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Intestinal Helminthic Infection among Prison Inmates of a Maximum-security Prison in Southern Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author AEA designed and made the draft of the work. Author JCI collected the samples and analyzed them with author HO. All authors read and approved the final manuscript.

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ABSTRACT

Background: Infection caused by intestinal parasites thrives in an environment with poor sanitary and unhygienic practices, over-crowding, poor housing, and poverty. The aim of this study was to investigate the prevalence of intestinal helminthic infections among inmates of Port Harcourt maximum security prison, Rivers State, Nigeria.
Methods: Stool samples were collected in clean universal bottles from 197 inmates and were analyzed following standard method of stool examination.
Results: The overall prevalence was 14.2%. Age-related distribution showed that age group 24-30 years had the highest prevalence of 29.4% followed distantly by ≥ 45 years with prevalence of 10.5% while 17-23 years had the least prevalence of 4.4%. The prevalence between the age groups was significant (x^2=20.096, df=4, p =0.000). Three different helminthes parasites were identified namely; *Ascaris lumbricoides* (8.6%), hookworm (7.6%), and *Stronglyloides stercoralis* (2.0%).
Conclusion: Intestinal helminthiasis is relatively high among inmates of Port Harcourt prison. Increased awareness and concerted efforts at improving sanitation, provision of water, and personal hygiene can drastically reduce infection among prison inmates.

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Keywords: Helminthiasis; infection; prison inmates; sanitation; Port Harcourt.

1. INTRODUCTION

Infections by intestinal parasites are widespread throughout the world. It is estimated that about 24% of the world population which is above 1.5 billion people are infected by intestinal parasites [1]. Intestinal parasitic infection is reported to have a high prevalence in Rivers State [2-6]. Infections caused by intestinal parasites thrive in an environment with poor sanitary and unhygienic practices, over-crowding, poor housing, and poverty which are the hallmark of a prison environment in Nigeria. Agunbiade [7] and Chukwudi [8] described the prison environment in Nigeria as appalling and not humane due to the aforementioned conditions among others.

"Prison inmates belong to the neglected population of society and over-crowding has become a global challenge to accomplish the minimum standards of services to prisoners" [9]. "It was reported that more than 10.2 million people were detained in prisons in 2013 (144 per 100,000 populations) and the annual turnover is closer to 30 million worldwide" [10].

In Nigeria, prison conditions remain unacceptable over the past years with an increase in disease burden among inmates. Filthy cells and floors, inmates' overcrowded per bed, blocked, overflowing or absent toilets and some cases no running water are common features in many Nigerian prisons. These conditions exacerbate the spread of diseases in prisons. Hand washing with soap and water which can control intestinal parasitic infections (as they are acquired via fecal-oral route) is out of reach in prisons [11]. Even when the prison has a small clinic, some guards often demand bribes from inmates before allowing privileges of such services [8]. Transmission of intestinal parasites and other communicable diseases will continue in prisons and other detention homes unless the level of hygiene and politics are improved [12] which brings the issues to a different dimension. "High exposure to contaminants, poor standards of personal hygiene, malnutrition, mobility issues, psychological disorders, and stress are some of the socioeconomic and behavioral factors that make prison inmates, more prone to parasitic infection" [13,14]. Disease prevalence has been reported to be higher among prisoners than other members of the society [15], which may be due to the fact that Prison health in developing countries is not seen as a profitable social project [16]. More so, because it is expensive and requires political will to improve the prison health.

Nigeria has 227 prisons with a total population of 62,260 inmates as of 2015 across the country out of which 45,158 (72.5%) were awaiting trial [17]. Port Harcourt maximum security prison was established in 1918 by the British Colonialists with a holding capacity of 804 inmates but today has a total population of 5000 inmates (3700 are awaiting trial, 402 are convicted) [18]. There are scarce reports of work carried out in this neglected settlement, which prompted this very research. The aim of this study was to investigate the prevalence of intestinal helminthic infection among inmates of Port Harcourt maximum security prison, Borokiri, Rivers State Nigeria

2. MATERIALS AND METHODS

2.1 Study Area

Port Harcourt is located at Long: 7°2' 0.9996" E and Lat: 4°49' 27.0012" N. It is the capital city of Rivers State, a major hub of oil exploration and exploitation activity at the heart of Niger Delta, Nigeria. There is an influx of people into the city because of the oil-related activities and the estimated population of Port Harcourt was put at ≥ 2,300,000 people by 2015 [19].

Maximum Security Prison Borokiri is located at latitude 4.749^0N and Longitude 7.035^0E in Port Harcourt Local Government Area, Rivers State, Nigeria. It is a neighborhood of the city of Port Harcourt situated just south of old Government Reserve Area (GRA) in Port Harcourt. It is bound by Ahoada Street to the North Okrika Island to the east (across Aboturu Creek), Orubiri oilfield to the South, and ship builders' road to the west.

Here, offenders of all categories of crime, including awaiting trial, convicts, and condemned criminals of both sexes are kept. It is located in the central or urban area and close to the courts. It is one of the earliest custody institutions in Nigeria. It was established by the British Colonialists in 1918. The institution has a holding capacity of 804 inmates. However, according to the National Bureau of Statistics [17], Port Harcourt prison has a total of 3824 inmates (3422 awaiting trial, 402 convicted).

2.2 Research Design

This is a cross-sectional, analytical, quantitative study. It involves the assessment and description of facts that were investigated on the prevalence of Intestinal parasitic infection among the prison inmates in Maximum Security Prison, Port Harcourt.

2.3 Population of Study

A total of 197 inmates were involved in this study. All the 197 were males between the ages of 17 years and 60years old.

2.4 Sampling

Stool samples were collected in clean universal bottles from 197 inmates and were transported to the Laboratory in the Department of Animal and Environmental Biology of the University of Port Harcourt where they were analyzed.

2.5 Sample Analysis

Samples were analyzed following the standard method of stool examination as described by Cheesbrough [20] in duplicate using saline/iodine and formol-ether concentration methods. A macroscopic examination of the stool sample was also carried out. The appearance, colour, consistency (whether formed, semi-formed, unformed, or watery), and the presence or absence of blood, mucus, and pus was noted. Any abnormalities were recorded. A drop of physiological saline was placed on a clean grease-free slide. With the help of an applicator stick, a little quantity of properly mixed stool samples was emulsified in a drop of saline. The preparation was covered with a cover-slip and examined with 100x and finally with 400x magnifications of an optical microscope. All the samples were concentrated using the formol ether concentration technique. One milliliter of a well-mixed stool sample was put in a tube containing 4mL of 10% formalin. Three milliliters of the 10% formalin were again added and mixed by shaking. The suspension was sieved using a coffee strainer into a centrifuge tube. Three milliliters of diethyl ether were added and stoppered. It was then shaken vigorously for 1min. The stopper was removed and the suspension centrifuged for one min at 400 rpm. The entire column of the fluid below the faecal debris and ether was carefully removed using a Pasteur pipette and transferred into another centrifuge tube. Ten percent formalin was added to the transferred suspension to make up to 10mL. It was then centrifuged at 1000 rpm for 10 mins. The supernatant was decanted and the bottom of the tube was tapped to re-suspend the deposit. The deposit was examined by light microscopy at 100x and 400x magnifications for the presence of ova or cyst of parasites.

2.6 Data Analysis

Statistical analysis was done using SPSS version 21. Data obtained were presented as prevalence in percentage. Chi-square tests were used to determine the association gastrointestinal helminths among age and sex. P-values less than 0.05 are considered to be significant.

3. RESULTS

The overall analysis of helminthiasis among inmates of Port Harcourt Prison showed that of the 197 feacal samples examined, 28(14.2%) were positive, Age-related distribution showed that the age group 24-30 years had the highest prevalence of 20(29.4%) followed distantly by ≥ 45years with the prevalence of 10.5% while 17-23 years had the least prevalence with 4.4%. The prevalence difference between the age groups was significant (x^2=20.096, df=4,p =0.000) Table 1.

Three different species of helminthes were identified from the faecal samples examined. These were *Ascaris lumbricoides*, hookworm, and *Strongyloide stercoralis*. Seventeen (17) inmates had *A.lumbricoides* with prevalence of 8.6%, hookworm 15(7.6%) and S.stercoralis 4(2.0%). *A.lumbricoides* was highest among ≥45years age group (15.8%) and the least in 17-23years (6.7%); Similarly, hookworm was highest among 24-30years (11.8%) and least in 38-44years (5.3%) while *S. stercoralis* was highest in 38-44years and least in 31-37 years (2.2%)(Table 2).

4. DISCUSSION

The current investigation indicates that the prevalence of intestinal helminthes among the inmates of Port Harcourt maximum security prison is 14.2%. This result is relatively low when compared to 77.0% reported in a similar study among inmates of Owerri prison, Nigeria [21], 42.6% in Ethiopia [22], 20.2% in Brazil [23], 24.7% in Kisii, Kenya [24], 26.5% in Selangor, Malaysia [25], 69.3% in Abidjan, Côte d'Ivoire [26], and 39.35% in Cameroun [27]. However,

Table 1. Overall prevalence of helminthiasis based on age among inmates of Port Harcourt Prison

Age group	No Examined	No Infected (%)	X2	P
17-23years	45	2(4.4)		
24-30years	68	20(29.4)		
31-37years	46	3(6.5)		
38-44years	19	1(5.3)		
>≥45years	19	2(10.5)		
Total	**197**	**28(14.2)**	**20.096**	**0.000**

Table 2. Age distribution of helminth species among various age groups among inmates of Port Harcourt prisons

Age group	No.Examined	A.lumbricoides	Hookworm	S.stercoralis
17-23years	45	(6.7)	3(6.7)	2(4.4)
24-30years	68	7(10.3)	8(11.8)	0
31-37years	46	4(8.7)	3(6.5)	1(2.3)
38-44years	19	0	1(5.3)	1(5.3)
>≥45years	19	3(15.8)	0	0
Total	**197**	**17(8.6)**	**15(7.6)**	**4(2.0)**

the 14.2% is higher than 9.2% reported by Ishaleku and Mamman [15] among inmates of Jos prison Nigeria. This variation may be as a result of environmental factors such as level of sanitation, enlightenment and awareness among the inmates, provision of health services by non-governmental organizations (NGOs), and geographical area of study.

Three different helminthes parasites were identified namely *A. lumbricoides*,(8.6%) hookworm (7.6%), and *S. stercoralis*(2.0%). In this study, *A. lumbricoides* was the most prevalent. This observation agrees with Amuga et al., [28] who reported *A.lumbricoides* (20.96%) as the most prevalent intestinal parasites among inmates at Keffi prisons, Nigeria, and Kuete et al., [27] who reported 10.4% prevalence in New-Bell Central Prison, Cameroun. Though the percentage prevalence was higher in Keffi compared to this finding, the variation could be as a result of the level of sanitation around the prison facility, showing that keffi environment may be inferior to the present study environment since eggs passed in feaces must be embryonated for at least 3 weeks in the soil before becoming infectious.

Hookworm encountered in the present study had a prevalence of 7.6%. This was lower than 19.16% reported at Jos prison [28], 13.1 % reported at Owerri prisons [21] however higher than what was reported elsewhere, 6.0% reported in Abidjan [26]. The climatic and the environmental exposure conditions, the sanitation level, the access to clean water as well as the hygiene education may be the reason for the variation. The finding corroborates the fact that Human hookworm disease is a common helminthic infection worldwide where the environmental exposure conditions allow it. Port Harcourt has temperature and rainfall that would support the transmission of hookworm since the geographical distribution is determined by temperature and rainfall, which influence the development of free-living larvae [1], among other factors such as drainage, type of soil, social habits, and customs, and Poor sanitation. The prevalence is also possible due to the fact that the longevity of the parasite may reach several years with most adult worms only eliminated in one to two years.

The prevalence of 2.0% was recorded for *Strongyloides stercoralis* in this study. This finding was higher than 0.4 % reported in Owerri Prisons [21] and elsewhere in Abidjan Côte d'Ivoire [26] but lower than 4.8% reported in Jos Prison [29] and elsewhere 8.8% in Malaysia [25]. "The finding of *S.tercoralis* among the prison inmates is significant. Although the health consequences of *S. stercoralis* infections range from asymptomatic light infections to chronic symptomatic strongyloidiasis, untreated infections have the potential to develop into severe disease in certain population subgroups and could cause serious problems" [30], especially in a prison setting.

"More so the *Strongyloides* life cycle is more complex than that of most nematodes with its alternation between free-living and parasitic cycles, and its potential for autoinfection and multiplication within the host" [30]. The variation in the prevalence rate could be attributed to dissimilarity in sanitation level in the different prisons since according to CDC [31], Infections are most common in areas with poor sanitation, rural and remote communities, institutional settings, and among socially marginalized groups.

5. CONCLUSIONS

Intestinal helminthiasis is relatively high among inmates of Port Harcourt prison. Increased awareness and concerted efforts at improving sanitation, provision of water, and personal hygiene can reduce the infection among the prison inmates at the Port Harcourt prisons.

CONSENT AND ETHICAL APPROVAL

Permission to carry out this study was granted by the office of the Research Management Committee of the University of Port Harcourt and approval was received from the State Comptroller of Prisons, which oversees the Maximum Security Prisons, Port Harcourt. Inmates had the right to accept or refuse to join the study without any consequences. Verbal consent of individual prisoners was also obtained. All information obtained was handled confidentially and this was maintained at all times. All procedures were followed according to the ethical standards of human experimentation and the Helsinki declaration revised in 2013.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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