











mounted on glass slides in saline solution, and viewed under the microscope using X4 objectives lens.

### **Administration of questionnaire instruments**

Two hundred (200) copies of well-structured questionnaire instrument which has been tested for viability and reliability were administered to occupants of the bedbug infested apartments (i.e., 5 copies per apartment) to help sample their feelings about the infestation and its attendant health impart, if any. They were left with respondents two days for careful study. The contents of the questionnaire were translated into different local dialects of the non-literate respondents to enable them understand and respond appropriately. At the expiration of the 2 days the 200 copies of (completed) questionnaire were retrieved and collated accordingly for analysis.

## **RESULTS**

### **Result of survey of apartments**

A total collection of 6,060 bedbug specimens (comprising 1,648/27.0% male and female adults, 875/14.0% nymphs and 3,577/59.0% eggs) was made during the survey of apartments in the selected communities of the study area. Of this, 419/25.4% adults, 62/7.1% nymphs and 712/10.9% were collected from apartments in Sabon-gari community, 505/30.6% adults, 166/18.9% nymphs and 1,020/28.5% were got from Zuma II apartments. Garba and Veritas communities recorded 439/26.6% adults, 256/29.3% nymphs and 925/25.9% eggs, and 285/17.3% adults, 391/44.7% nymphs and 920/25.7% eggs, respectively. The result also showed that Zuma II and Garba communities recorded the highest bedbug infestation with overall totals

of 1,621 and 1,620 numbers of adults, nymphs and eggs, while Sabon-gari and Veritas community apartments had milder infestations (Table 2).

**Table 1a: Bedbugs (*Cimexlectularius*) collection from the apartments in Sabon-gari in Bwari Area Council**

Stage of Bedbug	Sex of Bedbug	Apartments												Total
Adult		A	B	C	D	E	F	G	H	I	J	K	L	
	Male			12	-	24	-	36	27	-	63	28	4	194
	Female	-	-	26	-	12	-	44	73	-	37	26	7	225
Nymphs		-	-	10	-	15	-	6	9	-	11	6	5	62
Eggs		-	-	30	-	42	-	146	152	-	156	126	60	712
<b>Total</b>		-	-	78	-	93	-	232	261	-	267	186	76	1,193

**Table 1b: Bedbugs (*Cimexlectularius*) collection from the apartments in Zuma II, Bwari Area Council.**

Stage of Bedbug	Sex of Bedbug	Apartments												Total
-----------------	---------------	------------	--	--	--	--	--	--	--	--	--	--	--	-------

<b>Adult</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>G</b>	<b>H</b>	<b>I</b>	<b>J</b>	<b>K</b>	<b>L</b>	
<b>Male</b>	17		7	-	6	19	-	27	73	63	-	4	216
<b>Female</b>	13	-	6	-	11	15	-	73	127	37	-	7	289
<b>Nymphs</b>	42	-	18	-	33	35	-	9	13	11	-	5	166
<b>Eggs</b>	132	-	109	-	109	122	-	152	180	156	-	60	1,020
<b>Total</b>	204	-	140	-	159	191	-	261	393	267	-	76	1,691

**Table 1c: Bedbugs (*Cimexlectularius*) collection from the apartments in Garba, Bwari Area Council**

<b>Stage of Bedbug</b>	<b>Sex of Bedbug</b>	<b>Apartments</b>											<b>Total</b>	
<b>Adult</b>		<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>G</b>	<b>H</b>	<b>I</b>	<b>J</b>	<b>K</b>	<b>L</b>	
	<b>Male</b>	12	10	-	-	-	-	36	27	-	63	28	4	180
	<b>Female</b>	43	29	-	-	-	-	44	73	-	37	26	7	259
<b>Nymphs</b>		116	103	-	-	-	-	6	9	-	11	6	5	256
<b>Eggs</b>		152	133	-	-	-	-	146	152	-	156	126	60	925
<b>Total</b>		323	275	-	-	-	-	232	261	-	267	186	76	1,620



**Table 1d: Bedbugs (*Cimexlectularius*) collection from Veritas University hostels**

Stage of Bedbug	Sex of Bedbug	Female Hostels						Male Hostels						Total
		A	B	C	D	E	F	G	H	I	J	K	L	
Adult	Male	9	7	12	-	18	-	11	9	10	-	13	-	89
	Female	17	13	19	-	32	-	23	39	27	-	26	-	196
Nymphs		31	89	92	-	66	-	38	29	13	-	6	-	391
Eggs		101	108	112	-	123	-	115	128	112	-	121	-	920
Total		158	217	235	-	239	-	187	205	162	-	166	-	1,596

**Table 2:** The stages, number and percentages of the bedbugs collected from each community in the study area

Stage of bedbug	Number and percentage (%) collected from each part of the study area					Total
	Sex	Sabon-gari	Zuma II	Garba	Veritas hostels	
Adults	Males	194/46.3	216/42.8	180/41.0	89/31.23	679/41.2
	Females	225/53.7	289/57.2	259/58.9	196/68.77	969/58.8
	<b>Sub-Total</b>	<b>419</b>	<b>505</b>	<b>439</b>	<b>285</b>	<b>1648/100</b>
Nymphs		62/7.1	166/18.9	256/28.3	391/44.7	875/100
Eggs		712/19.9	1020/28.5	925/25.9	920/25.7	3,577/100
	<b>Grand Total (adults, nymphs &amp; eggs)</b>	<b>1,193/19.8</b>	<b>1,651/27.2</b>	<b>1,620/26.7</b>	<b>1,596/26.3</b>	<b>6,060</b>

**Result of sex and species of bedbug identification**

Based on the entomological morphometric identification keys of Pratt and Smith, (2005), the bedbugs were identified into male and female sexes by the finding that males have pointed abdomen whereas the females have blunt rounded abdomen. Similarly, two species of bedbug found during the study were *Cimexlectularius* and *Cimexhemipterus*, and they were identified by

the fact that *Cimexlectularius* has an upturned lateral flange on the margin of the pronotum on the thorax making it (i.e., the thorax) relatively broader more broader than that of *Cimexhemipterus*. Of the 1,648 adult bedbugs, 1,087 were *Cimexlectularius* while 561 were *Cimexhemipterus* species. The distribution among the communities sampled indicated that Sabon-gari had 236/56.3% *C. lectularius* and 183/43.7% *C. hemipterus*, Zuma II had 348/68.9% *C. lectularius* and 157/31.1% *C. hemipterus*, Garba recorded 311/70.8% *C. lectularius* and 128/29.2% *C. hemipterus* while in Veritas hostels 192/67.4% *C. lectularius* and 93/32.6% were from collected. These are the globally common bedbugs species associated with mostly human habitations because of the peculiar human attractant factors such as exhaled CO<sub>2</sub>, body heat, body odour and other various compounds usually emitted via the skin.

**Table 3: Distribution of bedbug species in the study area**

Selected Community	Species, number and percentage (%) of bedbugs present		Total
	<i>Cimexlectularius</i>	<i>Cimexhemipterus</i>	
Sabo-gari	236/56.3	183/43.7	<b>419/100</b>
Zuma II	348/68.9	157/31.1	<b>505/100</b>
Garba	311/70.8	128/29.2	<b>439/100</b>
Veritas Hostels	192/67.4	93/32.6	
<b>285/100Total</b>	<b>1,087/65.9</b>		<b>561/34.1</b>
<b>1,648/100</b>			

**Result of questionnaire administration.**

Of the 200 respondents, 157/78.5% acknowledged that they have seen bedbugs before whereas 43/21.5% of them claimed that they had never seen bedbugs. One hundred seventy (170/85.0%) respondents reported that they can recognize and distinguish bedbugs from other ectoparasitic insects, but 30/15.0% they cannot.

Similarly, 167/83.5% respondents admitted to have experienced bedbug infestation before, but 33/16.5% of them stated that they have not experienced it at all. Also, while 147/73.5% of the respondents reported that they have not suffered bedbug bites before, the rest 53/26.5% accepted that they had suffered bedbug bites before. On the common sensation that accompanies bedbug bites, 77/38.5% respondents bite sensation as itchy, 49/24.5% said it is a discomforting and rashly and irritating, 31/15.5% said the bite comes with reddish spots, and yet 43/21.5% claimed they cannot describe the bedbug bite sensation.

Regarding what brought about or the suspected source(s) of the bedbug infestation, many different opinions were proffered. But majority of the respondents (126/63.0%) guessed that the bedbugs may have come through visitors from bedbug endemic homes or communities, 58/29.9% opined that the bedbugs infestation may be the aftermath of filthy environment coupled with poor housekeeping attitude, and yet another 16/8.0% attributed the infestation to poor hygiene (both personal and group) of the inhabitants of the affected apartment.

Different biting periods were also reported by respondents. While a few of them (9/4.5%) alleged that bedbugs bite mostly in the early hours of the morning, 72/36.5% claimed that bedbugs bite only in the night, but 119/58.5% respondents pointed out that bedbugs have no specific biting time but once there is contact human host.

Respondents also highlighted many different types of habitats in the human living apartment where bedbugs are found including wooden/iron beds/bunks (91/45.5%), in the beddings (49/24.5%), in furniture/behind loosen wallpaper (38/18.0%) and in wall cracks/crevices (32/16.0%)

On the other hand, respondents also expressed various control measures they have been adopting to curb the menace of this monstrous bedbugs infestations in their homes. Seventy four (74/37.0%) stated that they used insecticide/pesticides such as Snipper, Raid, etc., 57/29.5% respondents adopted the destruction by burning of the infested furniture and other household items. The use of laundering and treatment of infected bedbugs with 'Hypo' solution were reported by 45/24.5%, while 34/17.0 responded that they use hot sun-drying method to drive away the adult bedbugs from the infested materials.

On the health impact of the bedbug infestation, respondents reported some cases of health effect suspected to be due to bedbug bites. Some respondents (62/31.0%) alleged that they have suffered eczema and urticarial infection following exposure to heavy bedbug bites, 27/13.5% reported of being victim of cellulitis, impetigo, 86/43.0% complained of lymphangitis and folliculitis and anaemia (mild and severe) in 33/16.5% respondents.

## **DISCUSSION**

This study has been able to establish not only the presence of bedbugs in the selected communities of Bwari Area Council of Abuja, the Federal Capital Territory, Nigeria, but also their high infestation in the entire area. Six thousand and sixty (6,060) bedbug specimens (comprising 1,648 adults, 875 nymphs and 3,577 eggs) collected from the 40 apartments of the four communities selected as study locations. A further breakdown showed that 1,193/19.8%

bedbug specimens came from Sabon-gari, 1,651/27.2% were from Zuma II, while Garba and Veritas had 1,620/26.7% and 1,596/26.3%, respectively. The study confirmed that dirty environment and poor personal and group practices are among the predisposing factors that promote bedbug infestation. This finding has conformed with the reports of the previous studies by Okwa and Ominiya (5) in Lagos, southwest, by Omudu (10) and Omudu and Kuse (7) in Gboko and Gbajima in Benue, North-Central, Nigeria, where occurrence of bedbug was investigated and its infestation rates was found to be high; ranging between 6.3% to 53 %. Similar to the reports of those previous studies, this survey revealed equally that except Veritas hostels all other study locations where bedbug infestations were high, are areas dominated by indigenes. More importantly, through this study the particular species of bedbugs that exist in this part of the world have been uncovered.

One thousand and eighty seven (1,087/65.9%) were *Cimexlectularius* while 561/34.1% were *Cimexhemipterus* species, with the distribution among the communities sampled showing that Sabon-gari had 236/56.3% *C. lectularius* and 183/43.7% *C. hemipterus*, Zuma II had 348/68.9% *C. lectularius* and 157/31.1% *C. hemipterus*, Garba recorded 311/70.8% *C. lectularius* and 128/29.2% *C. hemipterus* while Veritas hostels recorded 192/67.4% *C. lectularius* and 93/32.6%.

This finding agreed with reports of previous studies by Doggett *et al.*, (2); Reinhardt and Siva-Jothy, (21) Doggett *et al.*, (9) which states that *C. lectularius* and *C. hemipterius* are species that are very commonly associated with human habitations because they are endowed with olfactory sensory receptors for detecting human exhaled carbondioxide (CO<sub>2</sub>), human body heat and odour and other various compounds often emitted by humans via the skin.

The study also supported the findings that bedbug generally can passively disseminate themselves from one room to another through various unsuspecting means such as movement via electrical wiring through ventilation openings, clothings, second-hand furniture, beddings, books and luggages. In this study, victims have attributed sources of bedbug infestation to human movements ranging from displacement due to either, insurgencies, disputes, inter-communal clashes, to deliberate normal relocation from old to a new residence which may involve carriage or transfer of household property in luggages. Socio-cultural factors also play substantial role in bedbug infestation. The cultural lifestyle of the indigenous Gbagyi and Hausa tribes as demonstrated in their congested pattern of settlement and housing facilitate the spread of bedbugs. It is also suggested that social factors such as urbanization which had compelled people to immigrate into some of these study locations for acquisition of cheap accommodation, or job opportunities, or academic pursuit, etc., may have contributed to the bedbug infestation and dissemination in those places.

Although earlier researches on bedbug has dismissed the suspicion that bedbugs are infectious disease vectors for want of evidence (15, 4, 13, 3) bedbug bites have been associated with some minor health issues which have however been described as insignificant by certain authors. The result of this study has also highlighted cases of allergic urticarial reactions in victims of bedbug bites. There were also manifestations of minor reactions such as pruritic skin lesions, erythematous, firm papule or rashes arising from the itching bites. These observations agreed with the earlier findings of Delaunay *et al.*, (11) who reported similar manifestations from bedbug bites but which carry with them firm papule having a central vesicle or haemorrhagic crust at the point of bite. Situations also arose whereby some victims of bedbug bites experience severe itching and scratching leading to complications that take the form of scabies. This

observation corroborates the findings of Benac, (8) who in his study reported of similar experiences by those who were said to have been bitten by bedbugs. It is suspected that these complications cannot just be ordinary but may be due to secondary infections by opportunistic bacteria from around the site of the bedbug bites. Secondly, beside the euphoria and nuisance arising from heavy bedbug infestation, sleeplessness, anxiety, incessant headaches, fatigue, stigmatization and insomnia may result thereby impacting negatively on the victim's concentration and psychology and overall performance in school at home, or workplace (17).

### **Conclusions**

The study has established the presence of bedbugs in the four selected communities of the study area with all of them showing high infestation. The study has also established that even though bedbugs are said not to be vectors of any transmissible human diseases, their infestation may bring about some mild health issues.

### **Recommendations**

As a way of checking bedbug infestation and their possible spread, the following control measures are recommended for adoption.

- Proper public enlightenment campaign to create/or increase awareness can yield positive results in bedbugs control.
- Adequate, personal and group hygiene practices together with environmental sanitation in and around the residential quarters is eminent.
- All infested household furniture, beds, beddings, and mattress, should be destroyed completely by burning while the infested places should be adequately fumigated by before replacement of the household items.



- Use of pesticides-containing creams such as diphenhydramine, corticosteroid cream should be introduced for use by victims of bedbugs
- Regular fumigation coupled with regular inspections can make great impact in bedbug control. .

### **Acknowledgement**

The researchers wish to appreciate all those who have contributed to the success of this study. First in the list are the Executive Chairman, Bwari Area Council, Abuja, and the Management of Veritas University, Abuja, for the ethical approval granted us. Also worthy of appreciation are the Community Heads of Sabon-gari, Zuma II, Garba, the Dean of Students' Affairs of Veritas University, Abuja and all those who volunteered to participate in this research either as study subjects or surrendered their homes/apartments to be surveyed for bedbugs. We wish also to acknowledge the expertise contributions of the Laboratory staff of the Department of Biological Sciences, Veritas University, Abuja, especially for their assistance in bedbug specimens collection and preservation in the field. To them all, we say Thank you and God bless.

### **REFERENCES**

1. Ibrahim, O., Syed, U.M. and Tomecki, K.J. (2017). Bedbugs, helping your patient through an infestation. *Cleveland Clinic Journal of Medicine*, 84 (3), 207–211.

2. Doggett, S.L., Geary, M.J., Crowe, W.J., Wilson, P. and Russell, R.C.(2003). Has the tropical bed bug, *Cimexhemipterus*(*Hemiptera: Cimicidae*), invaded Australia. *Environmental Health*, 3, 80–82.
3. Goddard, J. and deShazo, R. (2009). Bed bugs (*Cimexlectularius*) and clinical consequences of their bites. *Journal of the American medical association*, 301(13), 1358–1366.
4. Klemptner, M.S., Unnasch, T.R. and Hu, L.T.(2007). Taking a bite out of vector-transmitted infectious diseases. *New England Journal of Medicine*, 356, 2567–2569.
5. Okwa, O.O. and Omoniyi, A.O. (2010). The prevalence of head lice (*Pediculus humanus capitis*) and bedbug (*Cimexhemipterus*) in selected human settlement areas in south-west Lagos State, Nigeria. *Journal of Parasitology and Vector Biology*, 2(1), 8 – 13.
6. Harraca, V., Ryne, C., Birgersson, G. and Ignell, R. (2012). Smelling your way to food, can bedbugs use our odour. *Journal of Experimental Biology*.
7. Omudu, E. A. and Kuse, C. N. (2010). Bedbug infestation and its control practices inGbajimba, a rural settlement in Benue State, Nigeria. *Journal of Vector BorneDiseases*, 47(4), 222 – 227.
8. Benac, N. (2010). Bedbug bites becoming bigger battle. *Canadian Medical Association Journal*, 182(15), 1606.
9. Doggett, S.L., Orton, C.J., Lilly, D. and Russell, R.C. (2011). Bed bugs, the Australian response. *Insecticide Resistance and Management Strategies*, 2, 96 –111.
10. Omudu, E. A. (2008). A survey of bedbug (*Hemiptera, Cimicidae*) infestation insome homes and hostels in Makurdi and Otukpo, Benue State, Nigeria with notes on public health implications. *The Nigerian Journal of Pure and Applied Sciences*, 1, 84 – 91.

11. Delaunay, P., Blanc, V., Del Giudice, P., Levy-Bencheton, A., Chosidow, O., Marty, P. and Brouqui, P. (2011). Bedbugs and infectious diseases. *Clinical Infectious Diseases*, 52(2), 200-210.
12. Onah, I.E., Alu, C. and Omudu, E.A.(2014). A survey of bedbug(*cimexlectularius*) infestation in some homes and hostels in Gboko, Benue State,Nigeria. *Psychology*, 5.
13. Pritchard, J, M. and Hwang, S.W. (2009). Severe anemia from bedbugs. *Canadian Medical Association Journal*, 181,287-288
14. Ryan, N., Peter, B. and Miller, P. (2004). A survey of bedbugs in short stay lodges. *New South Wales Public Health Bulletin*, 15(12), 215-217.
15. Thomas, I., Kihiczak, C.G. and Schwartz, R.A. (2004). Bedbug bites, a review. *International Journal Dermatology*, 43(6), 430–433.
16. Potter, M.F. (2008). The business of bedbug. *Pest Management Professional*, 76(1), 28-44.
17. World Health Organization (WHO, 2009), *Public Health Significance of Urban Pests*.

18. Pratt, H. D. and Smith, J. W. (2005). Arthropods of public health importance. In: Wentworth BB, editor. *Diagnostic Procedure for Mycotic and Parasitic Infections*. Washington DC: American Public Health Association.
19. Jerome, G. and Richard, D.S. (2012). Psychological effects of bedbug attacks (*cimexlectularius*). *The American Journal of Medicine*, 128(1), 101-103.
20. Boase, C. J. (2004). Bed-bugs reclaiming our cities. *Biologist*, 51, 1–4, 9-12.
21. Reinhardt, K., and Siva- Jothy, M.T. (2007). Biology of the bed bugs (*cimicidae*). *Annual Review of Entomology*, 52(1), 351-374.
22. Myamba, J., Maxwell, C. A., Asidi, A. and Curtis, C. F.(2002) . Pyrethroid resistance in tropical bedbugs, *Cimexhemipterus*, associated with use of treated bed nets. *Medical and Veterinary Entomology*, 16(4), 448–451.
23. Karunaratne, S. H. P. P., Damayanthi, B. T., Fareena, M. H. J., Imbuldeniya, V. and Hemingway, J.(2007). Insecticide resistance in the tropical bedbug *Cimexhemipterus*. *Pesticide Biochemistry and Physiology*, 88(1), 102–107.
24. Romero, A., Potter, M. F., Potter, D. A. and Haynes, K. F.(2007). Insecticide resistance in the bed bug, a factor in the pest's sudden resurgence. *Journal of Medical Entomology*, 44(2), 175–178.