Original Research Article

PREVALENCE OF INTESTINAL PARASITIC INFECTIONS AND ANAEMIA AMONG HUMAN IMMUNODEFICIENCY VIRUS (HIV) INFECTED PATIENTS IN SPECIALIST HOSPITAL YOLA, ADAMAWA STATE, NIGERIA

UNDER PEER REVIEW

ABSTRACT

Anaemia is among the usual haematologic malformations in patients with HIV and has been associated with disease advancement and poor clinical consequences. A better understanding of the causes of HIV-related anaemia may provide important entry points for improving the chronic indications of HIV-related disease. Intestinal parasitic infections and HIV/AIDS have been the major public health problems and remain a key cause of morbidity and mortality in developing countries, where HIV/AIDS cases are more centered. Almost eighty percent (80%) of AIDS patients die of AIDS related infections. Intestinal parasitic infections and HIV infections have also independently been associated with anaemia. This study was aimed at determining the prevalence of anaemia and intestinal parasitic infection among HIV infected patients attending Specialist Hospital Yola. Two hundred and twenty seven (227) fecal and blood samples were collected from HIV infected patients and examined macroscopically (for stool consistency) and microscopically for intestinal parasites. The blood samples were examined using hematology autoanalyser, Sysmex KN-21 and the data collected were analyzed using SPSS Version 25 and hi – square test was used to determine the relationship between the variables. The overall prevalence of anaemia in the study was 52.42 % which is statistically significant ($p<0.05$). In relation to sex, the males had the higher prevalence rate of 71.43% than their females Counterparts which had 46.19%, which is statistically significant ($p<0.05$) indicating that sex was a risk factor for acquiring anaemia among HIV infected patients. Based on age, the patients between the age group 0 -25 years had the highest prevalence rate 65.63% while the age group between 26 – 51 had the least prevalence rate of 49.11% indicating that age was not significantly associated with anaemia in HIV infected patients with ($p>0.05$). The prevalence of anaemia in association with intestinal parasites in this study was 94.44 % which is statistically significant. It is concluded that, there is significant prevalence of anaemia among HIV infected patients caused by intestinal parasites. It is therefore, recommended that treatment of intestinal parasites should be considered during the routine follow up of HIV infected patients to minimize HIV co-infection with intestinal parasites which impact negatively by lowering hemoglobin level of the patients.

Keywords: prevalence; Intestinal parasites; Anemia; Human Immunodeficiency Virus; infection

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1.0 Introduction

Intestinal Parasites Infection is a serious public health issue throughout the world particularly in the developing countries [1]. It is approximated that 3.5 billion persons are affected, and 450 million particularly children are ill as a result of these infections. These infections cause morbidity and mortality along with other signs like growth retardation, iron deficiency anaemia in children and other physical health difficulties [2]. Most of these infections are transmitted through soil, there route of transmission being faecal contaminated fingers or some move through skin to the intestine [3].

Several factors like poor sanitation, climatic conditions, unsafe drinking water, peoples' attitude, and lack of toilet facilities are the principal contributors to the high prevalence of intestinal parasitic infection in the tropical and subtropical countries [1]. Furthermore, lack of consciousness about the mode of transmission of parasitic infection increase the possibility of infection [4].

Parasitic infection in HIV infected patients are common in many regions and populations across Nigeria and represent a lasting public health challenge. It has long been recognized that interaction between HIV and other infective agents including parasites, influence the health status of people living with HIV/AIDS [5]. Anaemia is the reduction in oxygen carrying capacity of the red blood cell which may be due to reduced number of red blood cells, a low concentration of hemoglobin or a combination of both [6]. It is a major contributor to death among HIV infected patients in developing countries.

Anaemia occur frequently among patients seropositive for Human Immunodeficiency Virus (HIV), but its composite origin complicated its distinctive diagnosis and adequate treatment coupled with the diagnosis of Anaemia in HIV infection often remains unclear [7]. In the latest years, several attempts have been undertaken to explain the mechanisms leading HIV-associated anaemia.

There are several factors believed to play a part in the physiopathology of anaemia observed in HIV positive patients. First, many of the devious infections or malignancies to which HIV positive patients are exposed to can lead to anaemia [8]. This is particularly difficult in the developing world, where endemic infections such as hookworm or malaria can lead to considerable anaemia even in those without related HIV infection [8].

HIV and intestinal parasitic infection instigated childhood morbidity and mortality in developing countries and therefore warrant a high degree of precedence [9]. Based on these

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findings, this study focuses on relationship between intestinal parasites infections and anaemia among HIV infected patients in Specialist Hospital Yola.

2.0 Materials and Methods

2.1 The Study Area

The study was conducted in Yola North Local Government area of Adamawa State, North – Eastern Nigeria. It lies between latitude 7^{o} and 11^{o} north, and longitude 11^{o} and 14^{o}E of the Greenwich meridian. It shares boundaries with Taraba state in the south and west, Gombe state in the North-west, Yobe and Borno state to the North. The state covers a land area of about 38,741(km^2) square kilometer [10] with a population of 3,178,950 National Population Commission [11]. Yola North is located between latitude 9.2^{0}North and longitude 12.48^{0}E of the Greenwich meridian, it has a total land mass of 113km^2 and a population of 199,674 [11].

Adamawa state has a tropical wet and dry climate. Dry season last for a minimum of five months (November to March), while the wet season spans April to October. Mean annual rainfall in the state ranges from 700mm in the North-west, to 1,600mm in the extreme Southern part of the state [12].

2.2 Ethical Considerations

Before the commencement of the research work, an introductory letter was obtained from the department of Zoology, Modibbo Adama University Yola to Adamawa State Ministry of Health, Yola. Introducing the researcher and seeking for permission to carry out the research in the Hospital. Verbal consent was sought from volunteer participants before participating in the study. This was done after explaining the objectives and benefits of the research. Confidentiality and privacy was guaranteed throughout the study.

2.3 Sample Collection Site

The samples were collected in Specialist Hospital Yola, located at hospital road, Jimeta - Yola North Local Government Area. The sample collection took place between August to November 2019.

2.4 Study Design

This study was designed to involved laboratory based research. Blood and stool samples of HIV infected patients attending Specialist Hospital was collected. All the laboratory investigations to detect intestinal parasitic parasites and anaemia from the blood and stool

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samples of the HIV infected patients was carried out in the laboratory department of Specialist Hospital Yola, Adamawa state.

2.5 Laboratory Investigations

2.5.1 Collection and Processing of Blood Samples from the Study Participants

Five (5) mls of venous blood samples was aseptically collected from the participants into ethylene diamine tetra – acetic acid (EDTA) vacutainers. Blood specimen processing was done using sysmex KX – 21N haemotogy autoanalyser.

2.5.2 Procedure

The KX – 21N sysmex haematology autoanalyser was turned on and allow the instruction to perform its automatic microprocessor tests, motor check, auto rinses and a background count.

The machine displayed 'Ready',

Sample number was pressed and the patient identity number was entered and ENTER key was pressed;

The specimen was mixed very well, the stopper removed and the tube was hold up to the sample probe;

The start switch was pressed on prompting the machine to aspirate the blood sample;

The sample was removed from the sample probe and the result was printed on the thermal printer after 60 seconds and the result was recorded;

The machine was shut down by pressing the shutdown switch and cell clean was aspirated;

The machine was turned off by switching off the power source after the shutdown program had finished. (Sysmex KX – 21N operator's manual, 2000)

2.5.3 Collection and Processing of Stool Samples

Sterile universal stool containers were used to collect stool specimens from the study participants, taking down the laboratory number, age and sex of each participant. The consistency of the specimen was noted.

2.5.4 Direct Saline and Iodine Examination of the Stool Specimens

Slides were labeled and drop of saline was placed on one end of the slide and a drop of Iodine was placed on the other end of the slide.

An applicator stick was used to mix small amount of the stool specimen and a pea size (about 2 milligram (mg)) of the specimen was picked and emulsified on each drop of the saline

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and iodine respectively to make a smooth thin preparation. Each preparation was covered with a cover glass. The preparation was mounted on a light microscope and examined using the 10X and 40X objectives with the condenser iris closed sufficiently to give good contrast for detection and identification of eggs, cysts and oocysts of parasites; Cheesbrough, (2005) as adopted [1] .

2.5.5 Formol Ether Concentration Technique

Tubes were labeled and 4 millilitres (4mls) of 10% formol water was dispensed in each tube. An applicator stick was used to pick 1 gram (g) (pea size) of the stool specimen and emulsified in each tube. Three (3) ml of 10% formol water was added to each tube and mixed well by shaking.

The emulsified feaces were sieved into centrifuge tubes using filter paper. 4mls of diethyl ether was added into each tube. The tubes were covered with stopper and mixed for one (1) minute, the stopper was loosened using tissue paper. The tubes containing the stools suspension were centrifuge at 3000 resolution per minute (rpm) for one minute. An applicator stick was used to loosen the layers of fecal debris from the side of the tubes and the tubes were inverted to discard the ether, feacal debris and Formol water. The sediment remained and tubes was returned to their upward position and allowed the fluid from the sides of the tube to drain to the bottom. The buttom of each tube was tapped to resuspend and mixed the sediment. The sediment from each tube was transferred to a clean glass slide and covered with a cover glass and mount on a microscope and examined using the 10X and 40X objectives for detection and identification of eggs and cysts of parasites; Cheesbrough, (2005) as adopted [1].

2.5.6 Modified Ziehl – Neelsen

Thin smear on a clean glass slide was prepared from sediments of feaces used in formol ether concentration technique and allowed to air-dry. The dried smear was fixed in 3% hydrochloric acid (HCl) in methanol for three (3) minutes and rinsed briefly with distilled water. It was stained by application of heat with 1% aqueous safranin till the steam rises and rinsed with distilled. The stained smear was counter stained with methyl blue for 30 seconds and rinsed with distilled water and allowed to air-dried and viewed microscopically using 100X objective; Neelsen and Ziehl, as adopted [13].

2.5.7 Methods of Data Analysis

The data collected was recorded properly and entered into Microsoft Excel computer application for data preparation and then transferred into SPSS version 25 and statistically

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analyzed using Chi – square test to determine if there is any association between anaemia and intestinal parasites among HIV-infected patients.

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3.0 Results

3.1 Prevalence of Anaemia based on Age of HIV Infected Patients

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Table 1 the prevalence of Anaemia based on age of HIV infected patients in the study population. The result revealed that two hundred and twenty seven HIV infected patients were sampled. Age distribution of the HIV infected patients that were anaemic in the study revealed that the age group between zero and twenty-five years had the highest prevalence rate of 65.63% while the subjects within the ages of twenty six and fifty one had the lowest prevalence rate of 49.11%. The subjects that were non anaemic in the study were 108.

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3.2 Prevalence of Anaemia based on Sex of HIV Infected Patients

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Table 2 Based on sex, fifty six were male and one hundred and seventy one were females. The result shows that one hundred and nineteen HIV infected patients were anaemic representing the prevalence rate of 52.42 %. Out of these, the males were forty representing the prevalence rate of 71.43 % and their female counterparts were seventy nine representing the prevalence rate of 46.19 % as shown on the table.

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3.3 Prevalence of Anaemia among HIV Patients with Intestinal Parasite Infection at Specialist Hospital.

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Table 3 Five intestinal parasites were identified, Comprising of twelve *Cryptosporidium species*, thirteen *Ascaris lumbricoides*, eleven *Strongyloides starcoralis*, ten *Entomoeba histolytica* and eight *Schistosoma mansoni*.

Strongyloides starcoralis and *Entomoeba histolytica* had the highest prevalence rate of 100 % each and *Schistosoma mansoni* have the lowest prevalence rate of 87.5 %. The overall prevalence of intestinal parasites in the study was 94.44 %. Out of the fifty four HIV infected patients that were infected with intestinal parasites, fifty one were found to be anaemic, while three were non anaemic.

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Table 1 Prevalence of Anaemia among HIV Infected Patients Based on Age of the Patients

Variables		No. Examined	No. Anemic (Hb <13.0 g/dl: Males, 12.0 g/dl: Females)	Non-Anaemic	Prevalence %	P-Value
Age (years)	0 - 25	32	21	11	65.63	
	26 -51	169	83	86	49.11	0.195
	52 -77	26	15	11	57.69	
Total		227	119	108	52.42	

X^2 (Chi-square) = 3.268

df = 2

Key: % Percentage Prevalence

Hb: Hemoglobin

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Table 2 Prevalence of Anaemia among HIV Infected Patients Based on Sex of the Patients

Variables		No. Examined	No. Anemic (Hb <13.0 g/dl: Males, 12.0 g/dl: Females)	Non-Anaemic	Prevalence %	P-Value
Gender	Male	56	40	16	71.43	
	Female	171	79	92	46.19	0.000
Total		227	119	108	52.42	

X^2 (Chi-square) = 10.766

df = 1

Key: % Percentage Prevalence

Hb: Hemoglobin

Table 3: Prevalence of Anaemia among HIV Patients with Intestinal Parasite Infection at the Specialist Hospital Yola

Intestinal parasite	No. Infected	No. Anaemic	Prevalence	P-Value
Cryptosporidium spp	12	11	91.7	
Ascaris lumbricoides	13	12	92.3	

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Strongyloides stercoralis	11	11	100	0.000
Entamoeba histolytica	10	10	100	
Schistosoma mansoni	8	7	87.5	
Total	54	51	94.44	

X^2 (Chi-square) = 50.744
df = 5
Key: % Percentage Prevalence
Hb: Hemoglobin

4.0 DISCUSSION

This study revealed higher prevalence of anaemia in males than females, out of the 227 HIV infected patients examined for prevalence of anaemia. The overall prevalence of anaemia in this study was high which is in agreement with the reports of previous researchers [14]*;* [15]*;* [16]. In relation to age bracket, anaemia in HIV infected patients was a common occurrence in the population studied. The highest prevalence of anaemia was however observed among the age groups of 0 – 25 years, which is higher than the report of [17]. The reason for having higher prevalence in this study may be due to difference in living standards, level of environmental and personal hygiene and health awareness of the study participants in the two studies. The age group between 26 – 51 years had the least prevalence rate of anaemia. The differences in the observed prevalence rate based on age in this study indicate that there was no significant relationship between age and anaemia among HIV-infected patients (P>0.05).

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The prevalence of Anaemia based on sex in this study revealed that males had the higher prevalence rate than their female's counterpart which agrees with the findings of [18] who reported that Anaemia differ significantly between males and females among HIV-infected patients with males having higher prevalence rate than the females. Sex was found to be significantly associated with anaemia in this study (P<0.05) this is because gender and anaemia among HIV-infected patients may be adduced to males being expose to more opportunistic infections than females based on occupational grounds and risky sexual behaviour. In this study, there was significant difference in the prevalence of anaemia between males and females.

The overall prevalence of anaemia in association with intestinal parasites in this study was high, this disagrees with the findings of [19] who reported a lower prevalence of intestinal parasitic infection among HIV patients. This is because, the higher prevalence of intestinal parasite in this study is connected to the general level of poor sanitary conditions especially from a fecal polluted water bodies for domestic and agricultural purposes, extensive use of pit toilets and surface latrine system in both Yola metropolis and environs. Other factors that might have contributed to the high prevalence in this study were the problems of poor drainage system common to Yola and its environs. Yola residence has the habit of emptying refuse into drainage system and road sides. This study revealed that *Strongloides stercoralis* and *Entamoeba histolytica* had the highest prevalence as to that reported by [19]. This is attributed to low level of literacy within the study population. This study also revealed that *Schistosoma mansoni* had the lowest prevalence rate which is in consonance with the findings of [20]. The prevalence of anaemia in relation to intestinal parasites among HIV infected patients in this study was statistically significant (P<0.05). An interactive synergy was thus, establish between gastrointestinal parasite and HIV: while the parasitic infestation can cause drastic suppression of immune system, probably as part of the mechanism by which they protect themselves against host immune responses, damage intestinal walls, thus, enhance viral entry and multiplication. In addition parasite and associated intestinal damage can cause mal-absorption and resultant malnutrition, which further weaken the immune system. Cellular immunity is a major defense against intestinal parasitic infections [21]; [20].

5.0 Conclusion

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In conclusion, the overall prevalence of anaemia in relation to HIV in this study indicates a significant relationship between anaemia and HIV infection. The identification of intestinal parasite in relation to anaemia in this study also indicates that parasites causes anaemia in HIV infected patients. Therefore, it is recommended that; routine diagnosis of intestinal parasites among HIV infected patients is advocated in order to improve the management and quality of their lives; determination and monitoring of hematological profiles like hemoglobin level should be strengthened during follow-ups visits to make quality of HIV infected patients life better by reducing anaemia. Also, Public health authorities should continue to emphasize on the importance of environmental and personal hygiene like avoiding open defecation and consuming raw/unwashed fruits. Additional large scale longitudinal study is needed to determine other causes of anaemia in HIV infected patients.

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COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

References

1. Mengist, A. M., Taye, B. and Tsegaye, A. (2015). Intestinal Parasitosis in Relation to CD4+ T Cells Levels and Anaemia among HAART Intitiated and HAART Native Pediatric HIV Patients in A Model ART Center in Addis Ababa, Ethiopia. *Public Library of Science One*, 10 (2): 2-4.
2. Kotian, S., Sharma, M., Juyal, D. and Sharma, N. (2014). Infestinal Parasitic Infection-Intensity, Prevalence and Associated Risk Factors: A Study in the General Population from the Uttarakhard Hills. *International Journal of Medical Public Health*, 4:422-425.
3. Oyeniran, O. A., Ojurongbe, O., Oladipo, E.K., Afolabi, A.Y., Ajayi, O. O., Oloke, A. A. *et al.* (2014). Intestinal Parasitic Infection among Primary School Pupils. *Journal of Dental and Medical Sciences*, 13: 96-101

4. Rodríguez-Morales, A. J., Barbella, R. A., Case, C., Arria, M., Ravelo, M., Perez, H., *et al*., (2006). Intestinal Parasitic Infections among Pregnant Women in Venezuela. *Infectious Diseases,Obstetrics and Gynecology*, 23:125.
5. Akinbo, F. O., Okaka, C. E. and Omoregie, R, (2010). Prevalence of Intestinal Parasitic Infections among HIV Patients in Benin City. Nigeria. *Libyan Journal of Medicine*, 5: 55-56.
6. Norton, J. (2003). Recommendations to Prevent and Control Iron Deficiency Anaemia in with United States Centre for Disease Control and Prevention MMWR Recommended Report, 47 (3): 1-29.
7. Castro, L. and Goldani, L. Z. (2009). Iron, Folate and Vitamin B12 Parameters in HIV – 1 Infected Patients with Anaemia in Southern Brazil. *Tropical Doctor*, 39(2): 83-85.
8. Redig, A. J. and Berliner, N. (2013). Pathogenesis and Clinical Implications of HIV-Related Anaemia. American Society of Hematology [ASH], 377-381.
9. Behnam, M. G., Ali, P. M. H. K. and Ghodsie, E. (2017). Frequency of Intestinal Parasites in Patients with Malignancy in Ardabil Province, Northwest Iran. *Journal of Human, Environmental and Health Promotion*, 2 (2): 118-124.
10. Alfred, M. and Mathias, E. Z. (2015). Application of Geographic Information System (GIS) in Evaluating Suitable Areas for Wheat Cultivation in Adamawa State, Nigeria. *International Journal of Scientific Knowledge*, 6(1): 14-21.
11. National population Commission [NPC] (2006). Nigeria 2016 Census Data Projection.
12. Adebayo, A. A., Zemba, A. A., Ray, H. H. and Daya, S. V. (2012). Climate Change in Adamawa State. Evidence from Agro Climate Parameters. *Adamawa State University Journal of Scientific Research*, 2(2): 2-6.
13. Ochei, J. and Kolhatkar, A. (2000). Medical Laboratory Science Sixth Edition. Tata Mc Graw – Hill Publishing Company Limited, New Delhi. 954-959.
14. Denue, B. A., Kida, I. M., Hammagabdo, A., Dayar, A. and Sahabi, M. A. (2013). Prevalence of Anaemia and Immunological Markers in HIV-Infected Patients on Highly Active Antiretroviral Therapy in Northeastern Nigeria. *Infectious Diseases*, 6: 25–33.
15. Adane, A., Desta, K., and Kassa, D. (2012). HIV-Associated Anaemia Before and After Initiation of Antiretroviral Therapy at Art Centre of Minilik II Hospital, Addis Ababa, Ethiopia. *Ethiopian Medical Journal*, 50, 13–21.
16. Shen, Y., Wang, Z., Lu, H., Wang, J., Chen, J., Liu, L., *et al*. (2013) Prevalence of Anaemia among Adults With Newly Diagnosed HIV/AIDS in China. *Public Library of Science*, 1(8):73807.
17. Yesuf T., Muhie OA., Shibru H. (2019). Prevalence and Predictors of anemia among adult HIV infected Patients at the University of Gondar Hospital, Northwest Ethiopia.
18. Omoregie, R., Omokaro, E. U., Palmer, O., Ogefere, H. O., Egbeobauwaye, A., Adeghe, J. E. *et al*. (2009). Prevalence of Anaemia among HIV – Infected Patients in Benin city, Nigeria. *Tanzania Journal of Health Research*, 11(1) 1 – 4.
19. Akinbo, F. O., Christopher, E. O. and Richard, O. (2011). Prevalence of Intestinal Parasites in Relation to CD_4 Counts and Anaemia among HIV – Infected Patients in Benin City, Edo State, Nigeria. *Tanzanian Journal of Health Research*, 13(1): 8-13.
20. Dibua, U, M, Ejire, V, Lijoka, I. and Uma, A. (2013). Intestinal Parasitic Infestations among People Living With HIV/AIDS in Nsukka, Southeast Nigeria. *International Journal of Current Microbiology and Applied Sciences*, 2(11) 539-550.

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21. Omalu, I. C. J., Yako, A. B., Duhlinska, D. D., Anyanwu, G. I., Pam, V. A., Inyama, P. U., (2005). First Detection of Intestinal Microsporidia in Nigeria. *Online Journal of Health and Allied Sciences*. 3:4.

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