

# Prevalence of Bedbugs Infestation, Crowding and Awareness Level Among Government Boarding Secondary School Students in Moshi Urban, Tanzania

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## Abstract

**Background:** Bedbug infestation is the worldwide problem according to World Health Organization, and the infestation is characterized by biting reactions including systemic, cutaneous reactions and sometimes psychological disturbance. Prevalence of bedbug infestation is low (6%) in developed countries while in Sierra Leone is 98% and Tanzania is 56% in which is tremendously high. As the bedbug infestation is among neglected conditions and because of high prevalence in Tanzania, the studies to determine this burden, some risk factors (crowding) and awareness among specific populated communities especially schools is inevitable for planning strategies in eradication of bedbug.

**Objective:** To determine the prevalence of bedbug infestation, crowding and awareness level among boarding government secondary school students in Moshi Urban.

**Methodology:** A cross-sectional study was conducted from May to July 2018 at Moshi Urban in Kilimanjaro region. The structured standard questionnaire was used to obtain the demographics information of participants, assess awareness. Personal observation was used to determine prevalence and crowding in the corresponding student's dormitories.

**Results:** The prevalence of bedbug infestation was 58.1% (223) among 384 study participants. Logistic regression analysis showed that 72.6% of the students with bedbug infestation were found to be living in the overcrowded dormitories. There was association between overcrowd and bedbug infestation (OR=2.50, 95%CI (1.63-3.83)). Only 32.7% of the infested students involved in this study were aware with bedbugs (OR=0.8795% CI (0.56-1.35) P=0.54.

**Conclusion:** The overall prevalence of bedbug infestation was found to be high among students living in the overcrowded dormitories and those who were not aware on bedbug biology and behavior, transmission, control and prevention ways. Education concerning bedbugs is needed to increase the community awareness together with management of number of students in accordance to the available facilities and resources.

**Keywords:** Bedbug Infestation, Awareness, Crowding

## Background

Bedbug infestation is a worldwide problem; according to World Health Organization (WHO) overcrowded communities are mostly vulnerable [1, 2]. Bedbugs are hematophagous arthropods of class Insecta order Hemiptera and family Cimicidae, they have mouthparts which are capable of piercing the skin releasing saliva which contains anti-coagulants and vasodilators [3]. Bedbugs are wingless with elongated body and six-legs that require nourishment from the human blood and other small animals [2, 3]. Two common species are associated with human infestation, *Cimex lectularis* and *Cimex hemipterus*. *Cimex lectularis* is cosmopolitan while *Cimex hemipterus* is found in tropical regions [1, 2]. Bedbugs prefer to hide in the dark areas and they usually

appear at night, the favorite area to isolate bedbugs are cracks, beddings and within the furniture frames [4].

United States, Canada, Europe, Central Asia and Africa have recently reported resurgence of bedbugs [1, 2]. National Pest Management Association (NPMA) and WHO suggested the world and developed countries are on the verge of bedbug pandemic [4]. According to WHO the increased infestation was the result of the increased international travel, the ban of some insecticides like DDT, and increased resistance of bedbugs to insecticides [2]. Studies across United State (US) have pointed highly populated areas and low income communities are vulnerable to infestation [5-7]. In rural settlements of Benue state Nigeria among

199 residential apartments, which were surveyed 1056 bedbugs were collected from 26 apartments while other apartments showed probable infestation and some did not show any signs of infestation [8]. There is reported infestation in Freetown, Sierra Leone in which 238 rooms were searched during the day and night [9]. In Tanzania study conducted in Matimbwa and Kongo villages in Bagamoyo district found 61 houses infested among 108 houses inspected houses [10]. The study in Bagamoyo was among the studies conducted in Tanzania on bedbug insecticide side susceptibility, while there is no published study specifically determining prevalence of bedbug infestation [11-13].

Health impacts of bedbug infestation include bedbug bite reactions, psychological effects of bedbug attack and bedbugs as the vector of human disease [3, 14]. Bite reactions and psychological effects of bedbug infestation are experimentally and theoretically investigated while there is little evidence that bedbugs act as vectors of human disease [3, 14]. Skin of the arm, legs, trunk, neck, hands and face are the vulnerable areas for the bedbug biting reactions, the reactions from bedbug bite can be cutaneous or systemic [3, 8, 15]. Cutaneous bite reactions are characterized by itching or abraded 2-5mm pruritic maculopapular and erythematous lesions at bedbug feeding sites [15].

Despite several studies on bedbug insecticide susceptibility, in Tanzania bedbug infestation is expected to be increasing due to increase in resistant strains [11-13].

Since the infestation is more likely in overcrowded areas, especially the boarding schools are on the high risk of infestation because are coming from different region and families. This study determines the prevalence of bedbug infested beds, which was considered as the prevalence of infestation among students.

## Methodology

### Study Design

This was a cross-sectional study design conducted from May to July 2018 among secondary school students in Kilimanjaro region.

### Study Area

The study was carried in government boarding secondary schools which are Moshi Urban in Kilimanjaro region.

### Study Population

The study population was 384 students in three government boarding secondary schools in Moshi urban.

## Inclusion Criteria

Registered students in boarding government secondary schools at Moshi Urban.

Students willing to participate in the study.

## Exclusion Criteria

Students with visual disorders.

## Sample Size and Sampling Techniques

Convenient sampling technique was used in selection of three government boarding secondary schools located in Moshi Urban. Systematic random selection of students was applied to obtain the number of students who participated in the study for each school.

## Variables

### Dependent Variable

Bedbug infestation.

### Independent Variables

Crowding level, awareness, students' family residence, sex and age.

## Data Collection Tools and Methods

Questionnaires were the tools used for data collection, used to obtain social demographics information of the participants which were age, sex, and family residence. The observation checklist was used to assess the bedbug eggs and feces from student's dormitory beds.

## Data Analysis

Data were entered, cleaned, and analyzed by using Statistical Package for Social Science (SPSS) Version 20. Descriptive statistics was used to summarize data where in categorical data percentage and proportion was used to summarize data. Frequency tables and figures bar graph was used in data presentation and interpretation.

## Results

Out of 384 participants 54.9% aged 18 and above years which was relatively higher compared to those aged below 18 years (45.1%). Regarding class category 51.3% of the participants were in advanced level. To maintain confidentiality participating schools will from this point be referred using letters X, Y and Z. Of all participating students 34.4% were from X while 33.9% and 31.8% were from Y and Z respectively. Among the study participants boys constituted 53.1% while 53.9% of all students were from urban and 46.1% were from rural areas. Table 1 shows Socio-demographic characteristics of participants (N=384).

**Table 1: Socio-Demographic Characteristics of Participants (N=384)**

| Variables                      | N   | %    |
|--------------------------------|-----|------|
| <b>Age group (years)</b>       |     |      |
| 18 and above                   | 211 | 54.9 |
| Below 18                       | 173 | 45.1 |
| <b>School name (secondary)</b> |     |      |
| Z                              | 122 | 31.8 |
| Y                              | 130 | 33.9 |
| X                              | 132 | 34.4 |
| <b>Sex</b>                     |     |      |
| Male                           | 204 | 53.1 |
| Female                         | 180 | 46.9 |
| <b>Family residence</b>        |     |      |
| Urban                          | 207 | 53.9 |
| Rural                          | 177 | 46.1 |
| <b>Class category</b>          |     |      |
| O-level                        | 187 | 48.7 |
| A-level                        | 197 | 51.3 |

The overall prevalence of bedbug infestation was 58.1%. School-wise prevalence was 72.3% in school Y, 64.4% in school X and 36.1% in school Z. Y school had higher proportion in the

overall prevalence (24.5%) followed by school X (22.2%) while school Z contributed the least (11.5%). The table 2 summarizes prevalence of bedbug infestation in the respective schools.

**Table 2: Prevalence of Bedbug Infestation by School (N=384)**

| School name | Infestation status n (%) |              | Total    |
|-------------|--------------------------|--------------|----------|
|             | Infested                 | Not infested |          |
| Y           | 94(72.6)                 | 36(27.7)     | 130(100) |
| X           | 85(64.4)                 | 47(35.6)     | 132(100) |
| Z           | 44(36.1)                 | 78(63.9)     | 122(100) |

Out of 223 students who were found to have been infested 59.6% were boys, 52.5% were advanced level students (form V&VI), 55.6% were aged above 18 years and 44.4% aged below 18 years. In addition, among students who were infested with

bedbugs 50.2% were from rural while 49.8% were from urban areas. Majority of infested students were found to have other signs of bedbug infestation. Table 3 shows Social-demographic characteristics of bedbug infested students (N=223).

**Table 3: Social-Demographic Characteristics of Bedbug Infested Students (N=223)**

| Variable            | Frequency | Percentage |
|---------------------|-----------|------------|
| <b>Age</b>          |           |            |
| Below 18            | 99        | 44.4       |
| 18 and above        | 124       | 55.6       |
| <b>Sex</b>          |           |            |
| Male                | 133       | 59.6       |
| Female              | 90        | 40.4       |
| <b>Residence</b>    |           |            |
| Rural               | 112       | 50.2       |
| Urban               | 111       | 49.8       |
| <b>Bedbug stage</b> |           |            |
| Adult               | 98        | 43.9       |
| Other sign          | 125       | 56.1       |

Most of the students were found to be living in overcrowded dormitories, 63.8% of inspected students were living in dormitories which students outnumbered the beds. Overall number of boarding students and the corresponding number of beds in the respective schools were 1240 and 1220 in Y school, 790 and 760 in X school and 423 and 421 in Z school. Among 223 students who had bedbug infestation those living in overcrowded dormi-

tories had a higher infestation rate (72.6%). Univariate logistic regression showed there was statistically significant difference in the prevalence of bedbug infestation between the students living in the overcrowded dormitories compared to those living in non-crowded dormitories ( $p < 0.05$ ). Table 4 shows Univariate logistic regression of association between crowding and bedbug infestation (N=384).

**Table 4: Univariate Logistic Regression of Association Between Crowding and Bedbug Infestation (N=384)**

| Variable           | Infestation N (%) |          | cOR             | p-value |
|--------------------|-------------------|----------|-----------------|---------|
|                    | Yes               | No       |                 |         |
| <b>Crowded</b>     | 162(72.6)         | 83(51.6) | 2.50(1.63-3.83) | 0.001   |
| <b>Not crowded</b> | 61(27.4)          | 78(48.4) | 1               |         |

Of the 384 students who participated in the study only 31.5% were aware of the bedbug biology, transmission and control methods while the remaining students had limited awareness. About 92% of all participants were aware on bedbug biology, 47.4% were aware of methods involved in bedbug transmission and 70.3% were aware of control and prevention of bedbugs. Environmental cleanness was the most bedbug prevention method mentioned by 36.2% of the participating students; other methods familiar to the students were reduce crowding in dormitories (17.2%), sun-heating of beddings (13.3%), use of hot water (9.4%), use of iron beds (4.4%), freezing beddings (2.3%), education (2.1%), use of dried clothes (1.8%) while 13.3% of the students were not aware of any bedbug prevention or control method.

Univariate logistic regression result showed that students with limited or those who were not aware about bedbugs had higher prevalence of infestation (67.3%). However, there was no statistically significant association between prevalence of infestation and general awareness among students. Also, 93.7% of infested students were found to be aware about bedbug biology and behavior, however, the association was found to be statistically not significant, 48.4% of infested students were aware of bedbugs' transmission methods, the association was also statistically not significant (P=0.63). The prevalence of bedbug infestation among students who were aware of bedbug prevention and control methods were 71.7 %, the association was statistically not significant (P>0.05). Table 5 shows Univariate logistic regression of association between awareness level and bedbug infestation (N=223).

**Table 5: Univariate Logistic Regression of Association Between Awareness Level and Bedbug Infestation (N=223)**

| Variable                               | Bedbug infestation n (%) |           | cOR             | p-value |
|--|--------------------------|-----------|-----------------|---------|
|  | Yes                      | No        |                 |         |
| <b>Overall awareness</b>               |                          |           |                 |         |
| Aware                                  | 73(32.7)                 | 48(29.8)  | 0.87(0.56-1.35) | 0.54    |
| Not aware                              | 150(67.3)                | 113(70.2) | 1               |         |
| <b>Bedbug biology</b>                  |                          |           |                 |         |
| Aware                                  | 209(93.7)                | 14(8.7)   | 0.70(0.32-1.52) | 0.37    |
| Not aware                              | 14(6.3)                  | 147(91.3) | 1               |         |
| <b>Bedbug transmission ways</b>        |                          |           |                 |         |
| Aware                                  | 108(48.4)                | 74(46.0)  | 0.90(0.60-1.36) | 0.63    |
| Not aware                              | 115(51.6)                | 87(54.0)  | 1               |         |
| <b>Bedbug control &amp; prevention</b> |                          |           |                 |         |
| Aware                                  | 160(71.7)                | 110(68.3) | 0.85(0.54-1.32) | 0.47    |
| Not aware                              | 63(28.3)                 | 51(31.7)  | 1               |         |

## Discussion

The overall infestation rate among secondary school students was 58.1%. This was nearly the same of study conducted in Bagamoyo Tanzania which was 56.5% [11]. The prevalence was much higher compared to that found in New York City (6.6%) and 21.8% in Nigeria [9].

The students were coming from North- Eastern Zone were more affected by bedbugs this was similar to the previously commu-

nity study reported in Manyara and Tanga which are northern region in Tanzania [12, 13]. Therefore, the students coming from family with bedbug infestation might have carried bedbugs from their home to school and spread among themselves at higher rate.

The findings of the study also indicate that students from the rural setting had higher chance of being infested, though the difference of infestation is small because among study participants,

students from urban setting had high proportion.

The prevalence of bedbug infestation among students living in overcrowded dormitories was 72.6%. Association between bedbug infestation and crowding level in the community has been reported in the previous studies suggesting that poverty and crowding are predicting factors of bedbug infestation [16]. The findings of this study show that bedbug infestation is high among students living in overcrowded (high number of students per number of beds) dormitories. Also, because students have the tendency of sharing beds and mattresses, the increased interaction between students living in the same dormitory could also be significant in bedbug transmission. Many student dormitories were old and with old designs because the student beds were nearly placed, the pattern which was suggested to be the risk factor for the spread of bedbugs [4, 7].

The overall awareness among students with bedbug infestation was about 32.7%. Study done by Geraldo reported nearly similar results in which 30% of participants were able to correctly identify bedbugs, this highlights the fact that people who are less aware about bedbugs are prone to bedbug infestation [17]. Poor awareness among students leads to delay of information to the responsible authorities hence increase in bedbug infestation rate.

## Conclusion

The results of this study high prevalence of bedbug in government boarding secondary schools which was associated with overcrowding of the students in the dormitories. There was limited awareness of bedbug infestation for some secondary school students. The forums and prevention programs should focus on educating people so that to increase the community awareness about bedbugs. Also, the fumigation should be done in dormitories during students' entry soon after vacation.

## Abbreviations

CI: Confidence Interval, cOR: Crude Odds Ratio.

## Author Contributions

PRM, EEW and BG for design, data collection, data analysis and manuscript writing; JK and ALM contributed in reviewing the manuscript for intellectual content.

## Declaration of Conflicting Interests

The authors declare no potential conflicts of interest with respect to the research, authorship and publication of this article.

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## Ethical Approval

Ethical approval was granted from the Kilimanjaro Christian Medical University College Research Ethics Committee. The

permission to conduct this study was obtained from the Moshi Municipal Director, Moshi Municipal secondary schools education officer and school administration.

## Informed Consent

Written informed consent was obtained from the participants.

## References

- Centers for Disease Control and Prevention. (2010). Joint Statement on Bed Bug Control in the United States from the US Centers for Disease Control and Prevention (CDC) and the US Environmental Protection Agency (EPA).
- Bonnefoy, X., Kampen, H., & Sweeney, K. (2008). Public health significance of urban pests. World Health Organization.
- Goddard, J., & deshazo, R. (2009). Bed bugs (*Cimex lectularius*) and clinical consequences of their bites. *Jama*, 301(13), 1358-1366.
- Chen, H., & Copes, R. (2010). A review on bed bugs: epidemiology, health effects, and surveillance activities. Agency for Health Protection and Promotion.
- NPMA. National Pest Mangement Association. (2011). The bedbug Hub: One-Stop For Bedbug Information.
- Gounder, P., Ralph, N., Maroko, A., & Thorpe, L. (2014). Bedbug complaints among public housing residents—New York City, 2010–2011. *Journal of Urban Health*, 91(6), 1076-1086.
- Wang, C., Singh, N., Zha, C., & Cooper, R. (2016). Bed bugs: Prevalence in low-income communities, resident's reactions, and implementation of a low-cost inspection protocol. *Journal of medical entomology*, 53(3), 639-646.
- Kaylor, M. B. (2011). Prevalence, Knowledge, and Concern about Bed Bugs.
- Omudu, E. A., & Kuse, C. N. (2010). Bedbug infestation and its control practices in Gbajimba: a rural settlement in Benue state, Nigeria. *Journal of vector borne diseases*, 47(4), 222.
- Gbakima, A. A., Terry, B. C., Kanja, F., Kortequee, S., Dukuley, I., & Sahr, F. (2002). High prevalence of bedbugs *Cimex hemipterus* and *Cimex lectularius* in camps for internally displaced persons in Freetown, Sierra Leone: a pilot humanitarian investigation. *West African journal of medicine*, 21(4), 268-271.
- Temu, E. A., Minjas, J. N., Shiff, C. J., & Majala, A. (1999). Bedbug control by permethrin-impregnated bednets in Tanzania. *Medical and veterinary entomology*, 13(4), 457-459.
- Kweka, E. J., Mwang'onde, B. J., Kimaro, E. E., Msangi, S., Tenu, F., & Mahande, A. M. (2009). Insecticides susceptibility status of the bedbugs (*Cimex lectularius*) in a rural area of Magugu, Northern Tanzania. *Journal of global infectious diseases*, 1(2), 102.
- Myamba, J., Maxwell, C. A., Asidi, A., & Curtis, C. F. (2002). Pyrethroid resistance in tropical bedbugs, *Cimex hemipterus*, associated with use of treated bednets. *Medical and veterinary entomology*, 16(4), 448-451.
- Ashcroft, R., Seko, Y., Chan, L. F., Dere, J., Kim, J., & McKenzie, K. (2015). The mental health impact of bed bug infestations: a scoping review. *International journal of public health*, 60(7), 827-837.

- 
15. McMenaman, K. S., & Gausche-Hill, M. (2016). Cimex lectularius (“bed bugs”): recognition, management, and eradication. *Pediatric emergency care*, 32(11), 801-806.
  16. Giorda, F., Guardone, L., Mancini, M., Accorsi, A., Macchioni, F., & Mignone, W. (2013). Cases of bed bug (*Cimex lectularius*) infestations in Northwest Italy. *Vet Ital*, 49(4), 335-40.
  17. Gerardo, E. M. (2014). Increasing awareness of and education about bed bugs (*Cimex lectularius*) as a public health issue in Hawai‘i (Doctoral dissertation, [Honolulu]:[University of Hawaii at Manoa],[May 2014]).

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