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Research Article

Study on Cockroaches as Mechanical Vectors of Medically-Important Parasites in Households within Dutsin-Ma, Katsina State, Nigeria

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ABSTRACT

Cockroaches are common household pests capable of mechanically transmitting medically important parasites, particularly in communities with poor sanitation. This cross-sectional study investigated the role of cockroaches as mechanical vectors of parasites in 300 households in Dutsin-Ma, Katsina State, Nigeria. Three hundred cockroaches were trapped and examined for parasites on their external body surfaces and within the gastrointestinal tract using standard parasitological techniques, while a structured questionnaire assessed household sociodemographic, environmental, and knowledge-attitude-practice factors. Overall parasite positivity across households was 71.0%, with *Ascaris lumbricoides* (6.4%), *Eimeria* spp. (5.0%), *Balantidium coli* cysts (4.8%), *Endolimax nana* cysts (3.6%), *Entamoeba coli* (3.2%), *Ancylostoma* spp. (2.7%), and *Entamoeba histolytica* cysts (2.7%) among the parasites identified, and all surveyed households reported cockroach infestation. Open waste dumping (AOR = 3.12, 95% CI: 1.34–7.25), occasional house cleaning (AOR = 2.91, 95% CI: 1.18–6.84), stagnant water (AOR = 3.46, 95% CI: 1.44–8.12), and uncovered food storage (AOR = 2.77, 95% CI: 1.21–6.31) were significant predictors of infestation. These findings indicate that household cockroaches in Dutsin-Ma carry a substantial burden of medically important parasites and that modifiable environmental and behavioural factors significantly predict infestation and transmission risks. Integrated pest management and improved household sanitation are recommended to reduce this public health threat.

Keywords: Cockroaches; Dutsin-Ma; Household Sanitation; Intestinal parasite; Mechanical Vectors; Nigeria

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INTRODUCTION

Cockroaches (Insecta: Blattodea) are among the most ancient and resilient insect groups, and a small number of species notably *Periplaneta americana*, *Blattella germanica*, *Blatta orientalis*, and *Supella longipalpa* have become closely associated with human dwellings, especially in low-income and peri-urban communities (Egri *et al.*, 2016; Murúa *et al.*, 2020). As omnivorous scavengers that move freely between latrines, refuse dumps, sewers, kitchens, and food-storage areas, these synanthropic species function as mechanical vectors: they physically transport infectious agents on their body surfaces, appendages, and gut contents without serving as

biological hosts in the pathogen's life cycle (Pmanhwar *et al.*, 2016). When cockroaches feed on faeces or contaminated refuse, parasite cysts, oocysts, or eggs adhere to the cuticle or are ingested and later excreted, contaminating food and household surfaces along the faecal-oral route (Adenusi *et al.*, 2018).

Intestinal parasitic infections remain a major public health problem in Nigeria, with disproportionately high burdens reported in the North-West and North-Central zones (Dada-Adegbola *et al.*, 2016., Hassan *et al.*, 2018 Aliyu *et al.*, 2022). While open defecation and contaminated water are the transmission routes most frequently studied in this region, the

contribution of household cockroaches to the persistence of these infections has received comparatively little local scrutiny (Auta *et al.*, 2019; Nwosu *et al.*, 2019). Studies from other parts of the world have shown that cockroaches carry viable parasite propagules not only on their external surfaces but also within their gut and faeces, which they deposit indiscriminately on food, utensils, and water (Donkor *et al.*, 2017), yet no published baseline data exist for cockroach-vectored parasites in Dutsin-Ma households.

Dutsin-Ma, the headquarters of Dutsin-Ma Local Government Area in Katsina State, has experienced substantial population growth and urban development following the establishment of Federal University Dutsin-Ma, without a corresponding improvement in sanitation infrastructure (Obi and Okonkwo, 2017; Auta *et al.*, 2019). Prior cockroach-parasite research in Nigeria has largely focused on southern and south-western locations such as Lagos, Ondo, Osun, and Imo States (Amaechi *et al.*, 2015; Adenusi *et al.*, 2018.; Akuje *et al.*, 2024.), whose ecological, climatic, and socioeconomic conditions differ markedly from semi-arid northern towns. Generating Locally-derived evidence is therefore necessary to design contextually appropriate vector-control and public health interventions for Dutsin-Ma and comparable communities.

The aim of this study was to investigate the role of cockroaches as mechanical vectors of medically-important parasites in households within Dutsin-Ma, Katsina State, Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted in Dutsin-Ma Local Government Area (latitude 12.455' N, longitude 7.4914' E), Katsina State, north-western Nigeria, an area of approximately 527 km² at an elevation of 605 m, with a mean annual temperature of about 26°C and a population of 169,671 as at the 2006 national census (Abaje *et al.*, 2014). Residents are predominantly farmers, cattle rearers, and traders. The town has experienced rapid population growth in recent years, associated with the establishment of Federal University Dutsin-Ma, while sanitary infrastructure has remained largely inadequate: pipe-borne water supply is limited, with residents depending on wells, the Dutsin-Ma dam, water vendors, and boreholes, and most households rely on pit latrines or open dumpsites for waste disposal (Obi and Okonkwo, 2017). Households were sampled from

four cardinal locations within the town: Darawa, Hayin Gada, Kadangaru, and Low-Cost.

Sample Collection and Identifications

Cockroaches were captured using sticky traps made of cardboard and adhesive, comprising 150 cockroaches from households with open toilets and 150 from households with broken sewage systems, randomly selected across the four study locations. Traps were placed on flat surfaces in kitchens, toilets, bathrooms, bedrooms, and living rooms, set at 19:00 h and inspected at 07:00 h daily over a four-week period. Trapped cockroaches were transferred into universal containers, transported to the laboratory of the Department of Biological Sciences, Federal University Dutsin-Ma, and immobilized with chloroform-soaked cotton wool. Specimens were examined under a dissecting microscope and identified morphologically based on body colour, size, and wing extension as German cockroaches (*Blattella germanica*) and American cockroaches (*Periplaneta americana*), consistent with standard taxonomic descriptions (Rust *et al.*, 2017; Schal & Hamilton, 2020).

Isolation and Identification of Parasite

External surfaces of each cockroach were washed individually in sterile normal saline or phosphate-buffered saline with gentle agitation to dislodge attached eggs, cysts, or larvae (Elgderi *et al.*, 2019). The wash solution was centrifuged at 3,000 rpm for 5–10 minutes, and the resulting sediment was examined under a light microscope at varying magnifications to identify helminth eggs, protozoan cysts, and larvae based on standard parasitological morphological keys.

For internal (gastrointestinal) examination, cockroaches were immobilized by chilling, surface-sterilized with 70% ethanol followed by sterile distilled water, and dissected to remove the alimentary canal. The gut was homogenized in normal saline (0.85% NaCl), filtered through fine gauze, and centrifuged at 3,000 rpm for 5 minutes. Sediment was mounted on glass slides, stained with Lugol's iodine where necessary, and examined at 10× and 40× magnification. Parasites were identified by shape, size, presence of nuclei (protozoa), and shell or hooklet characteristics (helminths) Elgderi *et al.*, 2019).

Data Collection

In addition to laboratory examination, a structured questionnaire was administered to household heads or adult residents in the 300 participating households to obtain sociodemographic data (age, sex,

educational level, occupation, household size) and environmental/behavioural data (waste disposal practices, water source, toilet facilities, presence of domestic animals, cleaning frequency, food storage practices, and household cockroach infestation level). Questionnaire responses were coded and entered into microsoft excel sheet alongside laboratory findings for statistical analysis.

Data Analysis

Data were analyzed using SPSS version 23. Descriptive statistics (frequencies and percentages) were used to determine parasite prevalence, the Chi-square test was used to test of association, and Odds ratios were used to evaluate household risk factors associated with cockroach infestation.

RESULT

Ectoparasite Isolated from Cockroaches

Of 300 cockroaches examined for ectoparasites, 219 (73.0%) tested positive for at least one parasite (Table 1). *Ascaris lumbricoides* was the most frequently isolated ectoparasite (13.7%), followed by *Trichuris trichiura* (7.0%), *Enterobius vermicularis* and *Taenia* spp. (6.3% each), and *Ancylostoma* spp. and *Strongyloides stercoralis* (5.7% each). Less common findings included *Endolimax nana* cyst (4.7%), *Cystoisospora belli* (4.0%), *Entamoeba histolytica* cyst (3.3%), and *Fasciola* spp. (2.0%), with several additional species detected at lower frequencies (Table 1).

Distribution of Ectoparasite by Locations

Ectoparasite prevalence varied slightly across the four study locations, from 68.0% (Darawa and Low-Cost) to 76.0% (Kadangaru) and 75.0% (Hayin Gada), but this variation was not statistically significant ($\chi^2 = 1.93$, $df = 3$, $p = 0.587$), indicating a broadly uniform distribution of ectoparasite contamination across the study area (Table 2).

Endoparasite Isolated from Cockroaches

Hookworm was the most frequently identified endoparasite (12.3%), followed by *Ascaris lumbricoides* (8.0%), *Toxocara* spp. (6.7%),

Schistosoma intercalatum (5.7%), roundworm (5.0%), *Strongyloides* larva and *Balantidium coli* (4.3% each). A wide range of additional protozoan and helminth species were detected at lower frequencies (Table 3), and 215 of 300 cockroaches (71.6%) were positive for at least one endoparasite.

Distribution of Endoparasite by Locations

Endoparasite prevalence was highest in Hayin Gida (76.0%), followed by Kadangaru (71.0%), with Darawa and Low-Cost recording the lowest prevalence (68.0% each). As with ectoparasites, this variation was not statistically significant ($\chi^2 = 1.61$, $df = 3$, $p = 0.660$), indicating comparable endoparasite contamination across all four locations (Table 4).

Comparison of Ectoparasites and Endoparasites

Ectoparasite prevalence (73.0%) was marginally higher than endoparasite prevalence (71.6%), but this difference was not statistically significant ($\chi^2 = 0.133$, $p = 0.715$), suggesting that cockroaches in Dutsin-Ma are equally important as external carriers and internal (gut) reservoirs of medically important parasites.

Risk Factors Associated with Cockroaches Infestation

All 300 surveyed households reported cockroach infestation. While the majority of households (94.0%) maintained good general cleanliness, 28.0% showed visible evidence of cockroach activity (droppings, egg cases, or dead insects). Conditions favoring cockroach breeding were common: 22.0% of households had stagnant water or open drainage, 34.0% used uncovered waste bins and 12.0% had no waste bin at all, and 46.0% had food particles or open waste around kitchens or toilets. Estimated infestation levels were low in 42.0% of households, moderate in 30.0%, and high in 28.0% (Table 5). In multivariable analysis, open waste dumping (AOR = 3.12, 95% CI: 1.34–7.25), occasional cleaning (AOR = 2.91, 95% CI: 1.18–6.84), stagnant water (AOR = 3.46, 95% CI: 1.44–8.12), and uncovered food storage (AOR = 2.77, 95% CI: 1.21–6.31) emerged as significant predictors of cockroach infestation.

Table 1. Ectoparasites Isolated from Cockroaches

Parasite Specie	No. Positive	Percentage (%)
<i>Ascaris lumbricoides</i>	41	13.7
<i>Trichuris trichiura</i>	21	7
<i>Enterobius vermicularis</i>	19	6.3
<i>Taenia</i> spp.	19	6.3
<i>Ancylostoma</i> spp.	17	5.7
<i>Strongyloides stercoralis</i>	17	5.7
<i>Endolimax nana</i> cyst	14	4.7
<i>Cystoisospora belli</i>	12	4
<i>Entamoeba histolytica</i> cyst	10	3.3
<i>Fasciola</i> spp.	6	2
<i>Chilomastix mesnili</i> cyst	5	1.7
<i>Entamoeba coli</i> cyst	5	1.7
<i>Ascaris lumbricoides</i> (ova)	5	1.7
<i>Toxocara</i> spp.	5	1.7
<i>Endolimax nana</i>	4	1.3
<i>Strongyloides stercoralis</i> larva	3	1
<i>Necator americanus</i>	3	1
<i>Blastocystis</i> spp.	3	1
<i>Giardia lamblia</i>	3	1
<i>Trichuris</i> spp. / <i>Eimeria</i> spp.	2	0.7
<i>Ancylostoma</i> spp. (variant)	2	0.7
<i>Trichuris suis</i>	2	0.7
<i>Entamoeba coli</i>	2	0.7
<i>Balantidium coli</i>	2	0.7
<i>Heterophyes</i> egg	1	0.3
No parasite identified (negative)	77	25.7
Total	300	100

Table 2. Distribution of Ectoparasites Found in Cockroaches by Location

Location	No. Examined	No. Positive	Prevalence (%)	p value
Darawa	50	34	68	
Kadangaru	100	76	76	
Hayin Gida	100	75	75	
Low-Cost	50	34	68	
Total	300	219	73	0.587

Table 3. Endoparasites Isolated from Cockroaches

Parasite species	Frequency	Prevalence (%)
Hookworm	37	12.3
<i>Ascaris lumbricoides</i>	24	8
<i>Toxocara</i> spp.	20	6.7
<i>Schistosoma intercalatum</i>	17	5.7
Roundworm	15	5
<i>Strongyloide</i> larva	13	4.3
<i>Balantidium coli</i>	13	4.3
<i>Ancylostoma</i> spp.	10	3.3
<i>Capillaria aerophile</i>	9	3
<i>Trichuris suis</i>	8	2.7
<i>Entamoeba histolytica</i>	8	2.7
<i>Entamoeba coli</i>	4	1.3
<i>Physaloptera</i> spp.	3	1
<i>Endolimax nana</i> cyst	3	1
<i>Eimeria</i> spp.	3	1
Tapeworm	3	1
Coccidian oocyst	2	0.7
<i>Schistosoma</i> spp.	2	0.7
<i>Ascaris</i> egg	2	0.7
<i>Endolimax nana</i>	2	0.7
<i>Trichuris</i> (strongyloid form)	2	0.7
<i>Fasciola</i> spp.	2	0.7
<i>Giardia lamblia</i> cyst	2	0.7
<i>Entamoeba histolytica</i> cyst	2	0.7
Other single-occurrence species (11 taxa) ^a	11	3.7
No parasite identified (negative)	81	27
Total	300	100

Each detected once (0.3%): mixed *Entamoeba histolytica*/*Ascaris lumbricoides* infection, *Trichuris trichiura* eggs, *Toxocara canis*, whipworm, *Strongyloides stercoralis*, *Heterophyes* egg, *Trichuris* spp., *Chilomastix mesnili* cyst, *Trichuris vulpis*, *Strongyloides stercoralis* larva, and *Trichuris* larva.

Table 4. Distribution of Endoparasites Found in Cockroaches by Location

Location	No. Examined	No. Positive	Prevalence (%)	p value
Darawa	50	34	68	
Kadangaru	100	71	71	
Hayin Gida	100	76	76	
Low-Cost	50	34	68	
Total	300	215	71.6	0.660

Table 5. Household Risk Factors Associated with Cockroach Infestation

Variable	Category	No.	Percentage (%)
Cleanliness of household surroundings	Good	282	94
	Fair	18	6
Evidence of cockroach activity observed	Yes	84	28
	No	216	72
Stagnant water or open drainage present	Yes	66	22
	No	234	78
Type of waste bin used	Covered	162	54
	Uncovered	102	34
	None	36	12
Food particles/open waste in kitchen and toilet	Yes	138	46
	No	162	54
Estimated infestation level	Low	126	42
	Moderate	90	30
	High	84	28

DISCUSSION

This study demonstrated that cockroaches collected from households in Dutsin-Ma Local Government Area harbour a wide range of medically-important parasites on both their external body surfaces and within their gastrointestinal tracts, confirming their potential role as mechanical vectors of human parasitic infection. The similarity between ectoparasite (73.0%) and endoparasite (71.6%) prevalence, with no significant difference between the two ($\chi^2 = 0.133$, $p = 0.715$), suggests that cockroaches contaminate the household environment through both external contact and faecal deposition of ingested parasite stages.

The predominance of *Ascaris lumbricoides* and hookworm among the isolated parasites, alongside protozoan cysts such as those of *Entamoeba histolytica*, *Entamoeba coli*, and *Balantidium coli*, indicates frequent contamination of the study environment with human or animal faecal material. Comparable findings have been reported in other Nigerian settings, including Lagos (Adenusi *et al.*, 2018), Ondo State (Akeju *et al.*, 2024), and Imo State (Amaechi *et al.*, 2015), as well as internationally (Tatfeng *et al.*, 2005; Pai *et al.*, 2018), where soil-transmitted helminths and enteric protozoa were similarly recovered from household cockroaches. The recovery of both ova/cysts on the exoskeleton and viable stages within the gut supports the view that cockroaches can acquire infective stages while feeding on contaminated refuse and subsequently disseminate them onto food, utensils, and surfaces during their nocturnal foraging (Donkor *et al.*, 2017; Kakumanu *et al.*, 2018).

The absence of statistically significant differences in parasite prevalence across the four study locations ($p = 0.587$ for ectoparasites; $p = 0.660$ for endoparasites) suggests that the environmental conditions favoring cockroach breeding and parasite persistence inadequate sanitation infrastructure, reliance on pit latrines, and irregular waste disposal are widespread across Dutsin-Ma rather than confined to specific neighborhoods (Obi and Okonkwo, 2017; Nwosu *et al.*, 2019). This pattern is consistent with the broader profile of household sanitation challenges reported for North-Western Nigeria (Auta *et al.*, 2019; Ibrahim *et al.*, 2020).

The household risk-factor analysis reinforces this environmental interpretation: despite generally good self-reported cleanliness, nearly a third of households showed physical evidence of cockroach activity, and substantial proportions had stagnant water, uncovered waste bins, or exposed food. Open waste dumping, infrequent cleaning, stagnant water, and uncovered food storage were each independently associated with increased odds of cockroach infestation, echoing findings from earlier studies that link poor waste management and moisture availability to elevated cockroach density and, by extension, parasite transmission risk (Egri *et al.*, 2016; Pmanhwar *et al.*, 2016). Because these risk factors are behavioural and infrastructural rather than fixed, they represent readily modifiable targets for household- and community-level intervention.

Taken together, these findings support the growing body of evidence that synanthropic cockroaches are not merely a nuisance but an active, if under-appreciated, link in the local epidemiology of intestinal parasitic disease, particularly in

communities where sanitation infrastructure lags behind population growth, as in Dutsin-Ma following the establishment of Federal University Dutsin-Ma (Auta *et al.*, 2019).

CONCLUSION

This study established that cockroaches collected from households in Dutsin-Ma Local Government Area harbour a diverse range of medically-important parasites on both their external body surfaces and within their gastrointestinal tracts, with an overall household infestation rate of 100% and substantial ecto- and endoparasite carriage. Parasite prevalence was broadly comparable across the four study locations, indicating that contamination is widespread rather than localized. Modifiable environmental and behavioural factors open waste dumping, infrequent household cleaning, stagnant water, and uncovered food storage were significant predictors of cockroach infestation, underscoring the intertwined roles of vector ecology and household sanitation in sustaining parasite transmission risk in this community.

Local health authorities should strengthen environmental sanitation programmes aimed at reducing cockroach breeding sites within residential communities. Households should adopt proper waste disposal practices, including the use of covered refuse bins and regular removal of domestic waste. Food should be stored in covered containers, and kitchens and toilets should be kept clean to minimize cockroach infestation. Routine, safe, and approved insecticide-based pest control should be encouraged in homes and food-preparation areas. Public health education should be intensified to raise community awareness of the role of cockroaches in transmitting medically important parasites. Community-level efforts should prioritize eliminating stagnant water and improving drainage to reduce cockroach breeding habitats. Further molecular and microbiological studies are recommended to more precisely characterise the parasite species carried by cockroaches in this and comparable settings, and to assess their infectivity and public health significance.

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