

PARASITIC ORGANISMS ON NIGERIAN CURRENCY NOTES IN OJO LOCAL GOVERNMENT, LAGOS, NIGERIA

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ABSTRACT

Studies of the potential contamination of currency with parasites have not been given the interest it deserves. A lot has been done on microbial contamination of currency with viruses, bacteria and fungi. We therefore investigated the contamination of Nigerian currency with the eggs and cysts of parasites in Ojo local government, Lagos State, Nigeria. A Total of 100 samples of Nigerian currency (Naira) consisting of 20 pieces of lower denomination (₦5-₦10) were examined microscopically using the rinse method. The notes were grouped into dirty and dirty/mutilated. 59% were contaminated with the eggs and cysts of parasites. 18 (64.2%) of the dirty notes were contaminated while 41 (54.9%) of the dirty/mutilated notes were contaminated. Eggs and Cysts of five parasites were recovered. Eggs of *Ascaris lumbricoides* 38.9%, Hookworm 25.4%, *Enterobius vermicularis* 3.38%, *Trichurus trichiura* 10.1% and Cyst of *Entamoeba histolytica* 8.4%. There were also mixed infections (13.5%). Five Naira and Ten Naira notes were the most contaminated (23.7% each) while the least contaminated was ₦100 (15.2%). Citizens should be educated on ways of handling money through personal hygiene by not abusing, mishandling or mutilating the Naira. People should be encouraged to keep their money in wallets or purses and not on dirty surfaces. The Central bank of Nigeria should put in place and maintain a retrieval system which will ensure that mutilated notes do not remain in circulation for too long.

Keywords: Cyst, Eggs, Parasites, Currency, Naira notes, Denominations

INTRODUCTION

In ancient times, people did not need money. They practiced trade by barter. In the early 1800 s and 1900 s Scientist began to theorize that transmission of money was associated with the transmission of diseases (Alemu, 2014). A paper currency note is widely exchanged for goods and services worldwide and was first developed in China (Prasai *et al.*, 2008). Money is used as a medium for exchange of goods and services, settlement of debts and for deferred payments in economic activities (Beg and Fisher, 1997). Money is the most widely used and sought after service on planet earth with the potential of changing from one user to the other so could fuel disease spread and a risk to public health (Neel, 2012). An individual living in unhygienic condition will therefore contaminate the notes and these acts as a vehicle to the next user (Ogba, 2007). Currency is handled by large number of people under a variety of personal and environmental conditions thus increasing the possibility of acting as environmental vehicle for transmission of potential pathogenic organisms. Paper currency provides a large surface area as breeding ground for pathogens (Michael, 2002). The contamination of notes could be from several sources i.e. the atmosphere, storage, usage, handling or production (Matur *et al.*, 2008). Daily transactions have made money pass through many hands. The Naira (₦) is the legal tender in Nigeria. Lower denominations of currency are exchanged more than higher denominations because they are frequently handled in petty daily

transactions, more widespread and exchangeable between lower economic classes. Higher denominations show lesser contamination (Matur *et al.*, 2008, Awodi *et al.*, 2000, Oyero and Emikpe, 2007, Ekejindu *et al.*, 2005, Yazah *et al.*, 2012, Emikpe and Oyero, 2007). In this study lower denominations were collected for analysis. Age of the note and material used influences the degree of contamination. Paper notes have been shown to be more contaminated than polymer notes (Oyero and Emikpe, 2007). The Nigerian Naira note is a mixture of 75% Cotton and 25% linen (Brady and Kelly, 2000).

A lot of studies have been carried out on microbial contamination of currency with viruses, bacteria and fungi (Alemu, 2014, Brady and Kelly, 2000, Umeh *et al.*, 2007, Ayandele and Adeniyi, 2011, Yakubu *et al.*, 2014, Awe *et al.*, 2010, Orukotan and Yahaya, 2011). Accumulated data over the last 20 years on microbial status and survival of pathogens on currency notes indicated that they represent a potential cause of food borne diseases (Alemu, 2014). Microbes are ubiquitous and their ability to contaminate objects is more prevalent when compared to parasites (Jolaosho, 1991).

Parasites with direct life cycles do not need an intermediate host to infect a new host so can be acquired by direct ingestion of eggs or cyst and this can be from contaminated surfaces like banknotes. Parasites that have been observed to be able to contaminate naira notes are mainly of fecal origin (Awodi *et al.*, 2000).

Currency notes with parasites have been detected in Nigeria by several scientists. Parasites that have been isolated from currency in Nigeria are eggs of worms like *Ascaris lumbricoides*, Hookworms, *Trichurus trichiura*, *Enterobius vermicularis*, *Taenia*, *Toxocara*, *Hymenolepsis nana* and *dimunuta*. Cysts of protozoans like *Entamoeba histolytica*, *Giardia lamblia*, *Balantidium coli* and *Isospora* have been recovered so also flagellates, lice and mites (Matur et al., 2008, Awodi et al., 2000, Ekejindu et al., 2005, Matur et al., 2010, Orji et al., 2013, Uneke and Ogbu, 2007). Even Automated Teller machines (ATM) and currency counting machines have been observed to be infected with pathogens in Nigeria, presenting a risk to bankers and customers (Enemuor et al., 2012).

The objectives of this present study is to investigate the prevalence of parasites on Nigeria banknotes (lower denominations) which of these denominations have the highest and least contamination and what type of parasites are found on the currency notes.

MATERIALS AND METHODS

Study population

The study was conducted in Lagos State University (LASU), Zoology Laboratory. LASU is in Ojo local Government area of Lagos State, Nigeria. A total of 100 samples of Nigerian currency notes consisting of 20 pieces each of lower denominations (₦5- ₦100) were collected from food vendors, beggars, butchers, bus conductors, hawkers and traders outside the LASU Ojo Campus and from Students within the campus.

Collection of Naira notes

The Naira notes were collected aseptically with hand gloves into a sterile polythene bag and were conveyed to the Zoology Laboratory for parasitological examination and analysis.

Grouping of samples

The Currency notes were in various physical conditions and were categorized as dirty or Dirty/mutilated (damaged, soiled, and squeezed with tapes).

Laboratory examination

The rinse method of Matur et al., (2010) was used. The working bench was swabbed with 70% ethanol. Each Currency note was folded and inserted into a sterile bottle and 10 ml of 0.85% sterile normal saline was dropped on each of the currency notes using a 10 ml syringe. Each bottle

was covered and shaken vigorously and left standing for 30 minutes and shaken all over again. The notes were removed using a pair of sterile forceps and transferred to sterile polythene bags. The content of each bottle was centrifuged in a 15 ml centrifuge at 1500 revolutions per minute for 2 minutes. The resultant sediment was stirred with a clean applicator stick and a drop was placed on a clean grease free slide with a drop of Lugol's iodine (5%) and examined microscopically at x40 and x100 for the presence of parasite eggs and cysts under a compound binocular microscope.

Identification of parasites eggs and cyst

Only viable eggs and cysts were identified. *Entamoeba histolytica* cysts were identified by a four nuclei ovoid cyst of 10-15 µm containing rod shaped chromatoid bodies. The eggs of *Ascaris* were embryonated, oval with characteristics warty or mammilated appearance and 50 by 40 µm. They were brownish yellow and thick shelled with three layers. The eggs of hookworm were characterized by roundish, thin, transparent hyaline shells with blastomeres of between 2-8 cells (60 µm by 40 µm). *Trichuris trichiura* eggs were characterized by barrel or lemon shaped appearance with bipolar protuberances or opercular plugs (50 by 25 µm). *Enterobius vermicularis* eggs are small, translucent, sticky, clumped together in hundreds which aided visibility with a thick shell flattened on one side looking like a D shape, the size ranges from 50-60 µm by 20-30 µm.

RESULTS

Of the 100 samples of currency examined, 28% were dirty while 72% were dirty/mutilated. Five Naira note was the dirtiest (45%) while 100 naira was the most dirty/mutilated (80%). Overall 59% of the notes were contaminated with the eggs and cysts of parasites. Eighteen (64.2%) of the 28 dirty notes were contaminated while among the 72 dirty/mutilated notes 41 (54.9%) of them were contaminated with parasitic agents (Table 1). Overall, Hundred naira notes were the least contaminated with parasitic agents (15.2%) even though was the most dirty/mutilated while five and ten naira notes were the most contaminated (23.7%) each. The differences were not statistically significant ($P < 0.05$).

Cysts and eggs of five parasites were recovered. *Ascaris lumbricoides* eggs 38.9%, Hookworm eggs 25.4%, *Enterobius vermicularis* eggs (3.38%), *Trichuris trichiura* eggs (10.1%) and *Entamoeba* cyst (8.4%) (Table 2). There were mixed infections of *Ascaris lumbricoides*, hookworm and *Trichuris trichiura* in five and ten naira notes. Twenty naira notes had mixed infections with *A. lumbricoides* and

Table 1: Physical condition of the 100 Naira notes and Number contaminated.

Denomination (Naira)	Number examined	Dirty notes N (%)	Number Contaminated N (%)	Very dirty mutilated notes N (%)	Number contaminated N (%)	Total Contaminated N (%)
5	20	9 (45)	4 (44.4)	11 (55)	10 (90)	14 (23.7)
10	20	5 (25)	4 (80)	15 (75)	10 (66.6)	14 (23.7)
20	20	5 (25)	4 (80)	15 (75)	6(40)	10 (16.9)
50	20	5 (25)	3 (60)	15 (75)	9 (60)	12 (20.3)
100	20	4 (20)	3 (75)	16 (80)	6 (37.5)	9 (15.2)
Total	100	28(28)	18 (64.9)	72 (72)	41 (54.9)	59 (59)

Table 2: Prevalence of parasitic organisms observed on the currency notes.

Denomination (Naira)	Number Contaminated N (%)	<i>Ascaris lumbricoides</i> eggs	Hookworm eggs	<i>Enterobius vermicularis</i> eggs	<i>Trichurus trichiura</i> eggs	<i>Entamoeba histolytica</i> Cyst.	Mixed infections
5	14	6 (26)	3 (20)	1 (50)	1 (16.6)	1(20)	2 (25)
10	14	3 (13)	5 (33.3)	1 (50)	1 (16.6)	1 (20)	3 (37.5)
20	10	6 (26)	2 (13.3)	ND	ND	1(20)	1 (12.5)
50	12	3 (13)	3 (20)	ND	3 (50)	1(20)	2 (25)
100	9	5 (21.7)	2 (13.3)	ND	1 (16.6)	1(20)	None
Total	59	23 (38.9)	15 (25.4)	2(3.38)	6(10.1)	5(8.4)	8 (13.5)

ND=Not detected

Entamoeba cyst, fifty naira had mixed infections of *A. lumbricoides*, Hookworm and *Entamoeba* cyst but no mixed infections were found on the 100 naira notes. A total of 8 notes had mixed infections (13.5%).

DISCUSSION

Improper handwashing after using the toilet and ATM machines, counting paper notes using saliva or contaminated water, coughing and sneezing on hands when exchanging money, placement or storage of notes on dirty surfaces as socks, shoes, carpets or brassieres, placing of money in the mouth and biting off corners of notes leads to contamination of notes and are all potential risk. In Nigeria, the Naira notes are abused by squeezing, stapling, cello taping and writing on them. They are sprayed during ceremonies where they are trampled upon as they fall aground. These currency notes, hardly last for more than one year in Nigeria, owing to these poor or negative handling practices (Obi, 1999). This study confirms that the Nigerian money the Naira acts as vehicle to contaminate the next user and makes for cross contamination and easy transfer of pathogen such as parasites (Awodi et al., 2000, Ekejindu et al., 2005, Umeh et al., 2007).

The denomination of notes influence the level of contamination as the ₦100 was the least contaminated. This is in consonance with some studies where lower denominations were more contaminated than higher ones (Matur et al., 2008, Awodi et al., 2000, Oyero and Emikpe, 2007, Ekejindu et al., 2005, Yazah, 2012). This is also a reflection of the present poor economic situation in Nigeria where the Naira is highly devalued to the extent that higher denominations have suddenly become readily unavailable at all level for daily transaction. The Parasites observed in this study have also been observed from the results of past studies (Matur et al., 2008, Awodi et al., 2008, Ekejindu et al., 2005, Matur et al., (2010), Orji et al., 2013, Uneke and Ogbu, 2007). However, the potential health hazard of dirty and dirty/mutilated notes is obvious from this study. Mint and clean notes have been reported as having no parasites (Uneke and Ogbu, 2007).

Ascaris lumbricoides eggs occurred with the highest frequency in this study because of the resilience of the eggs that can withstand extremes of environmental conditions. The eggs are warty and coated with mucopolysaccharide which renders them adhesive to many surfaces. The eggs are very resistant to adverse environmental conditions and most chemical agents which enable the egg to remain viable for a long period.

CONCLUSION

The Central bank of Nigeria (CBN) embarked on a campaign in 1991 to educate the populace on the proper handling of the Naira which they explained was responsible for its short life span (Obi, 1999, Oladele, 1999). More of these campaigns are needed. The CBN should put in place a retrieval system which will ensure that mutilated notes do not remain in circulation for too long. Citizens should be educated to improve on the way they handle money and be encouraged to keep their money in wallets or purses to reduce contamination of money. Regular deworming of children will reduce the amount of eggs available for transmission.

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