



Original Article

POTENTIALS OF COCKROACH VECTORS IN TRANSMITTING PARASITES OF MEDICAL IMPORTANCE IN ABRAKA, DELTA STATE NIGERIA

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ABSTRACT

Poor housing conditions are strongly associated with increased cockroach infestation. In line with this assertion, a study was carried out in selected localities in Abraka, Delta State, Nigeria to ascertain and quantify parasites carried by cockroaches and respondent's attitude towards cockroach infestation. A total of Eight hundred and forty one (841) cockroaches were collected from residential homes and hostels from different sources using baits and examined for internal and external parasites between May and July, 2014. The dominant cockroach species identified was *Periplaneta americana* with a total of 684 (81.33%) individuals, *Blattella germanica* with 97 (11.53%) individuals and *Blatta orientalis* with 50(5.95%).The highest numbers of cockroaches were obtained from Ekrejeta Area. All the cockroaches irrespective of the species were carriers of parasite. It was also observed that the female cockroaches significantly ($p < 0.05$) harboured more parasites (93.2%) than the male specimens (49.5). Cockroaches found in the toilet significantly ($p < 0.05$) harboured more parasites (93.7%) than the other areas of the apartment. At least one of each of the seven different human parasites were encountered on the external and guts of the cockroaches in the following order; *Ascaris lumbricoides* (33.6%), *Strongyloides* (22.4%), *E. coli* (17.4%), *Nycothermus ovalis* (11.3%), *E. histolytica* (7.3%) *E. vermicularis* (6.1%) and Hookworm (1.9%). From a total of Two hundred questionnaires distributed to determine the rate of cockroach infestation, respondents' perception and the method of cockroach control, the most reported evidence of cockroach were live cockroach sighted in their rooms/cupboard (87.5%). About 21.5% of the respondents knew a disease or parasite carried by cockroaches. The most commonly used method of control was insecticides (73%).

Key words: Cockroach infestation, *Periplaneta americana*, *Blattella germanica*, *Blatta orientalis*, Parasites.

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INTRODUCTION

Cockroaches are household pests and ranged in size from $\frac{1}{4}$ "(0.64cm) to 3" (7.62cm) (Lynch, 2007). Over 3500 species have been identified, 30 of these species are more adapted to human habitation. Of these, *Blattella germanica* (German cockroach), *Periplaneta americana* (American cockroach) and *Blatta orientalis* (Oriental cockroach) are considered the most common pest to humans (Baumholtz *et al.*, 1997; Gullan and Cranston, 2005; Salehzadeh *et al.*, 2007; Hamu *et al.*, 2014).

They are the most abundant and obnoxious non biting insect pests in residential buildings, hospitals, hotels and restaurants (Piper and Antonelli, 2012). They are adaptable to domestic life around human and evolution has also conferred the insects with an advantage of avoiding frequent attacks from human due to its ability to survive in dark crevices coupled with nocturnal activities (Fortedor *et al.*, 1991).

Cockroaches are omnivores and have been reported to feed indiscriminately on faeces, human detritus, food stuffs, plastic insulation and wood and are mostly found in the toilets, cupboards and kitchens (Fortedor *et al.*, 1991; Tatfeg *et al.*, 2005; Salehhzadeh *et al.*, 2007, Lynch, 2007). They have the ability to survive without food for several weeks and breed throughout the year in suitable environmental conditions (Baumholtz, *et al.*, 1997; Kumie *et al.*, 2002). When they run over food, they contaminate the food by leaving an oily liquid that has offensive odour or contain bacteria that can cause food poisoning (Brenner *et al.*, 1987). They are also capable of transmitting many pathogens including bacteria, viruses, fungi, protozoa and pathogenic helminthes that threaten humans' health (Tawatsin *et al.*, 2001; Mlso *et al.*, 2005;

Pai *et al.*, 2004; Ghosh and Gayen, 2006). This is probably because cockroaches frequently feed on human feces. (Hamu *et al.*, 2014.) Some of the diseases caused by these pathogenic helminths and protozoans are amoebiasis, Giardiasis, Ascariasis which may also be responsible for chronic diarrhea, liver failure, intestinal disturbances and stunted growth in the affected individuals (Mbanugo and Abazie, 2002; Montessor *et al.*, 2002; Sam-Wobo, 2008 and Adeleke *et al.*, 2012). They are also the major sources of indoor allergens. Exposure and sensitization to cockroach allergens are associated with asthma-related health problems (Rosenstreich *et al.*, 1997, Hamu *et al.*, 2014), the magnitude to which depends on race and socio economic status (Sarpong *et al.*, 1996, Hamu *et al.*, 2014).

There is an unprecedented increase in cockroach population in public places all over the world particularly in Nigeria, the risk to human health arising from cockroach infestations have been reported (Allen, 1987). Cockroaches are abundant in most homes and hostels in Nigeria, where they are actually called "landlords" in homes (Bala and Sule, 2012) due to inadequate hostel accommodation for students and the lack of adequate maintenance of existing facilities, a disproportionately high incidence of pest infestation occurs, arising from poor hygiene and improper storage and disposal of waste (Bradman *et al.*, 2005; Wang *et al.*, 2008; Bamigboye, 2006). Poor house planning and conditions in Abraka which may result to overcrowding and unsanitary conditions in some areas would provide harbourage for pest infestation. This is because; they rely on pit latrines for faecal disposal, indiscriminate waste disposal system and hand dug wells for water supply. Also, the warm and moist

environment would make it an ideal habitat for the inhabitation by cockroaches.

The adverse housing and condition in homes and hostels is strongly associated with increased numbers of cockroach infestation. This is a serious problem in houses within Abraka. The extent of infestation, destruction caused to property, the species involved, parasites they carry and their perceived importance is yet to attract the required research interest in Nigeria especially in Abraka. Despite the high prevalence of intestinal parasites in Abraka town, there is no documented data on the species of cockroaches and their role as carriers of intestinal parasites and people's perception and attitude towards them in the study area to the best of my knowledge. This paucity of information on the role of cockroaches in carrying human parasites is what necessitated this study. The aim of this research is therefore to determine the extent of cockroach infestation the private residential houses, identify the species of the pests present, isolate the parasites of public health importance from the cockroaches and to access the attitude and methods of control practiced by residents.

MATERIALS AND METHODS

Study Area

The research was carried out in selected locations in Abraka. Abraka had a population of over 69,000 people at the end of 2003. Presently, the population is projected to be over 89,000 of which about 36,000 are students. This is because the Delta State University main campus is located in Abraka. The town is one of the main Urhobo clan of Delta State and has a tropical wet and dry climate with a lengthy wet season and relatively constant temperature

throughout the year with mean annual temperature of 30.60°C. The wet season runs from March through October and an annual relative humidity of about 83%. Abraka is drained by Ethiope River and surrounded by primary forests (Efe and Aruegodore, 2003). The housing systems are scattered and linear arrangement and houses are close to each other, mainly bungalows. The major occupations of the residents are farming, trading, schooling and civil service.

Selection of Apartments and Participants

Fifty (50) apartments were randomly selected from four locations in Abraka (Grammar School Area, Ekrejeta, Police Station Road and Monkey Joint Area). A total of Two hundred (200) private residential apartments (male and females) were used for the study. In each sampling, the same number of houses and traps were involved. In each of the selected apartment, the first resident was identified to provide information on students' attitude and practices towards cockroach infestation. Advocacy visits were made to each of the selected apartments to solicit occupants' cooperation and participation throughout the period of the study.

A semi-structured questionnaire was administered to the residents. The occupants provided information on the activities of cockroaches in their apartments and methods of control employed by them. This method was adopted from Omodu and Akosu (2013).

Method of Trapping and Identifying the Cockroaches

Cockroaches were collected using empty jars coated with thin film of Vaseline baited with assorted food items such as a piece of bread soaked in water/roasted fish or crayfish/ripe plantain and sugar. The collection jars were set-

up at 19.00hr and retrieved at 07.00hrs and then transported to the laboratory of the Department of Animal and Environmental Biology, Abraka. Only adult cockroaches with an intact body features were processed in the laboratory. Morphological identification was done using standard keys to determine the species of cockroaches and the sexes of the cockroaches. Samples were collected consecutively for 2(Two) months. This method was adopted from Mogbo (2013) and Hamu *et al.* (2014).

Parasitological Analysis

Isolation of Ectoparasites

The method of Bala and Sule (2012) was used in the isolation of ectoparasites from the cockroaches. In this method, each cockroach was placed in a test tube containing 2mls of normal saline. The test tube was shaken vigorously for two minutes to detach any parasite or their larval stages from the external body of the cockroach. Thereafter, the fluid was centrifuged at 3000rpm for 5 minutes decanting the excess fluid. The residual deposit was placed on a clean glass slide with a cover slip and stained with lugol's iodine and viewed under a X40 microscope objective lens. The parasites seen were identified and counted using standard keys.

Isolation of Gastrointestinal Parasites

From the isolation of gastrointestinal parasites of the cockroaches, references were made to already published works by Etim *et al.*, (2013), Bala and Sule, (2012) and El-Sherbini, and El-Sherbini (2011). Their techniques were adopted with slight modification. After external examination, the cockroaches were separately placed in 70% ethanol for five minutes (to remove parasites from the external surface) and then were washed in sterile saline to remove the alcohol from the body of the

cockroaches. They were allowed to dry at room temperature. The cockroaches were then fixed on a dissecting petri-dish; the head severed first, followed by the legs, the abdomen was opened using fine pointed forceps and discarded. The gut and other abdominal organs were removed using fine needles while the intestine was examined over a black background for detection of parasites. This was done by adding 2ml of normal saline to the intestine macerated. Then 1ml of the macerate was centrifuged at 2000rpm for 5minutes. The supernatant was discarded and the deposit was placed on a clean glass slide, covered with a cover slide and stained with 1% lugol's iodine before examination. Ova and cysts of parasites present were identified and counted following the techniques of Cheesebrogh (2009) and examined using x10 objective lens of the light microscope.

Data Analysis

All data collected were subjected to statistical analysis using Chi square, analysis of variance, and correlation using SPSS Version 20 statistical package.

RESULTS

A total of 841 cockroaches were collected indoors from 200 apartments selected from Private residential houses/hostels in Abraka town in Nigeria. The highest number of cockroaches was obtained from Ekrejeta (302) while the least number of cockroaches were obtained from Grammar School Area (220) as shown in Fig 1.

Three cockroach species namely *Periplanata americana* (81.33%), *Blattella germanica* (11.53%) and *Blatta orientalis* (5.95%) were encountered in the sampling sites (Table 1). It was observed that the density of *P*

americana was significantly higher ($p < 0.05$) than those of *B. germinica* and *B. orientalis*.

It was also observed that the proportion of female cockroaches harbouring

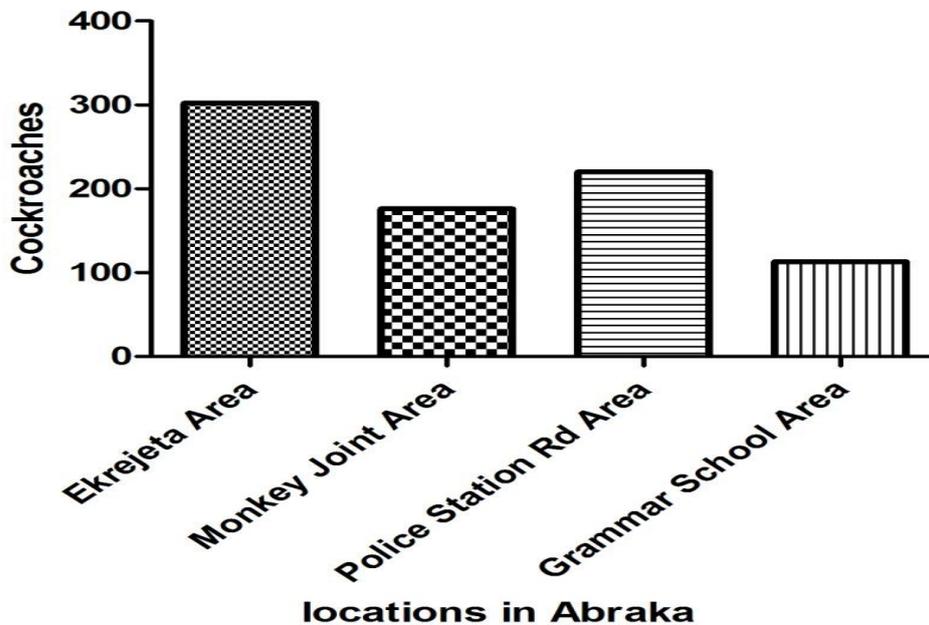


Figure 1. Density distribution of cockroaches in sampling locations in Abraka, Delta State Nigeria.

Table 1. Species composition and relative abundance of cockroaches in selected locations in Abraka, Nigeria

No	Locations	<i>P. americana</i> (%)	<i>B. germinica</i> (%)	<i>B. orientalis</i> (%)	Total Number obtained (%)
1	GSA	98(11.65)	25(2.97)	10(1.19)	133(15.8)
2	EA	270(32.10)	26(3.09)	6(0.71)	302(35.9)
3	PSRA	175(20.81)	27 (3.21)	18(2.14)	220(26.2)
4	MJA	141(16.77)	19(2.25)	16(1.90)	176(20.9)
TOTAL		684 (81.33)	97(11.53)	50(5.95)	841(100)

Two way ANOVA Rows- $p = 0.47$, Columns $p = 0.003$

GSA= Grammar School Area, EA= Ekrejeta Area, PSRA= Police Station Road Area, MJA= Monkey Joint Area

Table 2. Sex-wise distribution and parasite infestation rates of cockroaches from selected locations In Abraka, Nigeria

No	Sample locations	TNC from sample locations	FC from sample locations (%)	FC with Parasites (%)	MC from sample locations (%)	MC with Parasites (%)
	GSA	133	86 (64.7)	79 (91.9)	47 (35.5)	30(63.8)
	EA	302	156 (51.7)	146(93.4)	146(48.3)	78(53.4)
	PSA	220	135(61.4)	128(94.8)	85(38.6)	32(37.6)
	MJA	176	90 (51.1)	82 (91.1)	86(48.9)	40(46.5)
Total		841	467(55.5)	343(93.2)	364(43.3)	180(49.5)

$X^2(22.26)$ df (9) p (0.008)

TNC = Total number of cockroaches, FC = Female cockroaches, MC = Male cockroaches

Table 3. Total number of Cockroaches collected (%) from various apartments and the number positive with parasites

No	Sites in the house	Number of Cockroaches (%)	Number of Cockroaches with Parasites (%)
1	Toilet	319 (50.30)	299 (93.7)
2	Kitchen	350 (29.25)	145 (41.4)
3	Living Room	63 (7.49)	27 (42.9)
4	Wardrobe	109 (12.96)	52 (47.7)
	Total	841 (100)	523 (62.2)

Table 4. Percentage occurrence of parasites found on cockroaches in various apartments in Selected Locations in Abraka.

No	Apartment	No. Of Positive	<i>A. lumbricooides</i> (%)	<i>Strongyloides</i> (%)	<i>E. vermicularis</i> (%)	<i>E. coli</i> (%)	<i>Hookworm</i> (%)	<i>E. histolytica</i> (%)	<i>Nyctothermus ovalis</i> (%)
1	Toilet	299	103(34.4)	75 (25.1)	0 (0.0)	60 (20.1)	10 (3.3)	25 (8.4)	26 (12.0)
2	Kitchen	145	58 (40.0)	33 (22.8)	0 (0.0)	14 (9.7)	0 (0.0)	13 (9.0)	27 (18.2)
3	Living room	27	8 (29.6)	0 (0.0)	13 (48.1)	6 (22.2)	0 (0.0)	0 (0.0)	0 (0.0)
4	Wardrobe	52	7 (13.5)	9 (17.3)	19 (36.5)	11(21.2)	0 (0.0)	0 (0.0)	6 (11.5)
	Total	523	176 (33.6)	117 (22.4)	32 (6.1)	91 (17.4)	10 (1.9)	38 (7.3)	59 (11.3)

Total helminthes harboured 335(64.1%) Total Protozoa harboured 188(35.9%)

Table 5. Respondent's noticeable evidence of cockroach infestation in selected residential houses Ekrejeta of Abraka town Nigeria.

No	Indicator of cockroach infestation	Frequency	Percentage
1	Live cockroach sighted in their houses	175	87.5%
2	Adult cockroach seen	160	80%
3	Cockroach body part seen in their wardrobes/cupboard	45	22.5%
4	Cockroach odour perceived in wardrobes/cupboard	87	43.5%
5	Cockroach eggs seen in cupboard	124	62%
6	Cockroach droppings seen in their Wardrobes/cupboard	105	52.5%
7	Cockroach noise heard in rooms	38	19%
8	No evidence of cockroach is seen	5	2%

Table 6. Respondents' perception of cockroaches in selected areas of Abraka, Delta State.

No	Indicator of cockroach infestation	Frequency	Percentage
1	Does the presence of cockroaches irritates you?	66	33%
2	Do you see cockroach as a nuisance pest?	35	19%
3	Are you allergic to cockroaches?	71	35.5%
4	Do you know a disease or parasite carried by cockroaches?	43	21.5%

Table 7. Respondents' method of cockroach control in selected areas in Abraka

No	Indicator of cockroach infestation	Frequency	Percentage
1	Use of insecticides	146	73%
2	Physical killing	65	32.5%
3	Use of adhesive/glues	20	10%
4	Proper storage of food	135	67.5%
5	Never did anything	45	22.5%

Parasites was significantly higher ($p < 0.05$) than the males (Table 2).

Out of the 841 number of cockroaches collected, 350 cockroaches were obtained from the kitchen. It was observed that about 62.2% of the cockroaches harboured parasites. All cockroaches harbouring parasites obtained from toilets were significantly ($p < 0.05$) higher than cockroaches obtained from other parts of the apartment (Table 3)

It was observed that from the percentage of parasites found in the various apartments, *Ascaris lumbricoides* had the highest occurrence (33.6%) while Hookworm had the lowest occurrence (1.9%). It was also observed that the helminths harboured by the cockroaches were 64.1%, while the total protozoa harboured by the cockroaches were 35.9% (Table 4). The pathogenic helminthes species included are ova of *Ascaris lumbricoides*, ova of *Enterobius vermicularis* and ova of *hookworm*. The protozoa types that were identified include cysts of *Entamoeba coli* and *Nycothermus ovalis* were encountered from internal and external surfaces of the cockroaches.

Out of the 200 Questionnaires administered, 87.5% of the respondents had cockroaches in their residential homes and also noticed the presence of cockroaches (Table 5)

Of the 200 questionnaires administered, the respondents' perception about cockroaches indicated that only 21.5% of the respondent knew a disease or parasite carried by a cockroach while 19% saw cockroaches as nuisance pests (Table 6).

It was observed that 73% of occupants killed cockroaches using insecticides while 22.5% never employed any

method to control the cockroaches (Table 7)

DISCUSSION

The findings of this study showed that cockroaches constitute serious public health threats in Abraka in addition to their potential their destructive habits, irrespective of their species, as they are known to play important roles in the transmission of parasites especially those isolated and identified. As reported by Iwuala and Onyeka (1977) and Bala and Sule (2012), these species of cockroaches are common in Nigeria. They are also considered as the most common pests in human habitation (Baumholtz, *et al.*, 1997; Gullan and Cranston, 2005; Salehzadeh *et al.*, 2007; Hamu *et al.*, 2014). It was observed that high numbers of cockroaches were obtained from Ekrejeta area and Police station Road area and the least was obtained from Grammar school area. This may be as a result of the fact that the populations of indigenes and students were concentrated in Ekrejeta and Police Station road area when compared to other sites because of their proximity to the main campus of the university located in the town. These species of cockroach especially *P. americana* are known to reproduce rapidly and thrive in habitats with availability and abundance of diverse food materials, suitable refuge, and lack of comprehensive control efforts.

It was also observed that the female individuals of the three cockroach species encountered in this study had more parasites than their male counterparts. This may also be attributed to the fact that they roam more than the males in search of both food and sites to lay their eggs therefore come in contact with the contaminated materials making them more vulnerable to the pathogens. Similar findings on the

number of females harbouring parasites more than the male cockroaches have been reported by Bale and Sule (2012). Parasite Infection rate (62.2%) of cockroaches recorded in this study is higher than the 54.1% reported by Chamivat *et al.* (2011) but lower than those of Ajero *et al.* (2011), Al-Mayali and Al-yaqoobi (2010) and Bala and Sule (2012) who reported infection rates of 67%, 83.33% and 77.52% respectively. The differences in hygiene conditions in these various areas may account for the variation in the parasite carriage rate among different settings. The high cockroach densities recorded in Abraka area of Delta State may be due to low socio economic status of the people coupled with unsanitary conditions and lack of good hygiene practices. Many of the areas had garbage and dump sites around vicinities of the homes. This might have caused the high rate of contaminated cockroaches observed in this study.

It was also observed that the cockroaches collected from the toilets had more parasites, probably, because they were easily exposed to and contaminated by faecal matter. As a result of high mobility of cockroaches, they easily deposit parasites carried on their bodies or within them on food and other parts of the house. Similar findings were observed by Etim *et al.*, (2013) in which more parasites were isolated from cockroaches found in the toilets.

The parasites identified in this study are helminthes and protozoa which are all known parasites that produce disease in humans and many reports have shown these parasites to be common in different localities, especially in the area where personal hygiene is lacking. The high occurrence of *A. lumbricoides* over other gastrointestinal parasites and the risk of its transmission have been

associated with poor sanitary conditions. *A. lumbricoides*, Hookworm and *E. histolytica* have been reported to cause chronic diarrhoea, liver complications and stunted growth in affected people. In addition, the presence of *E. vermicularis* infestation indicates that the cockroaches might have had contact with infected people or contaminated clothes which emphasises their vectorial potential for parasitic diseases. The other parasites recovered from the body of the cockroaches have also been reported to cause many gastrointestinal disorders (Mbanugo and Abazie 2002; Chan *et al.*, 2004; Montessor *et al.*, 2002; Sam-Wobo *et al.*, 2006; Tatfeg *et al.*, 2005; Hamu *et al.*, 2014).

Results obtained from the questionnaires indicated that cockroaches were seen in most of the house hold sampled and mostly the adult stages were seen. A few respondents perceived them as nuisance pests and are aware of the parasites vectored by these cockroaches but the use of insecticides on these cockroaches was high. The health implications of cockroach infestation is aggravated by the increasing use of insecticide for control. The continuous use of pesticides may result in the environmental pollution in the various homes could lead to accidental contamination of foods. Similar findings were reported by Omodu and Akosu (2013) on the infestation of rodents and cockroaches in Benue State university student hostels. The use of alternative cheap biodegradable environmentally friendly insecticides should be encouraged in order to reduce the use of synthetic pesticides.

CONCLUSION

The parasites species obtained from habitats in Abraka were high. Many parasites known to cause serious health problems were isolated from guts and external bodies of the cockroaches and this study sheds light on the major role the of cockroaches in the mechanical transmission of human intestinal parasites. Therefore, efforts should be geared towards designing more efficient control intervention strategies and sensitization of the public for the control of cockroaches in their environment

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