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Study of Parasitic Pathogens on Nigerian Currency Circulating in Selected Markets in Lafia Metropolis, Nasarawa State, Nigeria

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ABSTRACT

Money is the most widely handled article throughout the world, it goes through clean and dirty hands and can get contaminated with parasites and pathogens. Thus, the study on parasites associated with circulating Naira notes in selected markets in Lafia metropolis, Nasarawa State, Nigeria was carried out from June, 2019 to March, 2020. A total of three hundred and twenty (320) samples of Nigerian Naira notes consisting of forty (40) pieces of each denomination was used for this study. Market samples were collected from food vendors, fish sellers, butchers, hawkers and fruits/vegetable sellers and then screened. Out of the 320 samples examined, 32 (10.00%) were contaminated with parasite species that spread across Ascaris lumbricoides 6 (1.88%), Entamoeba histolytica 7 (2.19%), hookworm 10 (3.13%), Taenia spp. 1 (0.31%) and Trichuris trichiura 8 (2.50%). The mint Naira notes had no parasitic contamination. The level of parasitic contamination of Naira notes in relation to currency sources, and as well as the physical conditions of the notesshowed a very high significant difference ($P < 0.001$). Also, parasitic contamination in relation to Naira notes denominations showed a very high significant difference ($P < 0.001$). Only the paper notes were contaminated with human pathogenic parasites while polymer notes were parasite free. In conclusion, this is the first study in Lafia, Nasarawa State that showed that the Nigerian currency notes in circulation within the metropolis are contaminated with five parasite species that are known to be pathogenic to humans. Also, the handlers of such Naira notes may possibly stand a chance of being infected with the parasites recorded if their hands are not properly washed and sanitized after transactions.

Introduction

Money, in the form of currency notes and coins, is extensively traded for goods and services in countries all over the world. Perhaps, it is the most widely handled article throughout the world; being exchanged by several hands each day [1]. Money goes through clean and dirty hands and can get contaminated with parasites and pathogens [2]. Previous studies conducted in different parts of the world shows that currency notes are common vehicles for pathogenic transmission of diseases [3-10]. They reported that ova and larvae belong to different species of microsporidia, cryptosporidium, Taenia, Trichuris, Enterobius, Amoeba and Ascaris. All of the reported parasites are known enteric pathogens. In Nigeria, the currency is highly abused and can be commonly

seen faded, torn, stapled, cello taped, squeezed and with writings on them. Being the most frequently passed item in the world it should not come as a surprise as these currency notes are usually contaminated with various pathogens and parasitic organisms as it is handled by persons of varying health and hygienic standards and is stored under varying environmental and personal hygienic conditions [11]. Awodi et al. [12] reported that the major source of currency contamination in Nigeria could be as a result of poor or negative money handling practices like spraying during ceremonies, here the notes are sprayed on the celebrant(s) and in the process fall on the ground where a large number of people dancing, step on them with soiled shoes which are often contaminated with parasites or pathogens.

Parasites that have been observed to be contaminants of the naira notes are mainly of faecal origin [12]. Generally, lack of personal hygiene is one of the common ways to contaminate the currency notes with parasitic pathogens. Unhygienic habit such as improperly washing of hands after visiting the toilets as well as the habit of wetting fingers with saliva during money counting to a greater extend leads to the contamination of these currency notes with cysts, eggs and larvae of pathogenic parasites [3-10]. In view of the above, the study aimed at isolating and identifying parasitic pathogens contaminating circulating Nigerian naira notes in selected markets in Lafia metropolis, Nasarawa State, Nigeria.

Materials and Methods

Study Area

The study was carried out in Lafia metropolis, Nasarawa State, Nigeria. The city of Lafia is the administrative headquarter of Lafia local government and the administrative capital of Nasarawa State, Nigeria. Lafia has a population of about 127,236 inhabitants and is situated on latitude 8.48° North, Longitude 8.52° East and 290 meters elevation above the sea level [13]. Lafia metropolis is about 100 km (straight distance) from the Federal capital city Abuja and approximately southeast (SE) from the federal capital territory (FCT) [14]. Lafia serves as a higher-order city in the provision of consumer goods and other services to the immediate smaller towns that are directly linked to it. A number of banks including first and second generation banks are operational in the city as business activities are high.

Collection of Samples

A total of three hundred and eighty-four (320) samples of Nigerian currency notes consisting of forty-eight (40) pieces of each naira note denominations (₦5, ₦10, ₦20, ₦50, ₦100, ₦200, ₦500, and ₦1000) of both polymer and paper were randomly collected for the purpose of this research from June 2019 to March 2020. Verbal consent of the participants was obtained before the collection and exchange of the notes. Naira notes were collected from two (2) markets (Lafia modern market, and Alamis market) selected within Lafia metropolis. In the market, samples were collected from food vendors, fish sellers, butchers, hawkers, fruits and vegetable sellers. The naira notes were collected aseptically, kept separately in a labelled sterile polythene bags and conveyed to the Department of Zoology laboratory of the Federal University of Lafia for screening. The notes were grouped as follows: Mints, dirty, very dirty and mutilated dirty. The mints notes served as control.

Parasitological Screening

The parasitological screening was carried out according to the methods outlined by Leonard and Olajumoke [7] and Ahmed and Mujittapha [8]. Each group of the identified currencies within the selected denominations were inserted into a sterile bottle containing 20 ml of normal saline. The bottle was vigorously shaken and left standing for 30 minutes, then shaken all over again for the last time. The Naira notes were then removed using a pair of sterile forceps and transferred into a sterile polythene bag. The contents of each bottle were poured into centrifuge tubes and centrifuged at 1000 rpm for 5 minutes. The supernatant was carefully decanted, while the resultant sediment was stirred, and a drop placed on a clean grease-free glass slide and then covered with a glass cover slip. The slide was then examined microscopically under x10 and x40 magnifications for presence of parasite cysts, eggs and larvae.

Statistical Analysis

Data obtained were analysed using R Console software (Version 3.2.2). Pearson's Chi-square test was used to compare prevalence rate between species of parasites. Also, prevalence of parasites in relation to currency denominations, currency sources and as well as the physical conditions of the currency was compared using Pearson's Chi-square test. Level of significance was set at $P < 0.05$.

Results

Composition and Prevalence of Parasites on Naira Notes Collected from Markets in Lafia, Nasarawa State, Nigeria

Out of the 320 currency notes analyzed for parasitological contamination, 32 (10.00%) were observed to be contaminated with parasites as shown in (Table 1). The most dominant parasite was hookworm 10 (3.13%) followed by Trichuris trichiura 8 (2.50%) then Entamoeba histolitica 7 (2.19%), Ascaris lumbricoides 6 (1.88%) while the least was Taenia spp. 1 (0.31%). However, the prevalence rate in relation to the parasite species showed no significant difference ($\chi^2 = 22.2145$, df = 4, $P = 0.6964$).

Table 1: Checklist of parasites isolated from Naira currency collected from markets in Lafia, Nasarawa State, Nigeria (n=320).

Species	No. of ₦ currency notes contaminated (%)
Ascaris lumbricoides	6 (1.88)
Entamoeba histolitica	7 (2.19)
Hookworm	10 (3.13)
Taenia spp.	1 (0.31)
Trichuris trichiura	8 (2.50)
Total (%)	**32 (10.00)**

Prevalence of Parasites in Relation to Currency Physical Conditions

From (Table 2), no parasites were found to contaminate the mint (control) Naira notes. However, very dirty Naira notes had the highest parasitic contamination of 13 (16.25%) followed by the mutilated dirty notes 11 (13.75%) and dirty naira notes 8 (10.00%). Therefore, there was a high significant difference (χ^2 = 15.312, df = 3, P = 0.001568) in the parasitic contamination of Naira notes in relation to physical conditions.

Table 2: Parasitic contamination of Naira notes in relation to their physical conditions.

Species	Conditions of currency notes				Total No. n = 320
	Mint (Control) n = 80	Dirty n = 80	Very dirty n = 80	Mutilated dirty n = 80	
Ascaris lumbricoides	0 (0.00)	2 (2.50)	3 (3.75)	3 (3.75)	8 (2.50)
Entamoeba histolitica	0 (0.00)	1 (1.25)	4 (5.00)	1 (1.25)	6 (1.88)
Hookworm	0 (0.00)	3 (3.75)	2 (2.50)	5 (6.25)	10 (3.13)
Taenia spp.	0 (0.00)	2 (2.50)	3 (3.75)	2 (2.50)	7 (2.19)
Trichuris trichiura	0 (0.00)	0 (0.00)	1 (1.25)	0 (0.00)	1 (0.31)
Total (%)	**0 (0.00)**	**8 (10.00)**	**13 (16.25)**	**11 (13.75)**	**32 (10.00)**

Prevalence of Parasites in Relation to Currency Denominations and Types of Notes

The hundred-naira (₦100) denomination had the highest parasitic contamination rate 12 (30.00%) followed by ₦200 10 (25.00%), then ₦500 7 (17.50%), ₦1000 3 (7.50%) while ₦5, ₦10, ₦20 and ₦50 were not parasitized (Table 3). Thus, there was a very high significant difference (χ^2 = 108.75, df = 7, P < 0.0001) in parasitic contamination in relation to denominations of notes. Of all the polymer notes screened, none was found to be contaminated with parasite while at least three notes and above from each of the paper notes denominations were contaminated (Table 3).

Table 3: Prevalence of parasites in relation to currency denominations and types of notes.

Naira currency denomination (₦)	Note type	No. examined	No. contaminated (%)
5	Polymer	40	0 (0.00)
10	Polymer	40	0 (0.00)
20	Polymer	40	0 (0.00)
50	Polymer	40	0 (0.00)
100	Paper	40	12 (30.00)
200	Paper	40	10 (25.00)
500	Paper	40	7 (17.50)
1000	Paper	40	3 (7.50)
Total (%)		**320**	**32 (10.00)**

Prevalence of Parasites in Relation to Currency Sources

Naira notes collected from butchers had the highest prevalence of parasitic contamination 11 (17.19%) followed by food vendors 9 (14.06%), fish sellers 8 (12.50%) hawkers 3 (4.69%) while those from fruits and vegetable sellers 1 (1.56%) had the least parasitic contamination (Table 4). Therefore, there was a high significant difference (χ^2 = 17.386, df = 4, P = 0.001626) in the level of contamination of the Naira notes in relation to currency sources.

Table 4: Prevalence of parasitic contamination in relation to currency sources.

Source of ₦ currency	No. examined	No. contaminated (%)
Food vendors	64	9 (14.06)
Fruits and vegetables sellers	64	1 (1.56)
Butchers	64	11 (17.19)
Fish sellers	64	8 (12.50)
Hawkers	64	3 (4.69)
Total (%)	**320**	**32 (10.00)**

Discussion

This is the first study in Lafia, Nasarawa State that showed that the Nigerian currency notes in circulation within the metropolis are contaminated with five parasite species as shown on the checklist (Table 1) that are known to be pathogenic to humans. This is in agreementt with studies conducted in other parts of Nigeria who reported similar findings [7,8,15-19]. The 10.00% parasites contamination recorded in the circulating notes in this study implies that the notes are a bit cleaner in comparison to the findings of Matur et al. [16], Ahmed and Mujittapha [7], Leonard and Olajumoke [8] and Nasiru et al. [18] who recorded a slightly higher parasitic contamination of 32.0%, 14.0%, 21.9% and 12.04% prevalence in the Federal Capital Territory, Abuja; Kastina metropolis, Kastina State; Ibadan city in Oyo State; and Dustin-ma metropolis in Kastina State respectively. Of the checklist of parasites generated, hookworm was the most prevalent parasite in the Naira currency notes probably due to high chances of the notes falling on the ground surface and as well as the possibility of users using soiled hands to handle these notes. Correspondingly, studies on parasites, cyst and egg on the Nigerian currency by Ombugadu et al. [20] indicated that hookworm was the most prevalent parasites screened from currency notes sourced within Keffi metropolis, Nasarawa State.

The very dirty notes were the most contaminated with parasites probably due to the fact that they had been in circulation for long and exchanged hands more frequently thus exposed to contamination. This agrees with findings of Ahmed and Mujittapha [7], Simon-oke and Ajileye [19] and Ombugadu et al. [20] who reported that the very dirty notes collected from Katsina, Akure and Keffi metropolis were the most contaminated with parasites. However, this is contrary to the finding of George and Ifenyinwa [21] in a study in Akure metropolis who reported that the dirty notes were the most contaminated with parasitic contaminants. The ₦100 denomination notes were the most contaminated with parasites possibly due to the fact that it is commonly at the reach of most people at the lower income group in the populace than the ₦1000-notes. This implies that the ₦100 denomination passes more hands and gets contaminated in the process than the ₦1000 notes which is not handled by many people. This finding is in agreement with the reports of earlier works of Leonard and Olajumoke [8] and Simon-oke and Ajileye [19] who found that the ₦100 notes carried more contaminants. On the other hand, the present observation does not agree with the finding of Ahmed and Mujittapha [7] who noted that the ₦200 denomination notes were the most contaminated.

From this study, it was observed that a number of the paper notes were contaminated with parasites whereas the polymer notes were parasite free. This may be as a result of the rough surface of the paper notes which probably promotes a good attachment area for the parasites whereas polymer notes has a smooth and slippery surface which will not support adherence of the parasites. El-Dars and Hassan [22] had opined that paper notes which are made of 75% cotton and 25% linen offer large surface area for pathogen attachment. Also, Dehghani et al. [23] reported that the degree of contamination is dependent on the texture of the currency. Similarly, this observation is in agreement with Leonard and Olajumoke [8] who recorded parasites on paper notes while none was found on polymer notes screened. On the contrary, the findings of Ahmed and Mujittapha [7], Ombugadu et al. [20] and Simon-oke and Ajileye [19] recorded high parasites prevalence in polymer notes. The very high prevalence rate of parasites in naira notes handled by Butchers may possibly be due to the nature of their job in which they handle meats (gastrointestinal parts) of various animals that might have been infected with parasites. This supports the findings of the studies in Dutsin-ma and Akure metropolis where currency notes handled by butchers were highly contaminated [18,19]. The contamination of notes obtained from food vendors and fish sellers ranked second and third respectively. This suggests that these sources are fun of unhygienic practices in relation to notes handling. For instance, food vendors often times handle money while they serve food at the same time to their customers. Previous works by FSA [24] and El-Dars and Hassan [22] suggests that simultaneous handling of food and money contributes and may as well cause sporadic food borne-diseases.

Conclusion

Findings from this study have shown that circulating Naira notes in Lafia metropolis were contaminated irrespective of currency sources and notes types. With the exception of mints, the physical conditions of all other Naira notes accommodate parasites on them. Paper notes harbor parasites while no polymer note was contaminated. The ₦100 notes were the most contaminated denomination of the Naira notes screened. It is therefore recommended that public health education and awareness campaign to the populace of Lafia metropolis should be carried out focusing on the health benefits of good personal hygiene and the high possibility of acquiring infections while handling Naira notes. Also, the change of paper notes denominations (₦100, ₦200, ₦500, ₦1000) into polymer notes will drastically reduce the prevalence rate of parasites in Naira notes. Food vendors should have separate cashier that strictly handle collection of funds so as to reduce chances of the falling off of parasites into food being served to consumers in the process of collection of Naira notes if the individual dishing out the food is simultaneously the cashier.

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