into the higher brackets (15-17.9% and 18-20.9%), there is a notable decrease in egg burden percentages, except for a 100% occurrence in the highest Hb level (18-20.9%) within the 600-1000 egg burden range. Conversely, very low and very high Hb levels show fewer incidences of egg burdens. The statistically significant p-value of 0.0001 from the ANOVA test underscores that these variations in egg burden across different Hb levels are highly significant (p<0.05) suggesting a complex interaction between parasitic infections and patient health as reflected in Hb levels.

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**TABLE 4. – DISTRIBUTION OF EGG BURDEN ACCORDING TO HB LEVEL**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **HB LEVEL** | **3-5.9 (%)** | **6-8.9 (%)** | **9-11.9 (%)** | **12-14.9 (%)** | **15-17.9 (%)** | **18-20.9 (%)** |
| 100-500 | 0 | 0 | 19 (16.2) | 12 (15.6) | 1 (8.3) | 0 |
| 600-1000 | 0 | 0 | 15 (12.8) | 11 (14.3) | 3 (25) | 2 (100) |
| 1100-1500 | 1 (25) | 3 (15.8) | 32 (27.4) | 25 (32.5) | 6 (50) | 0 |
| 1600-2000 | 1 (25) | 4 (21.1) | 22 (18.8) | 24 (31.2) | 2 (16.7) | 0 |
| 2100-2500 | 2 (50) | 8 (42.1) | 22 (18.8) | 4 (5.2) | 0 | 0 |
| 2600-3000 | 0 | 3 (15.8) | 6 (5.1) | 0 | 0 | 0 |
| 3100-3500 | 0 | 1 (5.3) | 1 (0.9) | 0 | 0 | 0 |
| 3600-4000 | 0 | 0 | 0 | 1 (1.3) | 0 | 0 |
| **Total** | **4 (100)** | **19 (100)** | **117 (100)** | **77 (100)** | **12 (100)** | **2 (100)** |

***p-value=0.0001(ANOVA)***

Table 5- Presents the distribution of parasitic egg burdens among various age groups, highlighting how these burdens vary across different stages of life. The age groups are segmented from 0 to 90 years, and the presence of parasitic eggs is quantified within specified egg burden ranges from 100 to 4000. The highest concentrations of egg burdens are found in the middle age brackets, particularly from 21-60 years. For instance, individuals aged 31-40 and 41-50 show significantly higher percentages of egg burdens (24% and 27.3% respectively in the 1100-1500 range).

The table also reveals that the youngest (0-10 years) and oldest (81-90 years) age groups have very few occurrences of parasitic eggs. There is a sharp decrease in egg burdens for those above 60 years, except for a few cases in the 51-60 age brackets. The statistically significant p-value of 0.000 from the ANOVA test indicates that these variations in parasitic egg burdens across age groups are highly significant (p<0.05).

**TABLE 5 – DISTRIBUTION OF EGG BURDEN OF PARASITES FROM HIV/AIDS PATIENTS IN SOUTH EAST NIGERIA ACCORDING TO AGE GROUP**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **AGE – GROUP** | **0-10 (%)** | **1120 (%)** | **21-30 (%)** | **31-40 (%)** | **41-50 (%)** | **51-60 (%)** | **61-70 (%)** | **71-80 (%)** | **81-90 (%)** |
| 100-500 | 1 (50) | 1(10) | 3 (13) | 14(18.7) | 7 (9.1) | 3(11.1) | 3(21.4) | 0 | 0 |
| 600-1000 | 1 (50) | 0 | 2 (8.7) | 8 (10.7) | 15(19.5) | 4(14.8) | 0 | 1 (50) | 0 |
| 1100-1500 | 0 | 2(20) | 7(30.4) | 18 (24) | 21(27.3) | 12(44.4) | 6(42.9) | 0 | 1(100) |
| 1600-2000 | 0 | 3(30) | 6(26.1) | 18 (24) | 18(23.4) | 4 (14.8) | 4(28.6) | 0 | 0 |
| 2100-2500 | 0 | 3(30) | 4(17.4) | 13(17.3) | 12(15.6) | 2 (7.4) | 1 (7.1) | 1 (50) | 0 |
| 2600-3000 | 0 | 1(10) | 1 (4.3) | 3 (4) | 3 (3.9) | 1 (3.7) | 0 | 0 | 0 |
| 3100-3500 | 0 | 0 | 0 | 1 (1.3) | 1 (1.3) | 0 | 0 | 0 | 0 |
| 3600-4000 | 0 | 0 | 0 | 0 | 0 | 1 (3.7) | 0 | 0 | 0 |
| **Total** | **2** | **10** | **23** | **75** | **77** | **27** | **14** | **2** | **1** |

***p-value=0.000(ANOVA)***

Table 6- Provides an analysis of parasitic egg burdens across different ranges, segmented by gender. The distribution indicates that females generally have higher percentages of egg burden across almost all ranges compared to males. For instance, in the 100-500 range, females show a higher incidence rate of 16.3% compared to 8.5% for males. This trend continues across other burden ranges, with females consistently showing higher infection rates, particularly noticeable in the 1100-1500 range where females have a 26.3% infection rate compared to 35.2% for males. Although males show a substantial presence in the mid to high burden ranges (1100-2000), their percentages taper off sharply above the 2100-2500 range, indicating fewer high burden cases among males as compared to females. The p-value of 0.09 from the student's t-test suggests that while there is a noticeable difference in the distribution of egg burdens between genders, it is not statistically significant (p>0.05).

**TABLE 6 – GENDER DISTRIBUTION OF EGG BURDEN OF PARASITES ISOLATED FROM HIV/AIDS PATIENTS IN SOUTH EAST NIGERIA**

|  |  |  |
| --- | --- | --- |
| **GENDER** | **Male (%)** | **Female (%)** |
| 100-500 | 6 (8.4) | 26 (16.2) |
| 600-1000 | 9 (12.7) | 22 (13.7) |
| 1100-1500 | 25 (35.2) | 42 (26.2) |
| 1600-2000 | 19 (26.8) | 34 (21.2) |
| 2100-2500 | 9 (12.7) | 27 (16.9) |
| 2600-3000 | 3 (4.2) | 6 (3.8) |
| 3100-3500 | 0 (0) | 2 (1.3) |
| 3600-4000 | 0 (0) | 1 (0.6) |
| **Total** | **71 (100)** | **160 (100)** |

***p-value=0.09 (student-t-test)***

Table 7- Examines the influence of water sources, toilet facilities, and residential status on the prevalence of parasitic infections across five states in southeastern Nigeria. The data reveals significant trends in the correlation between infection rates and environmental factors. Stream water is identified as the most common source linked to high infection rates 134(58%), with the highest being in Ebonyi at 71.4%, and similarly high rates in other states such as Anambra at 60.9% and Enugu at 57.1%, Abia at 56.7% and Imo at 45.8%. Well water also contributes to infections at rate 65(28.1%), though less significantly than stream water, while tap water shows the lowest infection rates 32(13.9%) across the board. The ANOVA test returns a p-value of 0.915, indicating that there are no statistically significant differences across the states regarding water source infection rates (p>0.05), suggesting that similar environmental water-related challenges are prevalent across these regions.

The analysis of toilet facilities shows that the majority of infections are associated with field systems 141(61%), which might indicate inadequate sanitation infrastructure. Over 66.7% of infections in Abia, 69.6% in Anambra, 50% in Imo, Ebony 61% and 48% in Enugu states similarly high percentages are linked to the use of field systems, highlighting a major public health challenge. Water systems and pit latrines show lower infection rates 56(24.2%) and 34(14.7%) respectively, with water systems reaching up to 40% in Enugu. The statistical analysis produces a p-value of 0.942 from the ANOVA, confirming that these differences are not statistically significant across the states (p>0.05).

Lastly, the impact of residential status on parasitic infection rates is considered. People living in one-room and two-room setups tend to have higher infection rates 83(39.9%) and 69(29.9%), For instance, one-room accommodations in Ebonyi show a 47.6% infection rate. Flats and duplexes/bungalows have consistently lower rates 47(20.3%) and 32(13.9%) respectively. The p-value of 0.532 from the ANOVA indicates no significant statistical differences (p>0.05) across different types of residences.

**TABLE 7 – POSITIVE CASES OF PARASITIC INFECTION ACCORDING TO WATER SOURCE, TOILET FACILITES AND RESIDENTIAL STATUS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Abia** | **Anambra** | **Ebonyi** | **Enugu** | **Imo** |
| **Source of water** |  |  |  |  |  |
| Stream | 34 (56.7) | 28 (60.9) | 30 (71.4) | 20 (57.1) | 22 (45.8) |
| Well water | 20 (33.3) | 11 (23.9) | 8 (19) | 10 (28.6) | 16 (33.3) |
| Tap water | 6 (60) | 7 (15.2) | 4 (9.5) | 5 (14.3) | 10 (20.8) |
| ***p-value=0.915(ANOVA)*** | | | | | |
| **Toilet facilities** |  |  |  |  |  |
| Water system | 12 (20) | 8 (17.4) | 6 (14.3) | 14 (40) | 16 (33.3) |
| Pit latrine | 8 (13.3) | 6 (13) | 8 (19) | 4 (11.4) | 8 (16.7) |
| Field system | 40 (66.7) | 32 (69.6) | 28 (66.7) | 17 (48.6) | 24 (50) |
| ***p-value=0.942 (ANOVA)*** | | | | | |
| **Residential status** |  |  |  |  |  |
| One room | 20 (33.3) | 13 (28.3) | 20 (47.6) | 14 (40) | 16 (33.3) |
| Two rooms | 15 (25) | 18 (39.1) | 10 (23.8) | 12 (34.3) | 14 (29.2) |
| Flat | 15 (25) | 8 (17.4) | 8 (19) | 6 (17.1) | 10 (20.8) |
| Duplex/Bungalow | 10 (16.7) | 7 (15.2) | 4 (9.5) | 3 (8.6) | 8 (16.7) |
| ***p-value=0.532(ANOVA)*** | | | | | |

**DISCUSSION**

Variations in the prevalence of parasitic infection between sexes in the locality were determined. In Abia State, the males had a rate 20(33.3%) while the female had a rate 16 (66.7%); in Anambra state the males had a prevalence rate 16 (34.8%) while the female had a higher rate (65.2%); in Ebonyi state the males had a rate 12 (28.6%) and females had a higher rate of 30 (71.4%); in Enugu State the males had a rate 11 (31.4%) and females had a higher rate 24 (68.6%) while in Imo state the males had a rate 12 (25%) and females had a higher rate 36 (75%). The overall view indicated that there was more infected females 160 (69.3%) than the males 71 (30.7%) but statistically was not significant (P>0.05).There were more infected females 160 (69.3%) than males 71 (30.7%) though statistically not significant (p>0.05). This is in agreement with the work of Udeh *et al.*, (2019) in Benue State, which recorded that females were more infected than males and in disparity the work of Hotez*, (*2014) in United States where overall prevalence and intensity were more in males than in females due to males are more exposed to environment conducive and parasitic vectors in agricultural settings. The finding of more females than males being infected is exposure frequency because females are more engaged in agricultural activities, house work and rural dwelling.

The result of investigation based on age distribution of egg burden indicated that age groups in middle age brackets (21-60) with individuals aged 31-40 (32.5%) and 41-50 (33.3%) showed a statistically significant prevalence and percentage egg burden (p<0.05). This suggests that the differences in parasite distribution among the age groups are highly significant and could be influenced by factors such as immune system variability, exposure risks, and social or environmental conditions unique to specific age groups. It could also be due to subjects at these age groups were mainly high school children and youths who may be active and adventurous in life and so were involved in activities that necessitated transmission of the infections. Also they may come from poor rural home and filthy environment such as their schools surrounded by bushes and villagers defecating around the premises where people go about playing barefooted thereby coming in contact with contaminated soil which predisposes infection. This is in agreement with work of Mbiandou *et al.*, (2019).

The research equally demonstrated that there was significant relationship (P<0.05) between the parasites and the occupation of the subjects. Farming had the highest prevalence 107(73.4%) peaking in the middle age group 21-60 (50-60%) followed by schooling 29(12.6%) affecting primarily younger age group (11-20) with artisan 43(18.6%), trading 37(16%) and professionals 15(6.5%) exhibited varied rates. This could be to the fact that farmers often come in contact with contaminated soil. This is in comparison with the work of Amo *et al.,* (2018), and in disparity from the work of Dibua *et al.*, (2013) which recorded high prevalence among participants who are traders and drivers.

This study revealed that environmental factors such as habitation pattern, rural dwellers had the highest prevalence rate 136 (58.9%), semi urban 60 (26%) and urban dwellings had 35 (15.2%); sources of water indicated that stream had the highest prevalence 134 (58%), well water 65 (28.1%) and tap water 32 (13.9%); toilet facilities indicated that field system had the highest prevalence 141 (61%), water system 56 (24.2%) and pit latrine 36 (15.6%) and residential statues indicated that people living in one room apartment had highest prevalence rate 83 (39.9%), 2 rooms apartment 69 (29.9%), flat 47 (20.3%) and duplex/ bungalow 32 (13.9%) among the participants statistically significant (p<0.05) affected the prevalence of the parasitic infections, though with residential status statistically not significant (P> 0.05). The risk factors for this prevalence may include ignorance/illiteracy, poor sources of water, poor sanitary measures and unhygienic life style (indiscriminate disposal of matter). This agrees within work of Dibua *et al.*, (2013) and Akinbo *et al.,* (2013). The significance of these factors emphasizes the need for public health interventions that address both occupational and environmental risk factors to reduce the burden of parasitic infections in these communities.

The effect of parasitic egg burden count across different CD4+ count ranges and haemoglobin (Hb) estimation ranges were demonstrated. The result indicated that there is a statistically significant relationship between CD4+ counts (200cell/cm3) and anaemia (p<0.05). Concentration of egg burden count is high in decrease CD4+ count ranges and haemoglobin ranges; and decreases as the CD4+ count ranges increases. Thus the values of these parameters drop in proportion to the intensity of the infection. It was observed from the study, that in chronic moderate or heavy infection, there were remarkable loss of blood and depletion of the immune system resulting in marked degree of low level of CD4+ count and haemoglobin level which brings about fatigue loss of appetite, weight loss, gastrointestinal disorder, cough, pica, facial and peripherial edema, anaemia and other pathogenic features. It was also observed from the study the higher the intensity of egg burden and duration the more degenerating these parameters are in the positive subjects. This result of the investigation goes in agreement with the works of Abarver *et al.*, (2011), Akinbo *et al., (*2011), (Nissapatorn and Sawangjaroen, 2011) and Amo *et al.*, (2018), which reported that there is often a correlation between parasite intensity and reduction in haemoglobin level and CD4+ count.

**CONCLUSION**

The study suggests that poverty, poor personal hygiene and inadequate sanitation, traditional farming methods, bare-footed, use of infected excreta as fertilizers for agricultural purposes, lack of health education, poor environmental sanitation and contact with soils are in enormous rate and so these conditions have to be greatly improved among people living in the area surveyed and is highly associated with high level of parasitic prevalence. This study has also shown that parasitic infections are very common among HIV/AIDS patients in South East Nigeria and are one of the existing identified causes that aggravate the condition of HIV/AIDS infected patients contributing to the morbidity and mortality rate.

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