Original Research Article

The Prevalence Of Bedbug Infestation (*CimexHemipterus)* And Associated Factors Among The Heads of Households In Nakuru Town, Kenya

Abstract

Background: Infestations and the resurgence of bedbugs have recently been documented as serious health issues worldwide. Kenya reported 4000 bedbug-infested homes in 2018, so the increase in infestations is comparable to that of other African countries and the global average.

Objective: the objective of the study was to determine bedbug prevalence and factors associated with bedbug infestation among heads of households in Nakuru County, Kenya.

Method: The study used a cross-sectional descriptive study design. Cluster sampling and proportionate sampling were used to recruit the study respondents in this study. TheCochran formula was used to recruit 422 study respondents. The threshold for statistical significance was set at 0.05.

Results: The prevalence of bedbug infestation was 53.1%. The presence of households with bedbugs was associated with the prevalence of bedbugs in the study households (p value<0.001). The purchase of second-hand furniture and clothes was associated with bedbug prevalence (p value=0.002 and 0.007 respectively). The number of rooms in households was associated with the prevalence of bedbugs (p value=0.008). The number of people living in households (p value=0.021) and the type of house were associated with the prevalence of bedbugs (p value<0.001).

Conclusion: The prevalence of bedbug infestation was 53.1%. The type of house, number of people in a household, number of rooms in the household, and social factors including the existence of neighbors, relatives, friends, and job mates with bedbugs in their homes, heightened the chances of spreading the bedbugs to others. The purchase of second-hand furniture and clothes increased the prevalence of bedbugs.

Keywords: Bedbugs, Determinants and Infestation

1. INTRODUCTION

Bedbugs (*Cimex lectularius*) are very small insects that depend on human blood and small animal blood for their survival[1]. Bedbugs are generally lively at night when people are fast asleep and during the daytime, they hide themselves in holes in furniture, bangs, wall cracks, bedding, and very congested areas of households. People bitten by bedbugs reported a lack of sleep, depression, stress, and clinical symptoms such as skin rashes and allergic reactions[2]. Under normal circumstances, bedbugs can live around one year, and during this period females can reproduce 200-500 eggs[3]. Reproduction of a bedbug's regularity depends on a number of things such as environment, A Normally developed bedbug could need blood every four days and an adult can live without food for up to one year.Approximately

20% of people worldwide have either had a bed bug infestation in their home, encountered bed bugs in a hotel, or known someone who has a bed bug infestation[4].

Cimex lectularius and C. hemipterus are the two primary bed bug species that are typically linked to human infestations[5]. While C. hemipterus is common and well-known in tropical and subtropical regions, Cimex lectularius, a common bed bug, lives in temperate regions of the Nearctic and Palearctic regions (Asia, Australia, Africa, and South America)[5]. Because of the disruption of this traditional division and the extension of their geographical dispersions caused by the rise in international travel, immigration, and secondhand trade, C. lectularius and C. hemipterus are now found sympatrically[6]. Concerns about bed bugs have grown as a result of the significant increase in bed bug infestations in human habitats over the last three decades[7]. Numerous clinical and psychological disorders can be attributed to them.Additionally, they lead to a number of economic issues that impact the tourism and cultural sectors[7]. Elderly neglect has increased during the coronavirus disease pandemic. Therefore, elder abuse and neglect may be exacerbated by the necessity of social isolation during pandemics. Infestations of bed bugs are now common in both public and private settings, such as public transportation, healthcare facilities, and senior living facilities, and are no longer restricted to homes and hotels[1].

Globally, it is not clear why bedbug infestation came back to such as number in the developed world, in the 19th century 75% of the houses in British were infested by bedbugs[8]. Introduction of widespread Dichlorodipheny and trichloroethane (DDT), Vacuum cleaners, and efficient measures for pubic hygiene are donated to the effective eradication of bedbugs in the developed world in the 1980s. Bedbug infestation in the developed world remained high[1]. The use of DDT stopped in the 1970s[1].Cases of Bedbug infestation have been reported to be rampant in African countries[9]. Regionally, bedbug prevalence has been reported in sub-Saharan Africa, and about 36 countries with a projected population of 5 million people are affected by bedbug infestations[10]. Regionally, bedbugs are prevalent reported in sub-Saharan Africa, about 36 countries, and a projected population of 5,070,000 people are suffering from bedbugs currently[11]. Research done in East Africa has indicated the relationship between the use of pyrethroid treatment mosquito nets and developed resistance to this insecticide in bedbugs[12]. Changes in the pest regulars industry might have also accidentally helped bedbugs to thrive[12].
Research done in East Africa has indicated the relationship between the use of pyrethroid treatment mosquito nets and developed resistance to this insecticide in bedbugs[13]. Changes in the pest regulars industry might have also accidentally helped bedbugs to thrive. Nakuru is situated in the former Rift Valley province in Kenya with an estimated population of 1.603 million[14]. Nakuru has been hit by quite a number of bedbug resurgences which have been in the public domain. Locally, According to health workers in the area, more than 5000 households were suffering from bedbug infestation and were using hot water as a treatment for bedbugs and they reported itchy and loss of sleep during nighttime[15].Therefore, the main of the study was to determine bedbug prevalence, and factors associated with bedbug infestation among heads of households in Nakuru County, Kenya.

2. METHODOLOGY

2.1 Research Design

The study used a cross-sectional descriptive study design for data collection to determine bedbug prevalence. Social and environmental factors that influence bedbug prevalence among heads of households in Nakuru town.

2.2 Study Area

The study was conducted in seven estates in Nakuru town in both the Nakuru East sub-county and Nakuru West sub-county. Nakuru East had four estates and they were Kivumbini, Bondeni, Lake View, and Flamingo while Nakuru West had three which included Phoda, Kaptembwa, and Mwariki.It is the third most populous county in Kenya, after Nairobi County and Kiambu County, with 2,162,202 residents as of the 2019 census. Its 7,496.5 km2 area makes it the 19th largest county in Kenya. Living situations in these estates match those of a 2002 UN conference definition of a slum household as a number of people living under one room missing one or more of these conditions; sanitation services and adequate living area or good housing, access to better quality and quantity of water and access to education (World Bank, 2008). Most of the houses in the estates were mud and earth houses, Semi-permanent and plaster houses most of them had electricity and tap water.

2.3 Study Population

The population is the total number of items from which an inference is made. The population of the study was 32,856 heads of households who had experienced sleeplessness and itch due to bedbug infestation.

Comment [KC1]: Author(s) should specify the source from which this population total was gotten.

2.4 Sample Size Determination

The sample size was determined using the Cochran formula for smaller populations. With the appropriate degree of significance and accuracy, the researcher was able to determine the sample size and estimate the proportions of an attribute present in the population. As a result, 422 study participants made up the sample size.

Comment [KC2]: The Cochran formula should be stated as used in this study

2.5 Sampling Technique

Seven estates in Nakuru town were selected, the estates were both Nakuru's east and west sub-counties. All heads of households within the estates were enumerated. The 422 heads of households who participated in the study were selected using snow-boiling sampling. Cluster sampling was used to select the affected estates where the list of estates was generated. Probabilities proportional to population size was employed to select households to be considered in the study. Thereafter snowballing sampling was used to discover households that were experiencing bedbug infestation and willing to interview until the needed sample was achieved.

Comment [KC3]: Justify and provide the unique characteristics that made these seven estates in Nakuru town suitable for the study instead of other estates.

2.6 Data Collection Method and Instruments

The study used semi-structured questionnaires to collect data from the field. All the heads of households selected to participate in the study were given a home visit by the investigator and research assistants. During the visit, the participants sought consent and signed the forms by the heads of households then the questions were asked. Section A of the questionnaire obtained data on the prevalence of bedbug infestation, Section B obtained data on social factors and Section C obtained data on environmental factors.

2.7 Validity and Reliability

Validity is the degree to which research instruments measure what is intended to be measured; therefore, the instruments were carefully examined by the supervisors and a public health expert to guarantee their accuracy[16]. The degree to which research apparatus consistently yields comparable results is known as reliability [17]. The tools were pretest-tested using 10% of the Baringo North Sub-county sample size. The reliability index was computed using Cronbach's alpha, a universal measure of internal consistency (reliability). The instruments were dependable, as indicated by the acceptable reliable value of 0.84.

2.8 Data Processing and Analysis

Quantitative data was analyzed using the Statistical Package for Social Sciences (SPSS) version 29. Data was entered into an Excel spreadsheet to guarantee data cleaning. Inconsistent data, missing values, and extreme situations were addressed and revised. The data was cleaned and then imported

into SPSS version 29. Categorical data in univariate analysis were described using numbers, frequencies, and percentages. To determine whether independent variables and the outcome variable are related, A p-value of less than 0.05 was deemed significant in the chi-square test for independence analysis.

3.0 Results

3.1 Prevalence of bedbug infestation

As provided in Figure 1, The prevalence of bedbug infestation was 53.1 % at the time of the study.

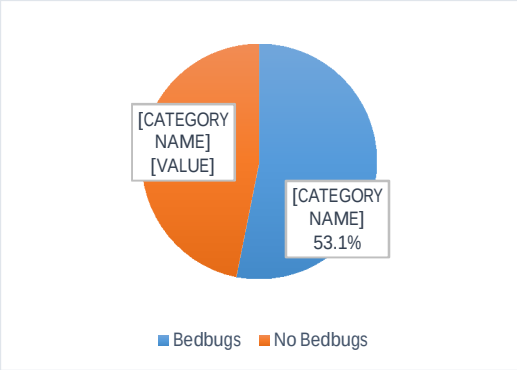

Figure 1: Prevalence of bedbug infestation

3.2 Bedbugs dwelling place

As indicated in Figure 2, Bedbugs were commonly found in furniture 196(31%), bed and bedding 293(46%), wall cracks, and dark places 115(18%), in the house.

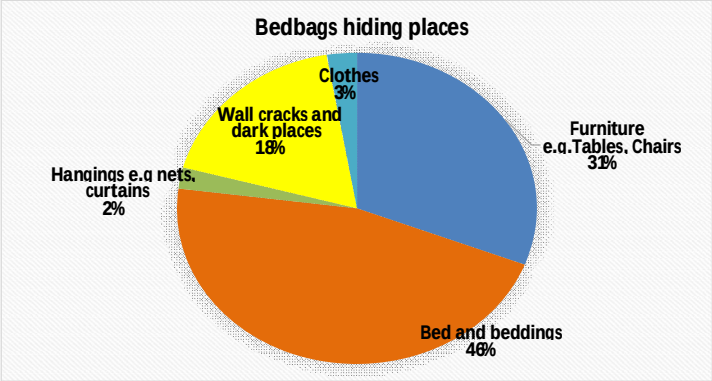

Figure 2: Bedbug hiding places

3.3 Social factors associated with bedbug infestation prevalence

3.3.1 Immigration and Transportation

As provided in Table 1, Most 223(53%) respondents had seen neighbors, relatives; friends, and job mates within their estates have bedbugs in their homes. The presence of households with bedbugs was associated with the prevalence of bedbugs in the study households (p value<0.001). The majority of households with bedbugs had other households within their estate that had bedbugs. A section of

98(23.3%) households had guests staying in or visiting the house before bedbug infestation. A Group of 60(14.1%) households had members who had traveled out before bedbug infestation. A proportion of 21(5%) households had members who had stayed out overnight in a hotel and hostel or private home bedbug infestation. Guests staying in or visiting, traveling out, and staying out overnight were not associated with bedbug prevalence; p values = 0.630, 0.959, and 0.198 respectively.

Table 1: Association between Immigration and transportation and bedbug infestation

Immigration and transportation		Bedbugs currently in house				P value
		Yes		No		
		N	%	N	%	
Who currently has bedbugs	Neighbors	170	40.4%	93	22.0%	<0.001
	Relatives	21	5.1%	5	1.2%	
	Friend	30	7.0%	39	9.2%	
	Job-mate	2	0.4%	5	1.2%	
Had any guests staying in or visiting	Yes	98	23.3%	78	18.4%	0.630
house before bedbugs infestation	No	124	29.4%	116	27.4%	
Traveled out before bedbugs infestation	Yes	60	14.1%	55	13.2%	0.959
	No	159	38%	135	32.0%	
Stayed out overnight in a hotel and hostel	Yes	21	5%	26	6.1%	0.198
or private home bedbugs infestation	No	194	46.1%	162	38.5%	

3.3.2 Second-hand items

As provided in Table 2, the Purchase of second-hand furniture and clothes was associated with bedbug prevalence (p value=0.002 and 0.007 respectively). A section of 254(60.2%) respondents felt that they were vulnerable to getting bedbugs upon buying second-hand items. Visitors who had bedbugs in their houses were considered more risky by 397(94.1%) respondents.

Table 2: association between secondhand items and bedbug infestation

Second hand items		Bedbugs currently in house				P value
		Yes		No		
		N	%	N	%	
Purchased any second hand furniture before	Yes	46	11%	18	4.2%	0.002
bed bugs infestation	No	173	41.1%	172	41%	
Purchased any second-hand clothes before	Yes	34	8.0%	60	14.1%	0.007
you had bed bugs	No	161	38.3%	151	36%	

3.4 Environmental factors associated with bedbug infestation prevalence

As provided in Table 3 below, The number of rooms in households was associated with the prevalence of bedbugs (p value=0.008). Houses with less than 3 rooms were most infested by bedbugs. Number of people living in households was associated with prevalence of bedbugs (p value=0.021). Houses with more than 2 members were most infested by bedbugs. The kind of house was associated with the

prevalence of bedbugs (p value<0.001). Semi-permanent and earth/mud houses were most infested by bedbugs.

Table 3:Environmental factors associated with bedbug infestation

Environment factors		Bedbugs currently in house				P value
		Yes		No		
		N	%	N	%	
Rooms in this household	One room	96	23%	78	19%	0.008
	Two rooms	105	25%	76	18.0%	
	Three rooms	17	4.1%	21	5%	
	Four rooms	6	1.5%	9	2.2%	
	More than five rooms	0	0.0%	8	2.0%	
People living in household	1-2	45	11%	51	12.1%	0.021
	3-5	127	30.0%	112	27%	
	6-8	41	10%	28	7%	
	9-11	10	2.5%	2	0.5%	
	Above 12	1	0.2%	0	0.0%	
Kind of house lived in	Permanent	78	18.60%	130	30.80%	<0.01
	Semi-permanent	25	6.00%	9	2.20%	
	Rental	2	0.50%	11	2.70%	
	Iron sheet cemented	11	2.70%	2	0.50%	
	Earth and plastered	43	10.10%	17	4.10%	
	Cemented	50	11.80%	14	3.40%	
	Single room	3	0.70%	4	1.00%	
	Mud house	11	2.70%	2	0.50%	
	Plastered	1	0.20%	2	0.50%	

4. Discussion

Study findings indicated that the prevalence of bedbug infestation was 53.1%. Another study carried out in Hong Kong recorded a higher prevalence of bedbug infestation[18]. Another study carried out in New Jersey documented a low(29.5%) prevalence of bedbug infestation. The possible explanation for recorded prevalence could be linked to studies being conducted in different settings and different study designs being employed.

The study sought to establish Social factors that are associated with the prevalence of bedbug infestation. Bedbug infestation was very rampant in the homestead locality including neighbors, relatives, friends, and job mates. The chi-square test of association revealed an association between the prevalence and presence of households with bedbugs in the locality. Neighbors' households infested were the greatest risk for bedbug transmission compared to relatives' and friends' households. This was because bedbugs could easily migrate between neighbors, relatives, and friends on their own or carried by persons or goods/ luggage moved between their households. Further shared amenities including social/ public gatherings and clothe-lines also posed a risk for bedbug transmission. Study respondents considered visitors who had bedbugs in their houses more risky in transmitting bedbugs.Findings from this study agreed with those of research carried out in Africa where similar results were documented[12].

Comment [KC4]: Which part of Africa?

Purchase of second-hand furniture and clothes before bed bug infestation was associated with an increase in bedbug prevalence. Study respondents felt that they were vulnerable to getting bedbugs upon buying second-hand items. Second-hand furniture or other items were the main sources of bedbugs as bedbugs move with the items. Many persons sold their items once infested while buyers never discovered they were infested.Results from this study disagreed with those of a study carried out in Canada between second-hand furniture and clothes and bedbug infestations[19].Environmental factors including overcrowding environment and climate were also assessed. Number of rooms in households was associated with the prevalence of bedbugs. Houses with less than 3 rooms which are presumed to be more crowded were most infested by bedbugs. Findings agreed with those of a study carried out in Hong Kong where the overcrowded household was a risk factor for bedbug infestation[18].

Number of people living in households was associated with prevalence of bedbugs. Houses with more than 2 members, which are presumed to be more crowded, were most infested by bedbugs. Crowded houses offered more breeding and hiding sites for bedbugs including shoes, clothes, joints of furniture, bedding, dark places, curtain frames, door frames, ceiling cracks, woolen carpet, and traditional/ laundry baskets.The findings from this research agreed with those of a study carried out in Ethiopia[20]. The kind of house was associated with the prevalence of bedbugs. 'All houses were vulnerable to bedbug infestation' however some houses were reported to be more prone to bedbug infestation as they provided more breeding and hiding places for bedbugs. Semi-permanent houses, mostly earth/mud/plaster and timber houses were most infested by bedbugs. This may have been due to dark cracks that provided breeding and hiding sites for bedbugs.The findings from this study disagreed with those of a retrospective case-control study[21].

5. Conclusion

Most households in Nakuru County were infested with bedbugs. The prevalence of bedbug infestation was 53.1%. Social factors including the existence of neighbors, relatives, friends, and job mates with bedbugs in their homes, heightened the chances of spreading the bedbugs to others. The purchase of second-hand furniture and clothes increased the prevalence of bedbugs. Overcrowded environments increased the prevalence of bedbug infestation as they provided more breeding and hiding places for bedbugs. Houses with less than 3 rooms; and houses with more than 2 members were presumed to be more crowded and were most infested by bedbugs. All types of houses were vulnerable to bedbug infestation, however, semi-permanent houses mostly earth/mud/plaster and timber houses, were more prone to bedbug infestation.

6. Ethical Issues

Clearance to obtain a research permit for the study was sought from Mount Kenya University School of Postgraduate Studies and the ethical review committee. Research permit approval to carry out the study was obtained from the National Commission for Science, Technology, and Innovation (NACOSTI/P/18/31794/23904). The research obtained clearance from the Director of Commissioner and Director of Education in Nakuru County. The study also reported to the county public health officer. Consent was sought from all heads of households who were selected to participate in the study and the study was voluntarily given a room for freedom of withdrawal at any time. All respondents were guaranteed that the information they gave would only be used for the purpose of the study and that the findings would be communicated to them. Also, the study guaranteed the participants that the study would not use any form of names or any other identification

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