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Bedbug infestation and its control practices in Gbajimba: a rural settlement in Benue state, Nigeria

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Abstract

Background & objectives: The common bedbug *Cimex lectularius* Linnaeus 1758 (Hemiptera: Cimicidae) is a globally re-emerging pest of serious public health concern. We investigated bedbug infestation in randomly selected apartments in Gbajimba community in Guma Local Government area in Benue state, Nigeria.

Methods: Beddings and furniture (bed frames, pillows, mattresses, cushion chairs, mats, mosquito nets and bamboo beds) were thoroughly inspected for bedbug infestation using the hand-picking technique. Data were analysed using chi-square analysis for differences in the infestation levels in harbourages and sampling locations.

Results: Only 16% of the apartments investigated showed no evidence of bedbug infestation as egg cases and faecal marks were sighted in 62.2% of apartments surveyed. The highest infestation rate was observed in Angwan Jukun area and infestation here was higher compared to other study locations within the town though the difference was not statistically significant ($\chi^2 = 7.92$, df = 6, $p > 0.05$). Bamboo beds harboured the highest number of bedbugs collected, accounting for 35.8%, while other harbourages like iron bed frames and sleeping mats had 23 and 22.7% infestation rates respectively. The infestation rates in these household items were significantly higher than other items inspected ($\chi^2 = 11.8$, df = 4, $p > 0.05$).

Interpretation & conclusion: This study demonstrates the urgent need for identification of evidences of infestation and bedbug management involving community participation in inspection, detection and education, including physical removal and exclusion as well as pesticide application.

Key words Bedbugs; harbourages; infestation; Nigeria

Introduction

The common bedbug *Cimex lectularius* Linnaeus 1758 (Hemiptera: Cimicidae) is a globally re-emerging pest of serious public health concern. They are bloodsucking ectoparasites that infest human habitations, and usually feed during the night when host is sleeping[1]. The mouthparts of bedbugs are especially adapted to feed on blood of humans, bats, chicken and occasionally domesticated animals[2]. Bedbugs seem to posses all of the necessary prerequisites for being capable of transmitting human diseases, but there have been no known cases of bedbug transmitting human diseases even though about 27 known pathogens have been reported to be capable of surviving inside bedbugs or its mouthparts[3].

The bites of bedbugs is usually painless, however, their saliva have been reported to contain antigen which stimulates an allergic IgE-mediated hypersensitivity[4]. Individual reaction and manifestations of bedbug bites vary from small, hard, swollen welt to severe scratching and dermatological reactions[5–8]. Frequent feeding can disrupt victim's sleep and may

result to anxiety, stress, emotional distress and insomnia[9]. Heavy infestation and feeding rates by bedbugs have resulted in significant blood loss and eventual anaemia, especially in malnourished children[4,10].

There has been a global resurgence of bedbug infestation, until recently, bedbugs have been considered uncommon in the industrialized world. However, since the mid-1990s the number of reports of human bedbug infestations has increased significantly in the United Kingdom[11–13], Australia[9,14], Israel[8], Canada[15], Demark[16] and Italy[17]. The ease of international travel has been blamed for these infestations especially with immigrants and refugees from developing countries where bedbug infestation has never eased[18,19] and indiscriminate use of insecticides which is resulting in resistance[20,21].

Bedbug infestation is common and widespread in Nigeria, it has, however, not attracted the research interest it requires. Consequently, there is a dearth of documented information on prevalence and intensity of infestation. Studies in Lagos, the commercial nerve centre of Nigeria, reported infestation rates of 50% and above in two out of five study sites[22]. Earlier study in Benue state reported heavy infestation in homes and school hostels[19]. This current study was designed to investigate bedbug infestation profile and dynamics in Gbajimba; a rural settlement in Benue state experiencing in a boom in commercial activities and influx of visitors from other parts of the country. In addition to these, the town recently hosted internally displaced persons resulting from the ethnic conflict in north-central Nigeria. These social and economic factors justified the selection of Gbajimba for the study. The methods for bedbug control employed in the community were also investigated. This article provides current infestation status that will serve as baseline information to mobilize and encourage community participation in vector control.

Material & Methods

Study area: Benue state is one of the 36 states in the Federal Republic of Nigeria, a tropical country on the west coast of Africa. Gbajimba town is the headquarters of Guma Local Government Area (LGA) of Benue state, a state that derives its name from the second largest river in Nigeria. The state covers an area of about 34,059 km^2 with a population of over 4.2 million people[23]. Majority of the inhabitants live in rural agricultural areas and engage in peasant agriculture. Benue state has two seasons, rainy and dry seasons as rainfall is the real climatic variable. The rainy season is from April–October (7 months with 800–1100 mm of rain) while the dry season runs from November–March (5 months with 200–400 mm of rain). Temperature ranges from 26–29.5°C in dry season and 19.5– 24°C in rainy season with mean relative humidity of 78%. The town lies between latitude 7°30'–8° 00'N and longitude 8°30'–9°00'E and situated in the guinea savanna region, a vegetative region in Nigeria. The inhabitants of the town are predominantly peasant farmers and fishermen. The town attracts very high number of visitors and traders for once in five days market because its reputation as fresh fish depot. Many of the traders and visitors lodge in short-stay hotels within the community. The town is a rural settlement lacking basic amenities like potable water, electricity and access roads. To ease sampling exercise, we divided the town into seven locations based on aggregation of residential apartments and landmark structures. Sampling was done at the end of every week during the three months duration of the study from January to end of March 2010.

Sampling techniques: After obtaining informed written consent and permission from the Local Government Health Authority and verbal consent from household heads and owners of hotels, randomly selected apartments, beddings and furniture (bed frames, pillows, mattresses, cushion chairs, mats, mosquito nets and bamboo beds) were thoroughly inspected for bedbug infestation using search guide recommended by Boase[12]. Physical handpicking and brushing method was employed and specific point from where the bugs were removed was noted. Signs of bedbug infestion were identified by the presence

of empty egg cases which remains in place long after hatching and black faecal spots (0.5–1 mm diam), on surfaces around the harbourage. The bedbugs were then transported in specimen bottles with 70% alcohol to the Entomology Laboratory of Benue State University, Makurdi for identification and sex determination using dissecting microscope. Identification and sex determination was done using keys provided in Pratt and Smith[24].

After the house inspection, household heads of infested apartments were asked about the control measures they employ to kill bedbugs, their responses were documented. Data were analysed using simple percentages and chi-square was used to test for significance in infestation levels in the sampling locations and harbourages.

Results

Of the 119 residential apartments and hotels surveyed during the study, 26 (21.8%) apartments had bedbug infestation and 1056 bedbugs were collected from these apartments. The mean number of bedbugs collected from an apartment was 40.6 (Table 1). Only 16% of the apartments investigated showed no evidence of bedbug infestation; and egg cases and faecal marks were sighted in 62.2% of apartments surveyed. The highest infestation rate was observed in Angwan Jukun area and infestation here was higher compared to other study locations within the town though the difference was not statistically significant ($\chi^2 = 7.92$; df = 6, $p > 0.05$).

Bamboo beds harboured the highest number of bedbugs collected, accounting for 35.8%, while other harbourages like iron bed frames and sleeping mats had 23 and 22.7% infestation rates respectively (Table 2), combined infestation rates of these three harbourages differed significantly when compared with the others ($\chi^2 = 11.8$; df = 4, $p > 0.05$). Clusters of bedbugs were usually found at joints of bamboo bed in heavy infest. Nymphs were the most predominant development stages collected accounting for 66.1% and of the 358 adults 62% were females.

Bedbug control methods employed by the residents are broadly categorised into chemical insecticides and physical techniques (Table 3). The use of insecticides is widespread, however, 16.1% of the residents reportedly did nothing to control infestation. The insecticides of choice were insect powder (Permethrin), Snipper (2,3-dichlorovinyl dimethyl phosphate) and Nuvan: Dichlorovos (2,2-dichloro-vinyl dimethyl-phosphate). Application of insect powder is done outdoor, household furniture suspected to be infested

Table 1. Bedbugs (*Cimex lectularius*) collected from study locations in Gbajimba, Nigeria

Study location	No. of apartments surveyed	No. of apartments with bedbugs	No. of bedbugs collected	Mean number of bedbugs	Apartments with evidence of infestation	Apartments without infestation
Logo	20	5 (25)	225 (21.3)	45	13 (65)	2 (10)
General Hospital	20	–	–	–	17 (85)	3 (15)
Angwan Jukun	20	9 (45)	467 (44.2)	51.2	10 (50)	1 (5)
Beach Hotel	20	4 (20)	118 (11.2)	29.5	12 (60)	4 (20)
Ishamior	20	6 (30)	207 (19.6)	34.5	10 (50)	4 (20)
Kwenev	10	2 (20)	39 (3.7)	19.5	8 (80)	–
Agbaka	9	–	–	–	4 (44.4)	5 (55.6)
Total	119	26 (21.8)	1056	40.6	74* (62.2)	19 (16)

*Apartments where egg cases faecal marks seen but no bedbug sighted. Figures in parentheses indicate percentages.

Table 2. Sex and development stages of bedbugs collected from harbourages in Gbajimba, Nigeria

Habourages	No. of harbourages surveyed	No. of harbourages infested	No. of bedbugs collected	Sex		Development stage	
				Male	Female	Adult	Nymph
Bamboo beds	16	10	378 (35.8)	48	80	128 (33.8)	250 (66.2)
Iron bed frames	12	2	243 (23)	31	51	82 (33.7)	160 (66.3)
Mats	27	6	240 (22.7)	31	50	81 (33.7)	159 (66.7)
Mattresses	199	9	57 (5.4)	8	12	20 (35.1)	39 (64.9)
Wooden bed frames	15	2	56 (5.3)	7	12	19 (33.9)	37 (66.1)
Mosquito nets	23	4	45 (4.3)	5	10	15 (33.3)	30 (66.6)
Cushion chairs	27	5	35 (3.3)	6	7	13 (37.1)	23 (62.9)
Total	319	38	1056	136	222	358 (33.9)	698 (66.1)

$\chi^2 = 7.08$; df = 6, $p > 0.05$; Figures in parentheses indicate percentages.

are carried outside and the powder applied to harbourages. Snipper and Nuvan on the other hand are applied indoors. The insecticide is drawn into used disposable syringes and sold at the open market depending on the quantity, the content of the syringe is then dropped on suspected harbourages and corners of the room. Dosage of insecticide application depends on perceived level of infestation as application is mostly done without professional advice or supervision. Though bedbugs were collected from households that reported recent use of insecticides, the numbers were significantly lower when compared to households that have not applied insecticides ($p > 0.05$).

Table 3. Bedbug control methods practiced by residents of Gbajimba

Control methods	No. of house holds
Chemical: Insecticides	
Insect powder (Permethrin)	41 (34.4)
Snipper 1000 (2,3,-dichlorovinyl dimethyl phosphate)	24 (20.1)
Nuvan: Dichlorovos (2,2- dichloro-vinyl dimethyl phosphate)	15 (12.6)
Non-chemical method	
Sun drying infested item	7 (5.9)
Hand picking	10 (8.4)
Hot water treatment	3 (2.5)
Do nothing	19 (16.1)
Total	119

Figures in parentheses indicate percentages.

Discussion

The study demonstrates that bedbug infestation in this community is high, which could be attributed to poor hygiene and housekeeping practices. Similar infestation rates have been reported in other parts of Nigeria[19] and elsewhere in Africa and the developed countries[13,16,18]. Though it has been said that bedbug infestation is not necessarily a reflection of poverty and poor sanitation, overcrowding of residential apartment and deteriorating sanitary conditions in this community may be contributing to the growing problem of bedbug infestation. Housing pattern observed within the community where most apartments were multi-tenanted also increase the tendency of bedbugs to disperse to other locations within some building[3,19].

While increasing bedbug infestation in developed countries is being blamed on the ease of international travel and refugee mobility[8,9,17], the same cannot be said of this community. The lucrative local fish industry in the community may be implicated for level of infestation observed, as traders come in from other parts of the country and lodge in short stay hotels scattered in the Agwan Jukun area of the town. Studies have indicated that infestations in high turnover

locations such as hotel rooms, and school hostels are particularly likely to give rise to more secondary infestation in the community[12,14,19]. Trade in second hand furniture, especially beds, mattresses and chairs, in many rural markets in Nigeria has also facilitated the transfer of bedbugs locally within surrounding communities. Most of these second hand furniture come into the market from Makurdi, the state capital, this town has its own share of bedbug problems[19]. The trade in second-hand household furniture and electronic goods has reached an all-time high in many sub-Saharan countries, this will no doubt continue to facilitate the spread of bedbugs or their eggs over longer distance[9,12,13,15].

The identification of bedbug harbourages is essential in guiding pest control personnel during intervention[12], the wide range of household items harbouring bedbugs in this community and their ability to spread to adjoining rooms and reinvade previously freed rooms within an apartment make individual control efforts unsustainable. Settlement and housing pattern in the community may also facilitate the dispersion of bedbugs from one household to another, since most inhabitants live in congested housing units and rooms. Predominant house types are a room and parlour attachment with shared kitchen, toilet and bathroom facilities and traditional huts. This may have accounted for the re-infestation observed in households that reported recent use of insecticides and not necessarily development of resistance.

The common practice of moving infested household materials outside in order to expose them to sunlight has been reported to have little or no impact on bedbugs because they are quick to hide away from sunlight into dark protected crevices[11,25]. The use of insecticides to control bedbugs could have severe public health consequences either by increasing human exposure to indoor pesticide residue or the recent evidence of high levels of resistance in bedbugs to two pyrethroid insecticides in addition to ineffective application techniques by untrained individuals[20,21,26,27]. Both factors are likely to contribute to increased infestation. Application of these insecticides served two purposes in this community, while it is being targeted on mosquitoes as well as other household insects including bedbugs being controlled.

There has never been an organized comprehensive bedbug control effort in Nigeria and controlling infestation has always been the responsibility of individuals living in infested buildings. The widespread application of these insecticides by untrained persons and without professional supervision will no doubt result in unacceptable indoor pesticide residue and development of resistance. Without the development of new tactics for bedbug management, further escalation of this neglected public heath problem should be expected. Changes in the dynamics of housing, sanitation and human activities may continue to create new and unexpected opportunities for the increase and dispersion of bedbugs. This study demonstrates the urgent need for members of the public to be aware of typical symptoms of bedbug bites and identification of evidences of infestation. Integrated approach should be used for bedbug management involving community participation in inspection, detection and education, including physical removal and exclusion as well as pesticide application.

References

1. Thomas I, Kihiczak GG, Schwartz RA. Bedbug bites: a review. *Intl J Dermatol* 2004; *43:* 430–3.
2. Krueger L. Don't get bitten by the resurgence of bedbugs. *Pest Control* 2000; *68:* 58–64.
3. Kell SA, Hahn J. Prevention and control of bedbugs in residences. Minneapolis, U.S.A: Department of Entomology, University of Minnesota 2007.
4. Leverkus M, Jochim RC, Schad S, Brocker EB, Anderson, JF, Valenzuela JG. Bullous allergic hypersensitivity to bedbug bites mediated by IgE against salivary nitrophorin. *J Investigative Dermatol* 2006; *126:* 91–6.
5. Doggett SL. Bedbugs: what the general practitioner needs to know. *Australian Family Phys* 2009; *20*(11): 11–6.
6. Liebold K, Schliemann-Wailers S, Wollina U. Disseminated bullous eruption with systemic reaction caused by *Cimex lectularius*. *J European Acad Dermatol Venereol* 2003; *17:* 461–3.

7. Scarupa MD, Economides AE. Bedbug bites masquerading as urticaria. *J Allerg Clin Immunol* 2006; *117:* 1508–9.

8. Mumcuoglu KY. A case of bedbug (*Cimex lectularius*) infestation in Israel. *Israeli Med Assoc J* 2008; *10:* 388–9.

9. Doggett SL, Geary MJ, Russell RC. The resurgence of bedbug in Australia: with notes on their ecology and control. *Environmental Health* 2004; *4*(2): 30–7.

10. TerPoorten MC, Prose NS. The return of the common bedbug. *Pediatr Dermatol* 2005; *22:* 183–7.

11. Paul J, Bates J. Is infestation with common bedbug increasing? *British Med J* 2000; *320:* 1141.

12. Boase CJ. Bedbugs: reclaiming our cities. *Biologists* 2004; *51*(1): 9–12.

13. Richards L, Boase CJ, Gezan S, Cameron MM. Are bed bug infestations on the increase within Greater London? *J Environ Health Res* 2009; *51:* 3–11.

14. Ryan N, Peter B, Miller P. A survey of bedbugs in short-stay lodges. *New South Wales Public Health Bull* 2004; *15:* 215–7.

15. Hwang SW, Svoboda TJ, De Jong IJ, Kabasele KJ, Gogosis E. Bedbug infestations in urban environment. *Emerg Infect Dis* 2005; *11*(4): 18–24.

16. Kilpinen O, Vagen Jensen KM, Kristensen M. Bedbug problem in Denmark, with an European perspective. In: Robinson WH, Bajomi D, editors. Hungary: *Proceedings of the VI International Conference on Urban Pest* 2008; p. 395–400.

17. Masetti M, Bruschi F. Bedbug infestation recorded in central Italy. *Parasitol International* 2007; *56:* 81–3.

18. Gbakima A, Terry BC, Kanja F, Kortequee S, Dukuley I, Sahr F. High prevalence of bedbugs *Cimex lectularius* in camps for internally displaced person in Freetown, Sierra Leone: a pilot humanitarian investigation. *West African J Med* 2002; *21:* 268–71.

19. Omudu EA. A survey of bedbug (Hemiptera: Cimicidae) infestation in some homes and hostels in Makurdi and Otukpo, Benue state, Nigeria with notes on public health implications. *The Nigerian J Pure Applied Sci* 2008; *1:* 84–91.

20. Romero A, Potter MF, Potter DA, Haynes KF. Insecticide resistance in the bedbug: a factor in the pest's sudden resurgence? *J Med Entomol* 2007; *44:* 175–8.

21. Myamba J, Maxwell CA, Curtis CF. Pyrethroid resistance in tropical bedbugs (*Cimex hemipterus*) associated with use of treated bednets. *Med Vet Entomol* 2002; *16:* 448–51.

22. Okwa OO, Omoniyi AO. The prevalence of headlice (*Pediculus humanus capitis*) and bedbug (*Cimex hemipterus)* in selected human settlement areas in southwest Lagos state, Nigeria. *J Parasitol Vector Biol* 2008; *2*(2): 8–13.

23. Report of the National Census Exercise 2005. *Official Gazette*. Lagos: National Population Commission 2006; p. 49.

24. Pratt HD, Smith JW. Arthropods of public health importance. In: Wentworth BB, editor. *Diagnostic procedure for mycotic and parasitic infections*. Washington DC: American Public Health Association 2005.

25. Cleary CJ, Buchanan D. Bedbugs: an emerging United States infestation. *The Nurse Practitioner* 2004; *29*(6): 46–8.

26. Karunaratne SH, Damayanthi BT, Fareena MH, Imbuldeniya V, Hemingway J. Insecticide resistance in the tropical bedbug *Cimex hemipterus*. *Pesticide Biochem Physiol* 2007; *88:* 102–7.

27. Harlan HJ, Faulde MK, Baumann GJ. Bedbugs. In: Beonfoy X, Kampen H, Sweeney K, editors. *Public health significance of urban pests*. Denmark: WHO Regional Office 2008; p. 131–53.

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