



Parasite Contamination of Nigerian Currencies in Ibadan City, South-West Nigeria

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Authors' contributions

This work was carried out by the both authors. Author MO designed the study, wrote the protocol and supervised it. Author OAL anchored the field study and gathered the initial data. Authors MO and OAL performed the preliminary data analysis and the interpretation. Authors MO and OAL managed the literature searches and produced the initial draft. Both authors read and approved the final manuscript.

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ABSTRACT

This study was conducted to determine the level of contamination of naira notes by parasites in Ibadan city. Naira notes of all denominations (₦5, ₦10, ₦20, ₦50, ₦100, ₦200, ₦500 and ₦1000) were randomly collected from students, butchers, food vendors and petrol stations, and checked for parasites using standard parasitological techniques. Out of a total of 192 naira notes collected, 27 (14.0%) were found to be contaminated with parasites. None of the clean and polymer notes were contaminated with any parasite. The parasites recovered from paper notes included *Enterobius vermicularis* (3.6%), hookworm (3.1%), *A. lumbricoides* (1.6%) and *Stroglyoides stercoralis* (1.0%). The very dirty/mutilated naira notes were more contaminated (32.8%) than the dirty ones, (9.4%). The one hundred naira (₦100) notes had the highest contamination of 41.7% followed by the ₦200 and ₦500 notes which had 29.2% each. According to sources of currency, contamination was highest on notes collected from food vendors and butchers, while notes from students and petrol stations had lesser contamination. There was a statistically significant association between the rate of parasitic contamination of the currency and the denomination of the currency and between parasite contamination and physical condition of the currency ($p < .05$) while the association

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between the prevalence of parasitic contamination of the naira notes and the source was found not statistically significant ($p > .05$). The result of this study shows that bank notes can serve as a vehicle for the transmission of pathogenic organisms. Good personal hygiene practices such as washing of hands after handling dirty currency is recommended to curtail the spread of these parasites.

Keywords: Parasite contamination; parasite transmission; currency notes; Ibadan city.

1. INTRODUCTION

Money is used as a medium for exchange for goods and services, settlement of debts and for deferred payments in economic activities [1]. We use money as a measuring unit in pricing a transaction and make it a store of value for our savings [2].

Being the most frequently passed item in the world it should not come as a surprise that bank notes are contaminated with various microbes 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 [3]. Paper currency also provides a large surface area as a breeding ground for pathogens [4].

Contamination of the bank notes arises from various handling, treatments and conditions to which the bank notes are exposed. Poor money handling culture which exposes money to being contaminated include keeping currency notes in socks, shoes and pockets, under the carpet or rugs and squeezing them in the hand and lubricating of hands with saliva before counting [2].

The level of contamination and type of organisms on the money vary depending on the country, season, environmental conditions, type of money (paper vs. coins), the type of material the money is made off (paper vs. polymer bank notes), local community flora, the general hygiene level of the population and who is likely to be handling the money. Also dirty/damaged money (indication of frequent exchange) has been shown to be significantly more contaminated than clean and mint condition currency notes, and low denomination notes were more likely to be contaminated than higher denomination notes a situation that probably reflects the frequency of use and socio-economic factors [5].

There is scarce information regarding the degree to which bank notes are contaminated with

pathogens in general and with parasites in particular [2]. Studies in bacterial contamination abound but few studies on the parasite contamination of currencies exist. This study is aimed at bridging the information gap pertaining to the health risk associated with the improper handling of Naira notes by assessing the parasite contamination of these notes.

2. MATERIALS AND METHODS

2.1 Study Area

This study was carried out in Ibadan North Local Government Area (LGA) which is located approximately on longitude 8°5' East of the Greenwich meridian and latitude 7°23' North of the equator. It has an area of 27 km². According to the 2006 National population census, Ibadan North LGA has a population of 306,795. The climate is a tropical wet and dry climate, with a lengthy wet season and relatively constant temperatures throughout the course of the year. The wet season runs from March through October with November to February forming the dry season.

Ibadan North LGA comprises 12 wards. This LGA consists of multi-ethnic nationalities predominantly the Yorubas, Igbos, Edos, Urhobos, Itsekiris, Ijaws, Hausas and Fulanis. The inhabitants are mostly traders, University and Polytechnic lecturers, civil servants and students [6].

2.2 Sample Collection and Categorization

A total of 192 samples of Nigerian naira notes of all denominations (₦5, ₦10, ₦20, ₦50, ₦100, ₦200, ₦500 and ₦1000 notes) were randomly collected from consenting individuals divided into students, food vendors, butchers and petrol stations attendants in Ibadan metropolis between November 2014 and January 2015. Hand gloves were worn to collect the naira notes into polythene bags appropriately labeled according to their denominations and immediately

conveyed to the University of Ibadan Zoology department laboratory for parasite examinations.

The bank notes were separated into three categories based on their physical conditions which included clean, dirty, and very dirty/mutilated. The term "clean" described notes that had clean appearance without any obvious damage. The dirty notes referred to notes that have considerable amount of dirt on them. The very dirty/mutilated notes were those that were faded, damaged, soiled or held together with bits of sticky tape [7].

2.3 Examination of the Naira Notes for Parasitic Contamination

Replicate samples of each naira note were folded and inserted into a sterile bottle and 30 mL of normal saline solution was poured into the bottle containing the naira note using a 30 mL syringe. Each bottle was covered properly, shaken vigorously and left standing for 30 minutes after which it was shaken for the last time. The notes were removed using a pair of forceps while the resulting solution transferred into a centrifuge tube and centrifuged at 2000 rpm for 5 minutes. The supernatant was decanted while the sediment was stirred with a drop placed on a clean slide and covered with cover glass and examined microscopically at a magnification of x10 and x40 for the presence of parasites [8,9]. Identification of parasites was done using the guide by [10].

2.4 Statistical Analysis

Data obtained from the laboratory examination of the naira notes were analyzed using tables, simple percentage and Chi square test. Statistical significance was set at 0.05.

3. RESULTS

3.1 Relationship between Parasite Species and the Physical Conditions of Naira Notes

Of the 192 currency notes analyzed for parasitological contamination, 27 (14.0%) were contaminated with parasites (Table 1). No parasite contamination was found on the clean naira notes and the polymer notes while a total of 6 (9.4%) of the 64 dirty notes and 21 (32.8%) of the 64 dirty/mutilated notes were contaminated

with parasites. Parasites isolated from the currency notes included *Enterobius vermicularis* (3.1%), Hookworm (3.1%), Lice (1.0%), Flagellates (1.0%), *Ascaris lumbricoides* (1.6%), *S. stercoralis* (1.0%), *Isospora belli* (0.5%), Fluke (1.0%) and some unidentified worms (1.6%).

3.2 Relationship between Prevalence of Parasite and Currency Denomination

Table 2 shows the relationship between prevalence of parasite and currency denominations. ₦100 notes were the most contaminated with parasites (41.7%), followed by ₦500 and ₦200 notes each having a parasitic contamination rate of 29.2%. ₦1000 notes had a contamination rate of 12.5%. None of the polymer notes (₦50, ₦20, ₦10 and ₦5) had any parasite contamination. There was a statistically significant association between the rate of parasite contamination of the currency and the denomination of the currency ($\chi^2 = 39.95$, $df = 7$, $p < .05$).

3.3 Relationship between Parasite Contamination and Physical Condition of the Currency

The relationship between parasite contamination and physical condition of the currency is presented in Table 3. The very dirty/mutilated notes had a higher parasite contamination (32.8%) than the dirty naira notes (9.4%) while the clean notes had no parasite contamination. There was a statistically significant association between parasite contamination and physical condition of the currency ($\chi^2 = 30.26$, $df = 2$, $p < .05$).

3.4 Relationship between Parasite Contamination and the Sources of Currency

Table 4 shows relationship between parasite contamination and the sources of currency sampled. Naira notes collected from food vendors had the highest prevalence of parasitic contamination (18.8%) followed by notes collected from butchers (16.7%). Naira notes from students and petrol station each had a parasite prevalence of 10.4%. This observable differences in the prevalence of parasite contamination with respect to the sources was not statistically significant ($\chi^2 = 2.20$, $df = 3$, $p > .05$).

Table 1. Parasite species in relation to the physical conditions of naira notes

| Parasite species | Physical conditions of currency (%) | | | Total number (N=192) |
|--------------------------------|-------------------------------------|--------------|-----------------------------|----------------------|
| | Clean (N=64) | Dirty (N=64) | Very dirty/Mutilated (N=64) | |
| <i>Enterobius vermicularis</i> | 0 (0) | 1 (1.6) | 5 (7.8) | 7 (3.6) |
| Hook worm | 0 (0) | 2 (3.1) | 4 (6.3) | 6 (3.1) |
| Lice | 0 (0) | 1 (1.6) | 1 (1.6) | 2 (1.0) |
| Flagellate | 0 (0) | 0 (0) | 2 (3.1) | 2 (1.0) |
| Ascaris | 0 (0) | 1 (1.6) | 2 (3.1) | 3 (1.6) |
| <i>Stroglyoides stecolaris</i> | 0 (0) | 0 (0) | 2 (3.1) | 2 (1.0) |
| <i>Isoospora belli</i> | 0 (0) | 0 (0) | 1 (1.6) | 1 (0.5) |
| Fluke | 0 (0) | 1 (1.6) | 1 (1.6) | 2 (1.0) |
| Unidentified | 0 (0) | 0 (0) | 3 (4.7) | 3 (1.6) |
| Total | 0 (0) | 6 (3.1) | 21 (10.9) | 27 (14.0) |

Table 2. Prevalence of parasites in relation to currency denomination

| Denomination (₦) | No examined | No positive (%) | No negative (%) |
|------------------|-------------|-----------------|-----------------|
| 5 | 24 | 0 (0) | 24 (100) |
| 10 | 24 | 0 (0) | 24 (100) |
| 20 | 24 | 0 (0) | 24 (100) |
| 50 | 24 | 0 (0) | 24 (100) |
| 100 | 24 | 10 (41.7) | 14 (58.3) |
| 200 | 24 | 7 (29.2) | 17 (70.8) |
| 500 | 24 | 7 (29.2) | 17 (70.8) |
| 1000 | 24 | 3 (12.5) | 21 (87.5) |
| Total | 192 | 27 (14.1) | 165 (85.9) |

$$\chi^2_{(7)} = 39.95; p < 0.05$$

Table 3. Prevalence of parasites in relation to condition of currency

| Currency condition | No examined | No positive (%) | No negative (%) |
|--------------------|-------------|-----------------|-----------------|
| Clean | 64 | 0 (0) | 64 (100) |
| Dirty | 64 | 6 (9.4) | 58 (90.6) |
| Very dirty | 64 | 21 (32.8) | 43 (67.2) |
| Total | 192 | 27 (14.1) | 165 (85.9) |

$$\chi^2_{(2)} = 30.26; p < 0.05$$

Table 4. Prevalence of parasites in relation to currency source

| Source of currency | No examined | No positive (%) | No negative (%) |
|--------------------|-------------|-----------------|-----------------|
| Students | 48 | 5 (10.4) | 43 (89.6) |
| Petrol attendants | 48 | 5 (10.4) | 43 (89.6) |
| Food vendors | 48 | 9 (18.8) | 39 (81.2) |
| Butchers | 48 | 8 (16.7) | 40 (83.3) |
| Total | 192 | 27 (14.1) | 165 (85.9) |

$$\chi^2_{(3)} = 2.20; p > 0.05$$

4. DISCUSSION

The result obtained from this study shows that some Nigerian currencies in circulation within the Ibadan North Local Government Area are contaminated with different parasites as was discovered in other parts of Nigeria [11,7]. An

overall prevalence rate of 14.0% was recorded for the currencies examined in this study.

The presence of these parasites on the Naira notes poses health risk to the masses in Nigeria where people do not wash their hands after counting dirty naira notes. *Ascaris lumbricoides*

and *Entamoeba histolytica* are transmitted orally. *Ascaris lumbricoides* cause ascariasis, a disease that is spread through oral contact with materials contaminated with the ova of *Ascaris*. Infection with large number of *Ascaris* worms may cause abdominal pains or intestinal obstruction. *Entamoeba histolytica* causes the disease amoebiasis which is spread orally through ingestion of the cyst. The pathology of the invasive form of amoebiasis is manifested with amoebic dysentery, liver abscess or possible death [12].

Only the paper naira notes (₦100, ₦200, ₦500 and ₦1000) were observed to be contaminated with parasites with ₦100 notes having the highest prevalence of parasitic contamination (41.7%). The polymer notes (₦5, ₦10, ₦20 and ₦50) examined had no parasitic contamination. The plausible explanation of this result might be that the surfaces of naira notes made of paper can enhance the attachment of parasites and retain moisture for their survival. This result agrees with [13] that the degree of contamination and types of micro organisms present on the currency notes is dependent on sanitary conditions of the area, micro organism endemicity and texture of the currency. The report of the absence of parasites on the polymer notes does not agree with [8,11] who reported the contamination of the polymer naira notes in circulation in Abuja and Abakiliki respectively. However the result that the ₦100 notes were the currency with the highest prevalence of parasitic contamination agrees with that of [7].

A significant association was found between parasite contamination and the condition of the currency ($p < .05$), with higher rates of parasite contamination on the dirty/mutilated notes. This could be as a result of the fact that the dirty and very dirty naira notes have been in circulation for a very long time and have changed hands so frequently that they were exposed to being contaminated. This is in accordance with the works of [7,8,11,14]. This finding has very important health and economic implications, especially in underdeveloped and developing tropical nations of the world and particularly in Asia and Africa. The climatic and environmental conditions of the tropics favour the thriving of many pathogenic microorganisms, and in the face of underdevelopment, inadequate water and sanitation, crowded living conditions, lack of access to health care, and low levels of education, a greater proportion of the populace, particularly the poor, become highly susceptible

to infection and disease [15,16]. Thus the risk of infection is increased several fold when objects that change hands at a high frequency, such as currency notes, are contaminated with micro organisms [17].

There was a significant association ($p < .05$) between contamination with parasites and denomination of currency with contamination being more prevalent among lower-denomination paper notes. This could be as a result of a higher rate of handling and hand-to-hand exchange of the lower denomination paper notes. This is in agreement with the work of [18].

This study found no significant association ($p > .05$) between contamination with parasites and the source of the currency although contamination was relatively more prevalent among food vendors and butchers. This is in agreement with the work of [7], that, in most developing countries, including Nigeria, sanitation facilities at slaughter houses and meat markets are grossly inadequate, resulting in very poor environmental sanitation, thus enhancing cross-contamination from simultaneous handling of money and animal products.

5. CONCLUSION AND RECOMMENDATIONS

The contamination of the naira notes with parasites showed that naira notes can serve as a vehicle for the passage of parasites from an infected person to a healthy individual.

To help control the spread of these parasites, the Central Bank of Nigeria should enforce laws on ethical handling of the naira that would discourage reckless spraying during social functions and ensure periodic withdrawal of dirty notes from circulation. The Central Bank can also change the naira notes made of paper into polymer notes as their surfaces are less likely to harbour parasites as proven by the results of this study. A regular disinfection of currency deposited in banks and post offices by ultraviolet light or formalin vapours should be practiced. Above all, the practice of good personal hygiene should be encouraged that will vehemently condemn tongue-wetting of hands during money counting.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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