PREVALENCE OF PARASITES IN COCKROACHES AND PERCEPTION ON THEIR INFLUENCE IN DISEASE TRANSMISSION IN MUBI-SOUTH, ADAMAWA STATE, NIGERIA

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ABSTRACT

Cockroaches are insects of significant medical importance because of their tendencies in transmitting diseases mechanically. This study was performed to determine the incidence of gastrointestinal parasites in the guts and body surfaces of cockroaches in the residential and hospital areas, and the perception of their role in disease transmission in Mubi-South, Adamawa State. Two hundred cockroaches (100 each from the residential and hospital areas respectively) were collected from various households and hospital areas in Mubi-South, and were screened for gastrointestinal parasites in the laboratory. A well-structured questionnaire was used to source data on peoples' perception on the role of cockroaches in disease transmission. The result revealed eight parasites (A. lumbricoides, E. coli, E. hystolitica, G. lamblia, Salmonella spp., Staphylococcus spp. and Streptococcus spp.) prevalent in the cockroaches collected. Out of the 200 cockroaches collected, only 62(31.0 %) tested positive for gastrointestinal parasites. A. lumbricoides was the predominant species of parasites, while the least was G. lamblia (1 %). The result also revealed the preponderance of parasites in cockroaches collected from the hospital (39 %) than residential (23 %). Also, there were more parasites encountered in body surfaces (61.3 %) of cockroaches than guts (38.7 %). The perception on the role of cockroaches in disease transmission revealed that cockroaches are potential mechanical transmitters of disease pathogens. Therefore, there is need to improve good sanitary measures in our environments in order to contain the influence of cockroaches in the spread of disease, most especially in hospital areas, where cockroach infestation is high.

Keywords: Cockroaches, Disease transmission, Gastrointestinal parasites, Hospital, Mubi-South, Residential area

INTRODUCTION

Cockroaches (Insecta: Blattaria) are worldwide in distribution (Ojiezeh and Ogundipe, 2015), with approximately 3500 known species (Kopanic, 1994). Out of these population, about 30 species live in human dwellings (Kinfu and Erko, 2008), and are associated with areas with biological wastes like septic tanks, garbage cans, animal cages etc. (Melton, 2012). Cockroaches consume rotten foods, stored and processed foods (Kramer and Brenner, 2009). Cockroaches have also been reported to feed on faeces, and are mostly found in cupboards,

kitchens and toilets (Fortedor *et al*., 1991; Salehzadeh *et al*., 2007). They are omnivores, and eat anything organic but with preference to foods like cheese, sweets, starches greases and meat products (Alzain, 2013). Cockroaches' indiscriminate choice of diets, their feeding and filthy habits in terms of their activities and their body structure make them suitable and effective mechanical transmitters of pathogenic parasites (Alzain, 2013; Adenusi *et al*., 2018). Hence, since they mostly live around human dwelling, their presence poses a serious threat to human health and the environment (Baumholtz *et al*., 1997; Alzain, 2013).

Cockroaches have been reported as carriers of gastrointestinal parasites on their body surfaces and guts in Nigeria (Adeleke *et al*., 2012; Hamu *et al*., 2014; Isaac *et al*., 2014), and other parts of the world (Salehzadeh *et al*., 2007; Kinfu and Erko, 2008; Alzain, 2013; Sayyad *et al*., 2016; Atiokeng Tatang *et al*., 2017). Ingested bacteria in cockroaches can survive for months or even years in cockroach's digestive system, and can pass to humans when cockroaches defecate on foods consume by humans, leading to mechanical transmission of diseases (Thaddeus *et al*., 2005). Diseases associated with these parasites, such as ascariasis, giardiasis, ameobiasis malnutrition, chronic diarrhea, growth stunting, liver complications etc. pose serious public problems especially in poor areas, where they lack proper hygiene to combat the spread (Anosike *et al*., 2006). They vomit and defecate on exposed foods, which can easily be transmitted to humans when they feed on foods contaminated by cockroaches (Ojizeh and Ogundipe, 2015).

Therefore, the present study was carried out determine the incidence of parasites of cockroaches from residential and hospital areas of Mubi-South, and peoples' perception on cockroach's role in disease transmission.

MATERIALS AND METHODS

Study Area: The study was carried out in Mubi-South Local Government Area of Adamawa State. It lies on Latitude 10° 00′ North and Longitude 13° 30′ East (Adebayo, 2004). Mubi South shares common border with the Republic of Cameroon and Maiha of Adamawa State to the South. It also shares common border with Mubi-North Local Government Area to the north and with Hong Local Government Area to the west. Mubi-South Local Government Area is characterized by tropical climate, with distinct dry and wet seasons (Adebayo, 2004).

Mubi-South Local Government Area is an urban area with inadequate infrastructural facilities especially those in the rural parts of the Local Government. The sanitary conditions in the study area were below WHO standard. Residential areas are underdeveloped with no pipe-borne water and therefore, residents rely mostly on wells and commercial bore holes for their water needs (Adebayo, 2004). Some lack good toilet facilities and organized community waste disposal systems, and so residents often resort to making use of nearby bushes for these purposes. There are small and large public waste and refuse dump sites around the community of which most are close to dwelling places, thus serving as suitable breeding sites for flies and cockroaches that eventually migrate into nearby houses.

Hospitals found within Mubi-South Local Government area are: General Hospital, Ekogate Hospital, Alheri Clinic, Nja'a Memorial Clinic, Assal Clinic, Alumma Clinic, Nakowa Clinic and Bekay Clinic, Mubi. Other health facilities within the 10 wards of Mubi South are: Dirbishi Primary Health Care Center (PHCC), Gandira Health Care (HC), Duvu PHCC, Chaba HC, Girburum Health Post (HP), Gella PHCC, Malluha PHCC, Gude PHCC, Monduva PHCC, Wuro-patuji HC, Gydkwara HP, Gavahi HP, Kwaja PHCC, Kissa HP, Kinga HP, Lamurde PHCC, Arhan-Kunu HC, Malangacha HP, Gaya HP, Mugulbu PHCC, Bajaure HP, Muda PHCC, Chakamaje, HP, Yadafa HC, Mujara PHCC, Baguna HP, Madanya HP, Sahuda PHCC, Yewa HC, Nassarawo PHCC, Wuro-Bulude HC, Kagii PHCC, Nduku HC, Ayuwa HC, Kwadankin HP, Dubu-Dubu HP, Beta HP and Tsarayi HP.

Ethical Clearance: The study received ethical clearance certificate with reference number (S/MOH/81/T.II/330) from Adamawa State Ministry of Health. Also, additional permission were sought and obtained from Primary Health

Care (PHC) Department, Districts Heads, Village Heads and key informants before the study commenced.

Collection of Cockroaches: Two hundred (200) cockroaches (100 each from the residential and hospital areas, respectively) were collected from randomly selected 20 households and 10 Health Centers respectively across Mubi-South Local Government, Adamawa State. The collections were made between October and November, 2019, between the hours of 8:00 am and 6:00 pm, until the desired number (200) was obtained. Each cockroach was collected and placed in a sterile text tube separately, and transported to Entomology/Parasitology Laboratory of Zoology Department, Adamawa State University, Mubi for parasitological analyses.

Isolation and identification of Parasites from Cockroach body surface: In order to dislodge parasites from body surfaces, cockroaches were washed individually by submersion in 10 ml sterile physiology saline and vortexing at low speed for 2 minutes. Cockroaches were removed from wash solutions using sterile forceps, and were air-dried at room temperature. The wash solutions were centrifuged at 2000 rpm for 5 minutes (WHO, 2019). The resulting sediment was mixed with 0.5 ml of saline and placed on slide, stained with Lugol's iodine and examined microscopically for body parasites.

Isolation of parasites from cockroach gut: Following washing in physiological saline, fixing in 70 % alcohol and subsequent air-drying, each cockroach was placed in a Petri dish and dissected under a dissecting microscope using entomological needles. The whole gut was removed and homogenized in 5 ml physiological saline. The homogenate was filtered through 420 micrometer gauze and centrifuged at 2000 rpm for 5 minutes, following which the supernatant was decanted. The residue was processed further using a modified formol-ether concentration technique (WHO, 2019). The resulting sediment was mixed with 0.5 ml of saline and placed on a slide, stained with Lugol's iodine and examined microscopically (WHO, 2019).

Culture, Isolation and Identification of Bacterial Parasites from Body Surface and Gut of Cockroaches: Microbiological assays viz: culture, isolation and identification of bacterial parasites were performed following the procedures and guides described by Cappuccino and Sherman (1983).

Data Collection Using Questionnaire: A well-structured closed ended questionnaire was used to source data on peoples' perception on the role of cockroaches in disease transmission. The closed ended questionnaire was used for easier analysis of the results and findings. The population size of Mubi-South Local Government area is 129,956 (NPC, 2006). The number of questionnaire (384) distributed was obtained from the sample size formula described by CDC (2012) as follows: $x = \frac{\mathrm{z}\,(1-\mathrm{p})}{2d2}$ where z = 1.96, p = prevalence rate, d = precise decision (0.05).

Statistical Analysis: Data obtained on the incidence of parasites of cockroaches, the parasites burden in the gut and body surface of the cockroaches from hospital and residential areas, and the perceptions of the respondents on the influence of cockroaches in diseases transmission were analyzed descriptively using percentages. Chi-square was used to compare the perception of respondents on the infection rate of parasites based on noticeable evidences and control methods use.

RESULTS

Out of the 200 samples collected, 62(31 %) tested positive for gastrointestinal parasites. 23(23 %) and 39(39 %) of the cockroaches collected harbored parasites at residential and hospital areas respectively (Table 1). Cockroaches from the hospital had more parasites (39 %) burden than those from the residential area (23 %), and most of the parasites were found on the body surface 38(61.3 %), compared to those found on the gut 24(38.7 %) of the infected cockroaches.

Table 1: Occurrence of gastrointestinal parasites in the gut and body surface of cockroaches collected in residential and hospital areas in Mubi-South LGA

Sampling area	Number of cockroaches examined	Number tested positive for parasites (%)	Parasites identified in	
			Gut (%)	Body surface (%)
Residential	100	23(23)	9(39.1)	14(60.9)
Hospital	100	39(39)	15(38.5)	24(61.5)
Total	200	62(31)	24(38.7)	38(61.3)

Ascaris lumbricoides was the most prevalent gastrointestinal parasites in the two study areas in Mubi-South, Adamawa State. *Giardia lamblia* and hookworm were not found on infected cockroaches collected in the residential area, whereas, *Streptococcus* spp. was not found on infected cockroaches from the hospital area (Figure 1).

Risk factors associated with disease transmission by cockroaches as perceived by respondents from Mubi-South, Adamawa State revealed that dirty environment (85.7 %), ability of cockroaches to fly from one place to another (66.9 %), feeding on cockroach infested foods (84.1 %), all favor the transmission of diseases by cockroaches (Table 2). Majority of the respondents also believed that cockroaches carry parasites (66.4 %), and can transmit diseases (80.5 %), either through their droppings (58.1 %) and bite (72.7 %) (Table 2).

Noticeable evidences of cockroach's infestation as perceived by respondents from Mubi-South revealed that the presence of body parts of cockroaches (71.85), odor (41.9 %), eggs (50.9 %) and noise (51.5 %) were indications of infestation by cockroaches (Table 3). The chi-square revealed that there was no significant difference ($p>0.05$) between the noticeable evidences of cockroach infestation (54.2 %) and the methods use in the control of cockroaches in dwellings (54.2 %), such as sanitation (59.4 %), exclusion (43.4 %), maintaining high standard of hygiene (47.9 %), use of traps (42.1 %) as well as the use of chemicals (59.1 %) (Table 3).

DISCUSSION

The study generally revealed that cockroaches pose a major threat to public health in Mubi-South, Adamawa State.

Eight of the parasites prevalent in cockroaches collected in residential and hospital areas have been implicated to cause gastrointestinal disorders of various forms, which may be life threatening. *Ascaris lumbricoides* and hookworm are soil transmitted helminths which constitute major disease burden on humans worldwide (Pullan *et al*., 2014). Some of the gastrointestinal parasites reported in this study like *A. lumbricoides*, *Entamoeba coli*, *Entamoeba histolitica* and hookworm, have been known to cause disorders such as malnutrition, amoebiasis, chronic diarrhea, growth stunting, and liver complications (Mbanugo and Abazie, 2002; Sam-Wobo *et al*., 2006; Anosike *et al*., 2006; Pullan *et al*., 2014; Skappak *et al*., 2014). *Giardia lamblia* which has been reported as the major cause of diarrhea (Osman *et al*., 2016) was the least encountered parasite in the study. Three out of the eight gastrointestinal parasites identified are bacterial isolates. These includes: *Salmonella* spp., which causes gastroenteritis and food poisoning, *Staphylococcus* spp. (which causes infections of the wound, skin and internal organs, and *Streptococcus* spp. (which causes pneumonia) (Ojiezeh and Ogundipe, 2015).

The results also revealed that majority of the parasites were encountered from cockroaches collected from hospitals. This was similar to the studies conducted by Salehzadeh *et al*. (2007), Adeleke *et al*. (2012) and Alzain (2013). The high prevalence of gastrointestinal parasites in cockroaches collected from hospital area may be because of the fact hospitals harbor patients suffering from different diseases caused by parasites; and these patients may drop these parasites in the area either through their feces or other activities, which can easily infect cockroaches during their activities especially at toilet sections of the hospital; hence, resulting to nosocomial transmission of diseases by the cockroaches.

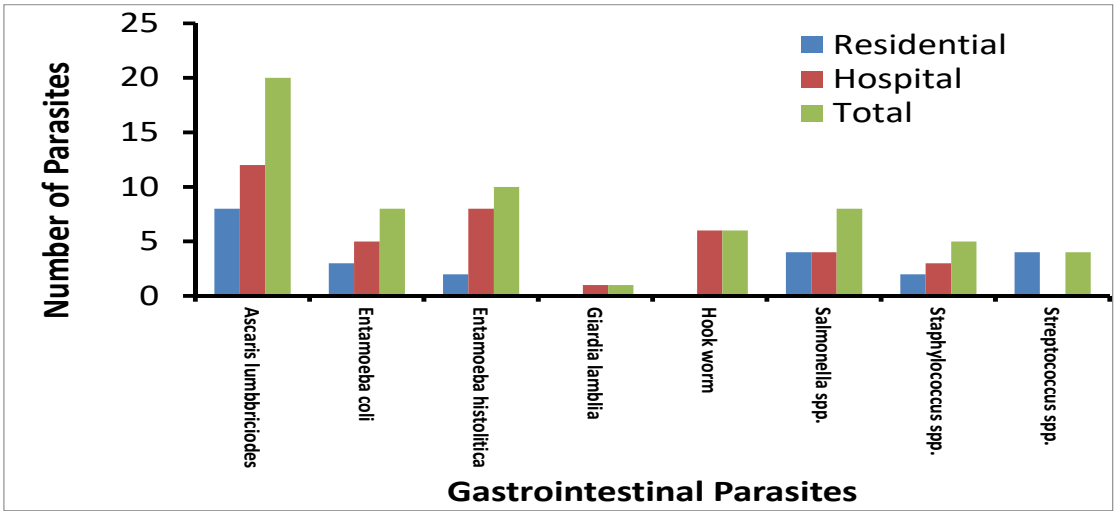

Figure 1: Prevalence of parasites on cockroaches in residential and hospital areas associated with disease transmission in Mubi-South, Adamawa State, Nigeria

Table 2: Perception on the influence of cockroaches in disease transmission in Mubi-South, Adamawa State, Nigeria

Risk Factors	Response	Frequency	Percent	Valid Percent	Cumulative Percent
Dirty environment attracts Cockroaches	Yes	329	85.7	85.7	85.7
	No	55	14.3	14.3	100.0
	Total	384	100.0	100.0	
Cockroaches fly from one place to another and aid in disease transmission	Yes	257	66.9	66.9	66.9
	No	127	33.1	33.1	100.0
	Total	384	100.0	100.0	
Feeding on cockroaches infested foods dangerous to human's health	Yes	323	84.1	84.1	84.1
	No	61	15.9	15.9	100.0
	Total	384	100.0	100.0	
Cockroaches carry parasites	Yes	255	66.4	66.4	66.4
	No	129	33.6	33.6	100.0
	Total	100.0	100.0	100.0	
Cockroaches transmit diseases	Yes	309	80.5	80.5	80.5
	No	75	19.5	19.5	100.0
	Total	384	100.0	100.0	
Cockroach dropping is harmful to human health	Yes	223	58.1	58.1	58.1
	No	161	41.9	41.9	100.0
	Total	384	100.0	100.0	
Cockroaches bite humans	Yes	279	72.7	72.7	72.7
	No	105	27.3	27.3	100.0
	Total	384	100.0	100.0	

Table 3: Perception on noticeable evidence of cockroach infestation in residence associated with disease transmission in Mubi-South, Adamawa State, Nigeria

		Number Examined	Yes (%)	No (%)	Chi-square
Noticeable evidence of cockroach infestation in residence	Cockroach body part seen in their wardrobes/cupboard	142	102 (71.8)	21 (14.8)	45.854[a]
	Cockroach odor perceive in wardrobes/cupboards	105	44 (41.9)	28 (26.7)	
	Cockroach eggs seen in cupboards	57	29 (50.9)	16 (28.1)	
	Cockroach dropping seen in wardrobes/ cupboards	39	12 (30.8)	20 (51.3)	
	Cockroach noise heard in rooms	33	17 (51.5)	6 (18.2)	
	Total	384	208 (54.2)	94 (24.5)	
Method used in controlling cockroach	Sanitation	217	129 (59.4)	36 (16.9)	28.768[a]
	Exclusion	53	23 (43.4)	21 (39.6)	
	Maintaining high standard of hygiene	73	35 (47.9)	26 (35.6)	
	Use of traps	19	8 (42.1)	4 (21.1)	
	Use of chemicals	22	13 (59.1)	7 (31.8)	
	Total	384	208 (54.2)	94 (24.5)	

Parasites carried cockroaches are usually acquired from their immediate environments (Menasria *et al*., 2015), and infestation of our residence and hospitals by cockroaches may be as a result of their poor sanitary conditions. *A. lumbricoides*, which has been reported for its high occurrence in human population (Sam-Wobo and Mafiana, 2005), was the most prevalent (32.3 %) gastrointestinal parasite both in residential (34.5 %) and hospital (30.8 %) areas. This is similar to studies conducted by Adeleke *et al*. (2012) and Alzain (2013).

There were more parasites encountered on the body surface (37) than those in the gut (24) of the cockroaches examined. This probably may be that cockroaches had more physical contact with the parasites than direct ingestion, which may lead gut infestation. Studies conducted by Adeleke *et al*. (2012) and Alzain (2013) also revealed same, when gastrointestinal parasites in the body surface was significantly higher than those encountered in feces of the cockroaches examined. Most of the gastrointestinal parasites identified in this study have been reported in previous studies (Bala and Sule, 2012; Etim *et al*., 2013; Isaac *et al*., 2014; Adenusi *et al*., 2018)

There has been a perception on the role of cockroaches as vectors of diseases by people in different places (Etim *et al*., 2013), but without any documented report (Nagham *et al*., 2011; Etim *et al*., 2013).

However, the result of this study revealed that cockroaches are potential mechanical transmitters of diseases. The parasites identified in the body part and gut of the cockroaches supports the perception of the respondents, as all the parasites identified have been incriminated to transmit pathogenic diseases to humans (Mbanugo and Abazie, 2002; Sam-Wobo *et al*., 2006; Anosike *et al*., 2006; Pullan *et al*., 2014; Skappak *et al*., 2014). This was in agreement with the study conducted by Adenusi *et al*. (2018), who reported the implications of cockroaches in public concerns in Lagos metropolis, southwest Nigeria.

Conclusion: The result of this study further proved the assertion that cockroaches are reservoir of pathogenic agents. As revealed, *A. lumbricoides*, a soil helminth, which transmits

diseases like chronic diarrhea and growth stunting in humans, is the most predominant gastrointestinal parasites in the study area. Therefore, there is need to improve good sanitary measures in our environments, especially in hospital areas, where cockroach infestation is high, in order to contain the influence of cockroaches in disease transmission.

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