



Science

## **CURRENCY NOTES AND ASSOCIATED RISK OF NEGLECTED TROPICAL DISEASES: STUDY ON THE NIGERIAN NAIRA**

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### **Abstract**

Currency notes could play a role in the transmission of faeco-oral pathogens. This study aimed at identifying the possible role of the Nigerian Naira in the transmission of some neglected tropical diseases (NTDs) and the implication on their intervention and control in Nigeria. Method: 250 samples of all denominations of mint, dirty and mutilated Naira notes were examined for presence of parasites using the rinse method. Result: 58.4% of notes were contaminated with 161 cysts and ova of a protozoan (45.3%) and helminths (54.7%): *Entamoeba histolytica* cysts (43.7%), *Enterobius vermicularis* ova (5.4%), *Ascaris lumbricoides* ova (34.7%) and Hookworm ova (12.6%). Parasite contamination was independent of currency denomination ( $X^2 = 45.4$ ;  $P=0.05$ ). Mutilated notes harboured more parasites (51.5%) than dirty notes (44.9%). Mint notes had zero contamination. This was statistically significant ( $X^2 = 5.6$ ;  $P<0.05$ ). Polymer notes were more contaminated (51.37%) than paper notes. This study has identified a public health risk and the potential role of the Naira notes in the epidemiology of some NTDs in the study area. Public education on the health implications of the abuse of the Naira, beyond reasons of patriotism is required now. The Central Bank should ensure quick withdrawal of mutilated notes from circulation.

**Keywords:** Fomites; Currency notes; Nigerian Naira; Parasites; NTDs; Calabar.

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### **1. Introduction**

Infectious agents get to vulnerable subjects and hosts through various routes such as direct contact, food, water, insects and a variety of inanimate objects called fomites. [1]. The role of fomites in disease transmission is significant, being, on the one hand, easily contaminable from various sources in the environment, and also readily available for direct contact with human subjects, on the other; especially in the pathogenic microbial infection chain. [2]. While many parasites take the cyclical or biological pattern involving active transmission by vectors, others that take the

faeco-oral route also have fomites as vehicle for transmission. Some of the debilitating neglected tropical diseases caused by geo-helminths, e.g. ascariasis, whipworm and hookworm infections, are in this group. [3].

Currency notes as legal tender have a prime place in nations' economies as a medium of exchange for goods and services, payment of debts, etc. Despite modern day concept of cashless economy, tremendous trade and other business transactions are still consummated with cash payments. In Nigeria, the cashless policy of the Central Bank is yet at its inception; and while compliance is enforceable through the banking system, the majority of the citizens engaging in low and medium scale business transactions in the rural, urban and township areas are handling and exchanging cash normally, from the motor parks, restaurants, farms, abattoirs, hospitals, schools, hotels, airports, shopping malls and supermarkets, to the open markets. Currency notes are therefore handled, exposed or enclosed by many people of various occupation and habit; and so represent a typical fomite. Studies have documented evidence of currency note contamination with microbial pathogens and parasites [4][5][6][7][8][9][10][11]. In Nigeria, studies on parasite contamination of the Naira notes have been widely reported from various parts of the country [12][13][14][15][16].

Neglected tropical diseases (NTDs) are a heterogeneous group of infections caused by parasite, viruses and bacteria, prevalent in tropical and subtropical conditions in 149 countries, where they affect over a billion of the world's poorest people and pose a significant economic burden to developing economies, but however receive little funding or attention from national governments and medical and donor communities. By the World Health Organisation (WHO) listing, these include Buruli ulcer, Chagas disease, Dengue and Chikungunya fever, Dracunculiasis, Echinococcosis, Foodborne trematodiasis, Human African trypanosomiasis, Leishmaniasis, Leprosy, Lymphatic filariasis, Mycetoma, chromoblastomycosis and other deep mycoses, Onchocerciasis, Rabies, Scabies and other ectoparasites, Schistosomiasis, Soil-transmitted helminthiases, Snakebite envenoming, Taeniasis/Cysticercosis, Trachoma and Yaws (endemic treponematoses). The fight against NTDs requires deploying relevant public health approaches for interventions that would enable detection, prevention and control of the infections. [17].

Over 50% of NTDs are parasitic infections and some, such as the soil-transmitted helminthiases are transmissible via contamination; and include debilitating nematode infections. While studies have widely highlighted the possible role of fomites, intervention strategies might have considered hygiene options; but not enough on the role of currency notes, which are very significant in the transmission course owing to their intensive crowd-handling and manner of use. Less attention to the role of currency notes in this regard might undermine the success of the WHO NTD Roadmap, which aims to eliminate many and eradicate at least two NTDs by 2020.

This study aimed at identifying the possible role of the Nigerian Naira notes in the transmission of some neglected tropical diseases and the implication on their intervention and control in Nigeria.

## 2. Materials and Methods

### Study Area

The study was carried out in Calabar South Local Government Area (LGA) of Cross River State, one of Nigeria's coastal States previously described. [18]. Calabar South LGA lies on the southern most part, sitting on the coastal fringe of the state. It has an area of 264km<sup>2</sup> and a population of 255,900 (2016, projected from 2006 National population Census). [19]. The area enjoys a tropical climate with alternating wet (March – October) and dry (November – February) seasons. The area hosts the largest retail market in Calabar capital city, the Watt market.

### Sample Collection

Samples of the available eight denominations of the Nigerian currency notes, the Naira (₦), were collected randomly from Banks, markets, motor parks, food vendors, street hawkers, sachet water sellers, butchers, meat sellers, fish sellers and students within the study area. A total of 250 samples comprising 32 each of ₦5, ₦10, ₦20, ₦50, ₦100, ₦200 and 29 each of ₦500 and ₦1000 denominations were collected with hands covered with gloves into sterile polythene bags and taken for examination in the Biology Laboratory of Cross River University of Technology, Calabar. The Naira notes were separated into three categories based on their physical condition as mint, dirty and the mutilated. "Mint" were the very clean notes obtained directly from source and not previously circulated; "dirty" referred to notes with considerable amount of dirt on them, and "mutilated" notes were those that were faded, soiled or partially torn and/or held together with bits of sticky tape.

### Examination of Naira Notes for Parasitic Contamination

Each currency note was examined using the rinse method with normal saline, and microscopy as described by Abdulhamid and Mujittapha [15][8][6]. Parasite eggs and cysts isolated were identified using the guide by [20]. The results were analyzed statistically using simple percentage and the Chi-square test.

## 3. Results and Discussions

### Contamination of Currency Notes

Out of 250 pieces of Naira notes examined, 146 (58.4%) were contaminated with parasite cysts and ova (Table 1). A total of 161 cysts and ova of four parasites comprising one protozoan (45.3%) and three helminth (54.7%) species, were recovered from the 146 positive notes. These included *Entamoeba histolytica* cysts (43.7%), *Enterobius vermicularis* ova (5.4%), *Ascaris lumbricoides* ova (34.7%) and Hookworm ova (12.6%), (Table 2).

Table 1: Occurrence of parasites on Naira note denominations

Naira Denomination (₦)	Number examined	Number positive (%)	Number negative (%)
5	32	18 (56.3)	14 (43.8)
10	32	20 (62.5)	12 (37.5)
20	32	21 (65.6)	11 (34.4)
50	32	16 (50.0)	16 (50.0)
100	32	22 (68.8)	10 (31.3)

200	32	20 (62.5)	12 (37.5)
500	29	15 (51.7)	14 (48.3)
1000	29	14 (48.3)	15 (51.7)
<b>Total</b>	<b>250</b>	<b>146 (58.4)</b>	<b>104 (41.6)</b>

**Parasite Occurrence and Currency Denomination**

Currency notes of all denominations were contaminated with parasites. ₦100 notes were the most contaminated (68.8%), followed by ₦20 (65.6%), ₦10 (62.5%), ₦200 (62.5%) and ₦5 (56.3%) in that order. The least contaminated notes were ₦1000 (48.3%); and ₦50 (50.0%), ₦500 (51.7%). Most of the denominations harboured all parasite forms observed, with mixed occurrences of: *Ascaris lumbricoides*, *Entamoeba histolytica*, Hookworm and *Enterobius vermicularis* on ₦5 notes; *Ascaris lumbricoides* and *Entamoeba histolytica* on ₦50 notes; and *E. histolytica* and *Ascaris lumbricoides* eggs on ₦100 notes.

*Entamoeba histolytica* (43.7%) had the highest occurrence, while the least observed was *Enterobius vermicularis* (5.4%), (Table 2). Parasite contamination was independent of currency denomination ( $X^2=45.4$ ;  $P=0.05$ ).

Table 2: Occurrence of parasites on Naira notes

Naira Denomination (₦)	Parasites Isolated				Total (%)
	<i>Ascaris lumbricoides</i> eggs (%)	Hookworm eggs (%)	<i>Enterobius vermicularis</i> eggs (%)	<i>Entamoeba histolytica</i> cysts (%)	
5	4 (6.9)	3 (14.3)	2 (22.2)	12 (16.4)	21 (12.6)
10	7 (12.1)	3 (14.3)	ND	12 (16.4)	22 (13.2)
20	13 (22.4)	ND	ND	9 (12.3)	22 (13.2)
50	10 (17.2)	ND	1 (11.1)	7 (9.6)	18 (10.8)
100	6 (10.3)	6 (28.6)	1 (11.1)	10 (13.7)	23 (13.8)
200	7 (12.1)	1 (4.8)	5 (55.6)	9 (12.3)	22 (13.2)
500	5 (8.6)	4 (19.0)	ND	8 (10.9)	17 (10.2)
1000	6 (10.3)	4 (19.0)	ND	6 (8.2)	16 (9.6)
<b>Total</b>	<b>58 (34.7)</b>	<b>21 (12.6)</b>	<b>9 (5.4)</b>	<b>73 (43.7)</b>	<b>161 (64.4)</b>

**Parasite Contamination and Physical Condition of Currency Notes**

Parasite stages were isolated from the dirty and mutilated Naira notes. Mutilated notes had a higher parasite contamination (51.5%) than dirty notes (44.9%). Zero contamination was recorded on the mint Naira notes (Table 3). The difference was statistically significant ( $X^2=5.6$ ;  $P<0.05$ ).

Table3: Occurrence of Parasites in relation to condition of currency

Currency Condition	Number Examined	Number Positive (%)	Number Negative (%)
Mint	9	0 (0)	9 (100)
Dirty	127	70 (55.1)	57 (44.9)
Mutilated	114	76 (66.7)	38 (33.3)
<b>Total</b>	<b>250</b>	<b>146 (58.4)</b>	<b>104 (41.6)</b>

#### 4. Discussions

This study has identified the potential role of currency notes in the epidemiology of some tropical diseases, having isolated parasite species such as *Ascaris lumbricoides*, Hookworm, *Enterobius vermicularis* and *Entamoeba histolytica* from some Nigerian currencies in circulation within Calabar South Local Government Area, southeastern Nigeria; corroborating reports in other parts of the country from Lagos, western Nigeria [16], to Anambra, Eastern Nigeria [14] and Katsina, Northern Nigeria [15]. The high percentage contamination of 58.4% recorded also compares with results from the western part of the country, but quite higher than those from other parts.

The Naira notes are not inherently parasite laden, but contamination obviously arise from handling and duration in circulation. The dirty and mutilated notes must have been in circulation for a long time, handled abusively by many hands under various conditions such as diverse occupation types, exposure attitudes like ‘spraying’ at social functions and home or mobile safe keeping practices. Dirty notes, especially paper notes are mostly damp and would most likely have higher propensity to trap and harbor parasite eggs and cysts than new and clean notes. In this study, the very dirty/mutilated notes were the most contaminated, while new notes (mint) not previously circulated were entirely free of contamination; with statistically significant association between parasite contamination and condition of currency ( $P < 0.05$ ). Similar findings have also been previously reported, [21][22][8].

The source of currency notes contamination may not be exhaustively listed, however, the remote causes would include the prevailing environmental and socioeconomic factors especially in tropical areas with hot humid climate, poor infrastructure, underdevelopment and poverty, where access to water supply, sanitation, healthcare and adequate housing conditions are lacking; coupled with poor knowledge, attitude and practice of key public health indices. Previous studies in Calabar South reported high prevalence of soil-transmitted helminths in soils/gardens blamed on poor sanitation and runoff effect caused by topography [23]; and amongst children, owing to poor toilet facilities, inadequate water supply and poor hygiene practice including indiscriminate play and licking of currency notes [24]. These may be contributory reasons for the high parasite contamination of the Naira in the area.

At disparity with the reports and submissions of zero contamination of polymer notes by Okoh and Morenikeji [22] because their surfaces are slippery and probably do not retain parasites eggs and cysts easily, this study recorded 58.6% contamination of polymer notes. Polymer Naira notes are in the lower denominations of ₦5, ₦10, ₦20 and ₦50; and these are the most readily available to children, beggars, hawkers and small petty traders in the open market. Indeed, the polymer notes were the most contaminated (51.37%) than paper notes ((₦100, ₦200, ₦500 and ₦1000) (48.63%). It thus appears that the children and the very low income divide of the population are the most vulnerable to the health consequences of currency contamination with pathogenic organisms.

Findings in this study have identified the possible role of the Nigerian currency notes in the epidemiology of some neglected tropical diseases. Isolated worms, *Ascaris lumbricoides*, hookworm and *Enterobius vermicularis* are causative agents of soil-transmitted helminthiases, a loose group of NTDs known to infect about 1.5 billion people worldwide, exerting a major disease

burden with associated morbidity and mortality. The affected population, especially children, in this study are at the risk of *Ascariasis*, the most common roundworm infection incriminated for 60,000 deaths, mainly in children annually [25]; hookworm infection and enterobiasis, which are highly debilitating intestinal worms especially having great impact on children. More than this, as much as currency circulation is not limited to a particular area, the potential risk associated with their contamination with parasites is also limitless. This makes it a significant public health issue and calls for purposive intervention.

## 5. Conclusions and Recommendations

Occurrence of infective stages of parasites on the Naira portends a significant public health problem. Since public handling of cash cannot be possibly eliminated from business transactions, urgent intervention is needed to educate the populace on sound hygienic and proper handling of currency notes. Existing campaigns against the abuse of the Naira is mounted on the perspective of patriotism. Renewed and rebranded efforts that would emphasize the health implications of abuse of the currency notes are required now. Appropriate government agencies should rise to this challenge. The Central Bank of Nigeria should fast-track existing modalities for quick withdrawal of mutilated Naira notes from circulation.

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