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# Prevalence of Cryptosporidiosis and *Helicobacter Pylori* Infection and Their Coinfection among Human Immunodeficiency Virus Positive and Negetive Patients in Adamawa State, Nigeria

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**Abstract** **Original Research Article**

Cryptosporidiosis is a public health problem affecting a wide range of vertebrates both domestic animals and humans causing potentially lethal diarrhea in AIDS, it extends from isolated events to epidemic proportions. *Helicobacter pylori* infection (HPI) is widespread with an estimated 50% of the world population infected (1). The burden of the infection in Africa is high with a reported prevalence of 70.1% (2). Recent studies reported by (3) showed that Nigeria has high load of *H. Pylori* infection with the prevalence rate of 87.7% with Northern part of the country having the highest prevalence compare to other regions of the country. The aim of this study was to determine the prevalence of Cryptosporidiosis and *H. pylori* infection and their co-infection among HIV/AIDS positive and negative patients using three health facilities of Adamawa state. A cross-sectional hospital-based design was adopted for the study. Stool samples were collected from participants and analyzed using standard parasitological and microbiological techniques for the detection of Cryptosporidium oocysts and *H. pylori*. Relevant clinical data were obtained using structured questionnaires. Data generated were analyzed using descriptive statistics, while inferential analysis was conducted using the chi-square test at a 5% level of significance to test for an association between Cryptosporidiosis and *H. pylori* infection among HIV/AIDS positive and negative patients. The findings revealed that *Helicobacter pylori* infection was the most prevalent with 52.3%, followed by Cryptosporidiosis with 47.7%, while co-infection occurred in a notable proportion of participants with 17.4%. Higher prevalence of infections was observed among HIV-positive participants compared to HIV-negative participants. Variations were observed across health facilities, however, most of these differences were not statistically significant.

**Keywords:** Prevalence, Cryptosporidiosis, *Helicobacter Pylori*, Co-infection, Human Immunodeficiency Virus, Transmission, Patients.



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## 1. Introduction

Human Immunodeficiency Virus [HIV] remains a major global public health problem, having claimed 40.4 million (32.9–51.3 million) lives so far with ongoing transmission in all countries globally; with some countries reporting increasing patterns in new infections when previously on the decline (4). There were an estimated 39.0 million (33.1–45.7 million) people living with HIV at the end of 2022, two thirds of whom (25.6 million) are in the WHO African Region. In 2022, 630 000 (480 000–880 000) people died from HIV-related causes and 1.3 million (1.0–1.7 million) people acquired HIV.

It is estimated that 1.8million Nigerians are living with HIV (National AIDS and STDs Control Programme (5). There is no cure for HIV infection. However, with access to effective HIV prevention, diagnosis, treatment and care, including for immune-related infections, HIV infection has become a manageable chronic health condition, enabling people living with HIV to leave long and sound live (4).

*Cryptosporidium* is a microscopic parasite that causes the diarrheal disease cryptosporidiosis. Both the parasite and the disease are commonly known as "Crypto." There are many species of *Cryptosporidium* that infect animals, some of which also infect humans. *Cryptosporidium parvum* and *Cryptosporidium hominis* are the two species which most commonly infect humans (6). The parasite is protected by an outer shell that allows it to survive outside the body for long periods of time and makes it very tolerant to chlorine disinfection.

*Helicobacter pylori* belongs to the family Helicobacteraceae. It is a transmissible and pathogenic gram-negative spiral shaped bacterium thought to be a contaminant of digested food as opposed to being a true colonizer of the gastric mucosa (7). It was first successfully isolated and discovered by Barry Marshall and Robin Warren in 1980, for which they were presented the Nobel Prize in 2005 (8).

Cryptosporidiosis is a public health issue affecting a wide range of vertebrates both domestic animals and humans causing potentially mortal diarrhea in AIDS, it extends from isolated events to epidemic proportions. Opportunistic infection with *Cryptosporidium* species may result in enteric disorders and other debilitating conditions culminating in high morbidity and mortality rates. *Cryptosporidium* species is currently a major cause of water borne occurrences worldwide reported in 239 waterborne outbreaks between 2011 and 2016 (9).

Despite the seemingly universal nature of Cryptosporidiosis, sufficient attention has not been paid to it, prompting the WHO in 2004 to list it among globally "neglected diseases" which have a common connection with poverty in most developing countries (10). (11) reported prevalence of *Cryptosporidium* infection among humans, cattle, sheep, goat, pigs, laboratory animals and birds in Nigeria to be 15.0%, 26.1%, 16.6%, 26.0%, 20.1%, 9.0% and 7.2% respectively. The pooled prevalence of *Cryptosporidium* species in different hosts were high and associated with several risk factors such as environmental contamination and animal contact.

*Helicobacter pylori* infection (HPI) is ubiquitous with an estimated 50% of the world population infected (1) the strain of the infection in Africa is high with a reported prevalence of 70.1% (2). Recent studies reported by (3) showed that Nigeria has high burden of *H. Pylori* infection with the prevalence rate of 87.7% with Northern part of the country having the highest prevalence compare to other regions of the country. Considering the high load of HPI in Africa and Nigeria with its associated pathological outcomes, accurate and prompt data is needed for management, treatment and eradication of the diseases.

Co-infection is the simultaneous infection of a host by multiple pathogens species. The overall effect of co-infection on human health is thought to be negative (12). Infection with multiple pathogens within the same host is common, as different infections agents are obtained through similar ways of vulnerability (inhalation, oral, ingestion of contaminated feed and water) (13).

Many works had been done on Cryptosporidiosis and *H. pylori* infection but information on their co-infection is lacking among the teaming population especially HIV/AIDS patients.

It is in view of the above that the study sets to investigate the co-infection of *Cryptosporidium*-species and *Helicobacter pylori* among HIV/AIDS positive and negative patients attending Specialist Hospital Yola, General Hospital Numan and General Hospital Mubi, Adamawa state.

## 2.0 MATERIALS AND METHODS

### 2.1 The Study Area

The study was conducted in Specialist Hospital Yola, General Hospital Numan and General Hospital Mubi, in Yola North, Numan and Mubi South Local Government Areas respectively of Adamawa State. The Hospitals are carefully chosen to present the three (3) senatorial Districts in the state. Specialist Hospital Yola, is where HIV/AIDS patients in the Central Senatorial District mostly assess their antiretroviral treatment and counselling while General Hospital Numan is where majority of HIV/AIDS patients from Southern Senatorial District get their antiretroviral treatment and General Hospital Mubi serve as center where HIV/AIDS patients from Northern Senatorial District get counselling and treatment.

### 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 ethical committee on health research. Introducing the researcher as a doctor of philosophy student who is seeking for permission to carry out the research in Specialist Hospital Yola, General Hospital Numan and General Hospital Mubi. The management of the respective Hospitals were informed about the study and their permission was sort and obtain before conducting the research. A consent form was given to the volunteer participants before their participation in the study. This was done after explaining to them the objectives and benefits of the research. HIV/AIDS positive and negative patients were enrolled in the research. Participants were given opportunity to ask questions and all the questions was answered by the researcher, confidentially and privacy was guarantee throughout the research work in the respective Hospitals. All participants were given a unique identification number which was used to identify them instead of their names.

### 2.3 Questionnaire

Questionnaire was administered to all the participant in the study for data collection. The questionnaire was contained information about the participant personal data.

### 2.4 Sample Collection Site

The samples were collected in Specialist Hospital Yola, located at hospital road, Jimeta - Yola North Local Government Area, General Hospital Numan, located at Sabon pegi, Numan Local Government Area and General Hospital Mubi, located at Ahmadu Bello way, Mubi South Local Government Area. The sample collection was taken place between November, 2024 to January, 2025.

### 2.5 Study Design

This study was design to involved laboratory-based research. Stool samples of HIV/AIDS positive and negative patients attending Specialist Hospital Yola, General Hospital Numan and

General Hospital Mubi. All the stool samples were examined in the laboratory departments of all the three respective Hospitals.

### 2.6 Sample Size

A total of seven hundred and fourty six (746) stool samples of HIV/AIDS patients was used for this study, using the formular $n = Z^2pq/d^2$ as used (14).

Where n = Desired sample size;

Z = Standard normal deviation at the required confidence level of 95% (1.96);

P = Prevalence;

q = 1 – P;

d = Desired absolute precision (0.05).

Using the prevalence of 38.2% of *Cryptosporidium* species in HIV positive and negative patients attending Hong General Hospital and Michika General Hospital, Adamawa State, Nigeria (15) $n = (1.96)^2 X 0.382 X 0.618)/(0.05)^2 = 363$ and prevalence of 46.8% of *Helicobacter pylori* infection among HIV-1 infected patients in Jos, North-Central, Nigeria (16)

$n = (1.96)^2 X 0.468 X 0.532)/(0.05)^2 = 383$

Total Sample = 363+383 = 746

## 2.7 Laboratory Investigations

### 2.7.1 Collection and Processing of Stool Samples

Sterile universal stool containers were used to collect stool specimens from the study participants, noting their laboratory number, age and sex of each participant. The specimens were transferred to the laboratory for analysis.

### *2.7.2 Macroscopic Examination of the stool samples*

The stool samples were examined macroscopically for colour, odour, consistency, presence of mucus, blood and segments of intestinal parasites (17).

### *2.7.3 Microscopic Examination of the faecal specimens*

### *2.7.4 Modified Ziehl-Neelsen Staining Technique*

The stool sample that was collected was processed using the modified Acid-fast technique for *Cryptosporidium* species as described (18).

A thin smear of faecal specimen was prepared on a clean grease free slide, and allow to air-dry. The dried smear was heat fix and keep on the staining rack; it was then be flooded with carbol-fuchsin. The flooded slide was heated until vapour begin to rise, and then allow to stain for 9 minutes and then rinse with distilled water. The slide was decolorized with 5% aqueous sulphuric acid for 30 seconds and then rinse with distilled water. The stain slide was counter stain with methylene blue for one minute. And then rinse with distilled water, and allow to air-dry and then view microscopically using the 100x objective lens; Neelsen and Ziehl, as adopted (18).

## 2.8 *Helicobacter pylori* Antigen Rapid Test

The stool samples that was collected was analyze for *Helicobacter pylori* using the Immunochromatography method as described (19).

The sample container was open and the withdrawal stick was removed from vial and plunge into the sample in 3 different points to pick the sample and then return to the vial containing diluents and then screw the cap back to close it. The end of the cap was broken, freeing the dropper part and then 3 drops ($100\mu l$) of the diluted sample was dispense into the well (S) indicated on the cassette, the result was read after 10 minutes. Appearance of two distinct redlines indicates positive result, that is the control region (C) and Test region (T). A negative result is indicated by the appearance of only one red line, that is the control line (C) while invalid result is indicated by non-appearance of red lines or red control line fails to appear or red line appearing only on Test region indicating the operator error or reagent failure. (19).

## 2.9 Data Analysis

Data collected was analyze using statistical package for social sciences (SPSS) version.

## 3.0 Results

### 3.1 Distribution of Cryptosporidiosis, *Helicobacter pylori* and Co-infection among Study Participants.

The distribution of Cryptosporidiosis, *Helicobacter pylori* infection, and co-infection among the study participants is presented in

Table 3.1. Out of the total examined participants (n = 746), 175 individuals were infected with at least one of the investigated pathogens, giving an overall prevalence of 23.45%. *Helicobacter pylori* infection recorded the highest frequency with 78 cases, representing a prevalence of 10.46%, followed by Cryptosporidiosis with 71 cases (9.52%). Co-infection with both Cryptosporidiosis and *H. pylori* was observed in 26 participants, accounting for a prevalence of 3.49%. As shown on the table, *Helicobacter pylori* constituted the most prevalent infection among the study population, indicating a higher occurrence of bacterial infection compared to parasitic infection. Cryptosporidiosis also accounted for a substantial burden of infection, reflecting the persistence of protozoan enteric pathogens in the study area. Although co-infection was less frequent than single infections, its occurrence emphasizes the coexistence of multiple enteric pathogens within the same individuals.

The observed distribution of infections suggests variations in exposure patterns, environmental sanitation, and individual susceptibility among participants. Importantly, the presence of co-infection highlights the public health concern posed by overlapping transmission routes and the need for integrated prevention and control strategies targeting both bacterial and parasitic intestinal infections.

**Table 3.1: Distribution of Cryptosporidiosis, Helicobacter pylori and Co-infection among Study Participants**

| Parasites | Frequency | Prevalence (%) |
|---|---|---|
| **Cryptosporidiosis** | 71 | 9.52 |
| ***Helicobacter pylori*** | 78 | 10.46 |
| **Co-infection** | 26 | 3.49 |
| **Total infected** | 175 | 23.5 |

**Table 3.2: Prevalence of Cryptosporidiosis and *Helicobacter pylori* among HIV-Positive and HIV-Negative Participants by Health Facility**

| Facility | HIV Positive | | | | | | HIV negative | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Cryptosporidiosis* | | | *H. Pylori* | | | *Cryptosporidiosis* | | | *H. Pylori* | | |
| | No. Exam. | No. Positive | Prev. (%) | No. Exam. | No. Positive | Prev. (%) | No. Exam. | No. Positive | Prev. (%) | No. Exam. | No. Positive | Prev. (%) |
| **Gen. Hosp. Mubi** | 124 | 9 | 7.3 | 124 | 9 | 7.3 | 124 | 5 | 4.03 | 124 | 6 | 5.8 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gen. Hosp. Numan** | 124 | 22 | 17.7 | 124 | 28 | 22.5 | 124 | 9 | 7.3 | 124 | 4 | 3.22 |
| **Specialist** | 125 | 19 | 15.2 | 125 | 26 | 20.4 | 125 | 7 | 5.6 | 125 | 5 | 4.0 |
| **Total** | 373 | 50 | 13.4 | 373 | 63 | 16.8 | 373 | 21 | 1.34 | 373 | 15 | 2.94 |

For HIV Negative and Crypto; $\chi^2$ =0.305; df = 1; P=0.581; P>0.05.

For HIV Positive and Crypto; $\chi^2$ =1.780; df = 1; P=0.182; P>0.05.

For HIV Negative and H. Pylori; $\chi^2$ =0.551; df = 1; P=0.458; P>0.05.

For HIV Positive and H. Pylori; $\chi^2$ =0.987; df = 1; P=0.321; P>0.05.

## 4.0 DISCUSSION

### 4.1 Distribution of Cryptosporidiosis, *Helicobacter pylori* and Co-infection among Study Participants

The findings of this study revealed that *Helicobacter pylori* infection constituted the highest proportion of infections among the study participants with 52.3%, followed by Cryptosporidiosis with 47.7%, while co-infection with both pathogens occurred in a smaller but notable proportion with 17.4%. This pattern suggests that bacterial gastrointestinal infection remains highly prevalent in the study population, even within a setting where parasitic infections are endemic.

The predominance of *H. pylori* observed in this study is consistent with several studies conducted among HIV-positive and HIV-negative populations in sub-Saharan Africa. (20) reported a similarly high prevalence of *H. pylori* infection among both HIV-positive and HIV-negative adults in Ethiopia, emphasizing the widespread nature of the organism irrespective of HIV status. Likewise, (21) and (22) documented substantial *H. pylori* prevalence among HIV-infected individuals in Nigeria, attributing this to poor sanitation, overcrowding, and persistent exposure to contaminated food and water sources. The observed burden of Cryptosporidiosis in the present study agrees with findings from systematic reviews and hospital-based studies that identify *Cryptosporidium* spp. as a common opportunistic pathogen among immunocompromised individuals. (23) and (24) reported similar prevalence levels among people living with HIV, highlighting immune repression as a crucial factor that increases susceptibility to infection. Similarly, (25) observed Cryptosporidiosis as a recurring intestinal infection among HIV- infected patients in Ghana, reinforcing the role of compromised cellular immunity.

The occurrence of co-infection in the present study further confirms existing evidence that multiple gastrointestinal pathogens can coexist within the same host, particularly among individuals with weakened immune defenses. (26) noted that HIV-infected individuals frequently nurture concurrent infections with *H. pylori* and other enteric pathogens, which may complicate clinical presentation and management. (27) also reported co-infection patterns among HIV-positive patients in Nigeria, suggesting shared transmission routes and overlapping risk factors such as unsafe water consumption and poor hygiene. Overall, the distribution of infections observed in this study supports existing literature indicating that *H. pylori* and Cryptosporidiosis remain important gastrointestinal pathogens in both HIV-positive

and HIV-negative populations, with a higher burden often observed among immunocompromised individuals.

### 4.2 Prevalence of Cryptosporidiosis and *Helicobacter pylori* Infection by Health Facility among HIV-Positive and HIV-Negative Participants

The findings of this study showed variations in the prevalence of Cryptosporidiosis and *Helicobacter pylori* infection across the different health facilities among both HIV-positive and HIV-negative participants. Although General Hospital Numan recorded relatively higher prevalence rates for both infections compared to General Hospital Mubi and the Specialist Hospital Yola, the chi-square analysis indicated that these differences were not statistically significant. This suggests that the observed variations across health facilities may be attributable to chance rather than to systematic differences related to facility-specific factors.

This pattern is consistent with findings reported in similar hospital-based studies, where differences in prevalence across health facilities did not reach statistical significance. (23) noted that while Cryptosporidiosis prevalence may vary between hospitals and regions, such variations often indicate differences in patient composition, referral patterns, and sample size rather than true epidemiological disparities. Similarly (24), in a systematic review of Cryptosporidium infection among people living with HIV in Nigeria, reported wide inter-facility variability but emphasized that these differences were rarely statistically significant when adjusted for population size and immune status. The higher prevalence of *H. pylori* infection observed in some facilities in the present study is in agreement with reports by (20) and (26), who found that *H. pylori* infection is widely distributed across healthcare settings in sub-Saharan Africa. These studies suggested that the organism's transmission is largely community-based and influenced by environmental exposure rather than health facility characteristics. As a result, patients presenting to different hospitals often share similar risk profiles, leading to comparable prevalence levels.

Furthermore, (21) and (22) reported that hospital-based differences in *H. pylori* prevalence among HIV-positive patients in Nigeria were limited and statistically non-significant, supporting the concept that infection is acquired primarily outside healthcare settings. This supports the findings of the present study, where no significant association was found between health facility and infection status. This underscores the importance of community-level interventions, such as improved water quality, sanitation, and public health education, rather than facility-specific control measures alone.

## 5. Conclusion

Based on the findings of this study, it can be concluded that Cryptosporidiosis and *Helicobacter pylori* infections remain important public health concerns among both HIV-positive and HIV-negative individuals in Adamawa State. The higher burden of infection observed among HIV-positive participants underscores the role of immune suppression in increasing susceptibility to intestinal infections. Although differences in prevalence were observed across health facilities, these variations were not statistically significant. This suggests that exposure to intestinal pathogens may be widespread in the study area and not confined to specific demographic subgroups. Overall, the study highlights the need for routine screening and integrated management of intestinal infections, particularly among HIV-positive individuals, regardless of clinical presentation.

## 6. Recommendations

Based on the findings and conclusions of this study, the following recommendations are made:

i. Routine Screening: Regular screening for Cryptosporidiosis and *Helicobacter pylori* should be incorporated into the routine care of HIV-positive patients.

ii. Integrated Management: Health facilities should adopt integrated diagnostic and treatment approaches that consider the possibility of co-infection with multiple intestinal pathogens.

iii. Public Health Education: Community-based health education programs should be strengthened to promote awareness of intestinal infections, emphasizing safe water use, proper sanitation, and personal hygiene practices.

iv. Water and Sanitation Improvement: Government and relevant stakeholders should intensify efforts to improve access to safe drinking water and adequate sanitation facilities in both urban and rural communities.

v. Capacity Building: Laboratory capacity for the diagnosis of intestinal infections should be strengthened through training of personnel and provision of essential diagnostic materials.

**Further Research**: Future studies should adopt longitudinal designs and include molecular diagnostic techniques to better understand transmission dynamics, risk factors, and the impact of immune status on infection outcomes.

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