

Full Length Research Paper

Cockroach and rodents infestation in Benue State University students' hostel in Makurdi and their epidemiological implications

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Accepted 9 January, 2013

Adverse housing conditions in homes and hostels are strongly associated with increased odds of both rodent and cockroach infestation. This study was designed to determine the species of rodents and cockroaches infesting university hostels, the extent of infestation and the methods of control practiced by students. Cockroaches and rodents were trapped using the Hercules mouse glue board. An average of 1.72 rats per room was collected. The number of rats caught from boys' hostel (Unity campus) and girls' hostel (Technical block) were significantly higher than those caught from the other hostel blocks ($\chi^2 = 39.3$, $df = 4$, $P < 0.05$). Three species of rodents were identified, *Mus musculus* (24.1%), *Rattus norvegicus* (34.0%) and *Rattus rattus* (41.9%). 502 cockroaches were caught from 142 (54.6%) of the hostel rooms inspected, and an average 3.53 cockroaches were caught from a room. Girls' hostel technical block accounted for the highest cockroach infestation rate (32.3%) and this differs significantly from the other hostel blocks ($\chi^2 = 11.4$, $df = 4$, $P < 0.05$). This study shows that overcrowding, cooking in the hostel and refuse accumulation provide conducive breeding ground for cockroaches and rodents. The severe health implications arising from cockroach and rodent infestation justify the need to provide hygiene education to both students and hostel management staff to be able to link cockroach and rodent infestation to health and disease.

Key words: Cockroach, rodents, infestation, university hostels, Makurdi, Nigeria.

INTRODUCTION

Pest infestation is a recognized residential hazard that has been associated with higher risk of asthma symptoms in the case of cockroach (Wang et al., 2008; Sarinho et al., 2004) and Lassa fever, in the case of rodents (Bonner et al., 2007; Bradman et al., 2005). 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 housing conditions resulting to overcrowding of limited hostel facilities in

many Nigerian Universities, provide ample habourage for pest infestation due to unsanitary stacking of food items, as well as congestion of rooms with varieties of articles (Majekodunmi et al., 2002; Onyido et al., 2009). The high incidence of cockroaches in public housing apartments poses numerous public health risks, including exposure to allergens through the air and via food contamination, resulting in an increased incidence of health problems, mainly asthma (Wang et al., 2008; Lwebuga-Mukasa et al., 2002). Cockroaches are also capable of transmitting many pathogens including bacteria, viruses, fungi, protozoa and pathogenic helminthes that threaten human

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health (Tawatsin et al., 2001; Ilso et al., 2005; Pai et al., 2004; Ghosh and Gayen, 2006). Rodents infestation on the other hand has long been associated with risk of Lassa fever epidemics and the transmission of many serious diseases including plague, hantavirus pulmonary syndrome, murine typhus, rat bite fever, salmonella and leptospirosis (Fisher and Miller, 2003; Bonner et al., 2007; Bradman et al., 2005). Lassa fever is endemic in West Africa and has been reported from Sierra Leone, Guinea, Liberia, and Nigeria. Some studies indicate that 300,000 to 500,000 cases of Lassa fever and 5000 deaths, occur yearly across West Africa (Ogbua et al., 2007). The synergistic health and economic consequences of rodents and cockroach infestation is resulting to the use of home pesticide for their control, a situation that increases indoor pesticide residue (Arlan, 2002).

That adverse housing condition in homes and hostels is strongly associated with increased odds of both rodent and cockroach infestation is not in doubt.

The extent of infestation, destruction caused to property, the species involved and their perceived importance, is yet to attract the required research interest in Nigeria. The objectives of this study therefore, were to determine the extent of rodents and cockroach infestation in a University hostel, species of these pests involved and methods of control practiced by the students. The findings of this study will be used to design and develop pest control strategies that will involve education and students' participation.

MATERIALS AND METHODS

Description of study area

The study was conducted at the Benue State University (BSU), Makurdi, between October, 2009 and March, 2010. Makurdi is the capital of Benue State in Nigeria; the State covers an area of about 34,059 square kilometers with a population of over 4.2 million people (National Population Commission, 2006). Benue State has two seasons called the rainy and dry season, as rainfall is the real climatic variable.

The rainy season is from April to October (7 months, with 800 to 1,100 mm of rain) while the dry season runs from November to March (5 months, with 200 to 400 mm of rain). Temperature ranges from 26 to 29.5°C in the dry season and 19.5 to 24°C in the rainy season, with mean relative humidity of 78%.

The town lies between latitude 7° 30' to 8° 00' N and longitude 8° 30' to 9° 00' E and situated in the guinea savanna vegetative region in Nigeria. The University was established 17 years ago and has 13 halls of residence, each averaging about 48 rooms to serve a student population of about 18,000. Each room was originally designed for 2 students but now officially has between 3 to 4 students per room due to large increase in student admission without corresponding increase in hostel facilities. A common feature of most Nigerian university hostels is the stocking of foodstuffs by individual students inside their rooms, especially under their beds and inside the wardrobe (Bamigboye, 2006). Significant among the problems created by cooking in the hostel are the increased volume of garbage generated and poor strategies for disposal and hygiene.

Selection of rooms and participants

Twenty (20) rooms were randomly selected in each hall of residence, and in each of the selected rooms the first occupant was identified to provide information on students' attitude and practices towards cockroach and rodent infestation. Advocacy visits were made to each of the selected rooms to solicit occupants' cooperation and participation throughout the period of the study. A semi-structured questionnaire was administered to the room occupants. The questions investigated activities of cockroaches and rodents in the rooms and methods of control employed by students.

Methods of trapping cockroaches and rodents

Cockroaches and rodents were trapped using the Hercules mouse glue board, measuring 30 cm in length and 20 cm in width. After thorough visual inspection of the room to identify cockroach and rodents' tracks, droppings and eggs, the glue board was then placed on the path. Pieces of crayfish or smoked fish were placed in the middle of the board as bait. The glue board was left overnight and trapped cockroaches and rodents were collected in the morning and taken to the Zoology laboratory for preservation and identification. While rodents were identified using keys provided in Fisher and Miller (2003), the cockroaches were identified using identification keys in Runstrum and Bennet (1990).

Data analysis

Data was analyzed using percentages and frequencies while chi-square was used to test for significance of infestation rates in the different halls of residence.

RESULTS

The study inspected 260 students' hostel rooms for rodents and cockroach infestation, and a total of 203 rats were caught from 118 (45.5%) rooms (an average of 1.72 rats per room). The number of rats caught from Boys' hostel on the unity campus and girls' hostel Technical block were significantly higher than those caught from the other hostel blocks ($\chi^2 = 39.3$, $df = 4$, $P < 0.05$). Three species of rodents were identified, *Mus musculus* (24.1%), *Rattus norvegicus* (34.0%) and *Rattus rattus* (41.9%) (Table 1). On the other hand, 502 cockroaches were caught from 142 (54.6%) of the hostel rooms inspected, and an average 3.53 cockroaches were caught from a room. Girls' hostel Technical block accounted for the highest cockroach infestation rate (32.3%) and this differs significantly from the other hostel blocks ($\chi^2 = 11.4$, $df = 4$, $P < 0.05$) (Table 2). The American cockroach, *Periplaneta americana* was the most predominant cockroach species encountered, accounting for 50.6% of total cockroaches caught. Other species were the German cockroach, *Blattella germanica* (34.7%) and *Supella longipalpa* (14.7%). Students reported several evidences of rat infestation in their rooms, the three most reported evidences were rat runs noticed in room corners (24.6%), rat droppings in wardrobes (18.5%) and rat burrows in boxes and cupboards (15.8%)

Table 1. Common species of rodents trapped from BSU students' hostels in Makurdi, Nigeria.

Hostel	Number of room inspected	Number of rooms with rodents (%)	Number of rodents caught	<i>Mus musculus</i>	<i>Rattus norvegicus</i>	<i>Rathus rattus</i>
Boys' hostel main campus	20	7 (35.0)	16 (7.9)	2 (12.5)	6 (37.5)	8 (50.0)
Girls' hostel main campus	40	17 (42.5)	26 (12.8)	6 (23.0)	8 (30.8)	12 (46.2)
Boys' hostel unity campus	60	38 (63.3)	62 (30.5)	14 (22.5)	28 (45.2)	20 (32.3)
Girls' hostel unity campus	80	21 (26.3)	28 (13.8)	16 (57.1)	11(39.3)	1 (3.6)
Girls' hostel technical block	60	35 (58.3)	71 (35.0)	11 (15.5)	16 (22.5)	44 (62.0)
Total	260	118 (45.4)	203	49 (24.1)	69 (34.0)	85 (41.9)

($X^2 = 39.3$, $df = 4$, $P < 0.05$).

Table 2. Common species of cockroach trapped from BSU students' hostels in Makurdi, Nigeria.

Hostel	Number of room inspected	Number of rooms with cockroach (%)	Number of cockroaches caught	<i>Periplaneta americana</i>	<i>Blattela germanica</i>	<i>Supella longipalpa</i>
Boys' hostel main campus	20	18 (90.0)	125 (25.0)	79 (63.2)	41 (92.8)	5 (4.0)
Girls' hostel main campus	40	19 (47.5)	58 (11.6)	23 (39.6)	29 (50.0)	6 (10.4)
Boys' hostel unity campus	60	28 (46.7)	84 (16.7)	46 (54.8)	21 (25.0)	17 (20.2)
Girls' hostel unity campus	80	35 (43.8)	73 (14.5)	31 (42.5)	22 (30.1)	20 (27.4)
Girls' hostel technical block	60	42 (70.0)	162 (32.3)	75 (46.3)	61 (37.7)	26 (16.0)
Total	260	142 (54.6)	502	257 (50.6)	174 (34.7)	74 (14.7)

($X^2 = 11.4$, $df = 4$, $P < 0.05$).

Table 3. Respondents' noticeable evidence of rodents' infestation in BSU hostels in Makurdi, Nigeria.

Indicators of rodents infestation	Frequency	Percentage
Rat runs noticed in corners of rooms	64	24.6
Rat droppings found on floor and in wardrobes	48	18.5
Hole/burrow in wardrobes/cupboards	41	15.8
Live rats often sighted inside cupboards/wardrobes	26	10.0
Reduction in amount of food stuff	24	9.2
Rat noise heard	21	8.1
No evidence of rat infestation	36	13.8
Total	260	100

(Table 3). Some of these noticeable evidences of rat infestation were reported even in rooms where rats were not caught. The three most reported evidences of cockroach infestation were sighting live cockroaches (38.8%), cockroach body parts seen in wardrobes/ cupboard (27.3%) and cockroach odour perceived in cupboards (13.5%) (Table 4). Respondents were more concerned with rat infestation than cockroach infestation; 64.7% of respondents' preferred cockroach infestation to rats.

The most commonly reported damages to properties resulting from cockroach and rat infestation were contamination and consumption of food stuff (29.6%), books (21.1%) and bags (9.6%) (Table 5).

Students in the hostels have resorted to a wide range of activities targeted at controlling cockroaches and rats. The most commonly used method is the use of insecticides for cockroach (44.6%) and a variety of rodenticides popularly known as rat killers (26.1%). This usually combined with physical killing for both rats and cockroaches (Table 6).

The findings from this study demonstrate that students in the hostel have to cope with both physical health risks and the nuisance of cockroach and rat infestation. Both rodents and cockroaches were caught from 20.7% of the rooms inspected; this combined infestation could have additional consequences.

Table 4. Respondents’ noticeable evidence of cockroach infestation in BSU hostels in Makurdi, Nigeria.

Indicator of cockroach infestation	Frequency	Percentage (%)
Live cockroach often sighted in room/cupboard	104	38.8
Cockroach body parts seen in wardrobes/cupboard	71	27.3
Cockroach odour perceived in wardrobes/cupboards	35	13.5
Cockroach eggs seen in cupboards/wardrobes	28	10.8
cockroach droppings seen in cupboards	9	3.5
Cockroach noise heard in room	3	1.1
No evidence of cockroach infestation	13	5.0
Total	260	100

Table 5. Damage to items caused by rodents and cockroaches in BSU students hostels in Makurdi, Nigeria.

Item	Frequency	Percentage
Food stuff	77	29.6
Books	55	21.1
Bags/ boxes	25	9.6
Textiles	27	8.5
Shoes	21	8.1
Carpets rugs	16	6.2
Mattresses/pillows	11	4.2
No item damaged	33	12.7
Total	260	100

DISCUSSION

The incidence of cockroaches and rodents in students’ hostels poses numerous public health risks. The outcome of this study indicates that overcrowding, cooking in the hostel and low level sanitation and hygiene encourage the breeding of rodents and cockroaches. Species of cockroaches and rodents encountered in university hostels in this study seem to be widespread. *R. rattus* and *R. norvegicus* have been frequently reported in residential buildings in both urban and rural areas in many parts of the world (Stojcevic et al., 2004; Bradman et al., 2005; Omudu and Ati, 2009). The American cockroach, *P. americana* and the German cockroach, *B. germanica*, on the other hand are the commonest roaches infesting buildings worldwide (Tawatsin et al., 2001; Sarinho et al., 2004; Mlso et al., 2005; Bradman et al., 2005; Omudu and Eyumah, 2008). These species of rodent and cockroaches are known to reproduce faster and thrive in habitats with availability and abundance of diverse food materials, suitable refuge, and lack of comprehensive control efforts.

Several studies have linked adverse housing conditions in residential apartments to an increased odds of both rodent and cockroach infestations (Bradman et al., 2005; Bonner et al., 2007; Wang et al., 2008). Our finding

corroborates earlier studies in university hostels and residential apartments in Nigeria (Mbanong et al., 2002; Bamigboye, 2006; Omudu and Eyumah, 2008; Omudu and Ati, 2009). In addition to poor sanitation and lack of proper maintenance, Nigerian universities are known to be largely overcrowded, with more than twice the number of students expected to occupy the rooms. Also contributing is the fact that many students cook in the hostel, these factors substantially provide a wide range of food items, increase the amount of waste generated and escalate the breeding of rodents and cockroaches (Bamigboye 2006; Wang et al., 2008; Onyido et al., 2009).

Poor sanitary conditions in the hostel and overcrowding provide enabling environment for cockroach and rodent infestations, both of which are allergenic and can carry infectious diseases. A large number of microorganisms have been isolated from cockroaches captured, either from residential apartments, hospitals or other buildings. Recent studies in Iran reported a high percentage of test cockroaches (98%) carrying various microorganisms (bacteria, fungi and parasites) in and on their bodies, some of them of medical importance (Salehzadeha et al., 2007). Exposure to cockroach allergens through air and via food contamination results to an increased incidence of health problem, mainly asthma and cockroaches are potential to vector dysentery and gastroenteritis (Bradman et al., 2005; Wang et al., 2008). Studies have reported robust association between cockroach infestation and development of asthma as relevant allergens have been identified in the body and secretions from cockroach’s body (Sarinho et al., 2004). On the other hand, rodent infestation is associated with the occurrence of Lassa fever. Evidences of rodent infestation like rodent burrows have been strongly associated with Lassa fever incidence in homes (Davis et al., 2005; Bonner et al., 2007). Other health implications of rodent infestation are that they are reservoirs for a variety of zoonotic diseases like *Toxoplasma goondi* (Stojcevic et al., 2004; Murphy et al., 2007). The involvement of rodent and cockroaches in transmission of life-threatening infections is epidemiologically significant and could be responsible for increasing incidence of emerging infectious diseases. Refuse disposal and food handling practices in many Nigerian

Table 6. Respondents' methods of rodent/cockroach control in BSU hostels in Makurdi, Nigeria.

Adopted control methods	Frequency	Percentage
Rodents		
Physical killing	96	37.0
Rat poison	68	26.1
Use of traps (glue board, snap trap)	44	17.0
blockage of burrows and tracks	17	6.5
Proper storage of food stuff	10	3.8
Never did anything	25	9.6
Total	260	100
Cockroaches		
Use of insecticides (Chlorpyrifos DDVP, Permethrin, Dichlorvos)	116	44.6
Physical killing	93	35.8
Use of adhesive gum	18	7.0
Proper storage of food stuff	9	3.5
Never did anything	24	9.2
Total	260	100

universities hostels provide ideal habitats for cockroaches and rodents to breed. The Girls' hostel technical block and the boys' hostel Unity campus are surrounded by open fields overgrown with weeds providing a mosaic of agricultural and village areas. These may be the reason for the significantly high infestation rates recorded in these hostel blocks. It has been reported that human environment, such as shrubs and refuse dumps, attract rodents for shelter and refuge (Onyido et al., 2009). Poor external hygiene may act as a risk factor for rodent and cockroach infestation of residential homes and transmission of lassa virus and precipitation of asthmatic attacks (Sarinho et al., 2004; Bonner et al., 2007).

Additional health consequences of rodent and cockroach infestation are the resultant increase in use of pesticides. Frequent pesticide use results in environmental pollution and poor air quality within rooms. The high percentage of student resorting to rodenticides and insecticide to control infestation could cause accidental contamination of foods stuff inside students' rooms and increase indoor pesticide residue (Majekodumi et al., 2002; Bamigboye, 2006; Wang et al., 2008). Control strategies should therefore be directed to emphasis of knowledge of the biology and ecology of target rodent and cockroaches, improvement in sanitation and hygiene and limited pesticide use.

Conclusion

This study shows that overcrowding, cooking in the hostel and accumulating refuse provide conducive breeding

ground for cockroaches and rodents. The severe health implications arising from cockroach and rodent infestation justify the need to provide hygiene education to link cockroach and rodent infestation to health and disease.

Controlling pest infestation in hostel settings will require a comprehensive approach targeted at reducing overcrowding of rooms, improvement of hygiene and sanitation, and general maintenance of hostel facilities on campus.

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