



# **Socioeconomic Factors and Cultural Practices Influencing the Resurgence of Bedbugs (*Cimex hemipterus*): A Case of Nakuru Town, Kenya**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors M. Dennis and M. Dominic designed the study. Author M. Dennis involved in data collection, data analysis and preparation of the final manuscript draft. Authors KJ and M. Dominic managed the analysis of the study, Authors KS and SA managed the literature searches. All authors read and approved the final Manuscript.*

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## **ABSTRACT**

Bedbugs are parasitic insects that feed mostly on blood (human). *Cimex hemipterus* commonly known as the Tropical bedbug resurge in warmer climates like Africa, Asia and America. Over the years bedbug infestation has remained a major public health concern among the residents of Nakuru Town Kenya. The purpose of this study was to determine socioeconomic factors and cultural practices that influence the resurgence of bedbugs in Nakuru Town, Kenya.

This study adopted analytic epidemiological study design and used cross sectional descriptive survey for data collection. It was conducted in seven estates in Nakuru Town, Kenya with an estimated population of 32,856 in a period of seven months. Cluster sampling was used to sample the households in the estates with the study surveillance being done in four hundred and twenty two (422) households whereas 57% and 43% of the participants were male and female respectively.

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The main source of income among the respondents was self-employment with only 27% of the participants being employed. According to the findings of this study 31% of the residents were earning between 5000 and 10000 with only 4% of their monthly income been allocated to healthcare. The current socioeconomic status among the residents of Nakuru Town is inhibiting the fight against bedbug elimination. Cultural beliefs like witchcraft are limiting the eradication of bedbugs and leads to the resurgence in some of the households.

In conclusion, the current socioeconomic status among the residents of Nakuru Town is inhibiting the fight against bedbug elimination. The findings of this study will be used to inform the policy makers in the Nakuru County government on measures to be taken to improve the socioeconomic status of its residents so that in the future residents are empowered to eradicate the bedbugs.

**Keywords:** *Cimex hemipterus*; resurgence; socioeconomic factors; Nakuru; Kenya.

## 1. INTRODUCTION

Bedbugs are insects of parasitic origin in the genus *Cimex* and human blood is their meal of preference [1]. The *Cimex hemipterus* is likely to be found in warm regions like Africa and Asia. The life cycle and feeding behavior determines the size and color of bedbugs [1].

Bedbugs are not exclusively nocturnal but their active feeding times are at night. Bedbugs that are fully grown are known by their pyramid-shaped head, compound eyes, antennae and a proboscis [2]. A bedbug pricks the skin of its victim and a small amount of saliva is inoculated which is used as anticoagulant and anesthetic to assist in obtaining the blood. This makes the bite of the bedbug incognito to the human senses [1]. Neck, face, arms and hands are usually the common location for the bites [3].

Bedbugs' causes ill health and lack of wellbeing making them a public health issue considering they are environmentally communicable [4]. People who are exposed to bedbug bites manifest symptoms like; pain, itching, sleep loss, psychological distress etc. [2,5]. Bedbugs' bites reactions differ from one individual to the other with some individuals experiencing bite symptoms while other individuals suffer from systemic reactions like difficulty in breathing, dysphagia, lethargy and chest tightness [2]. Bedbug infested residents are sometimes denied health care service or public services by service providers for the phobia of bed bugs [4]. It is an expensive affair controlling bedbug infestation [6,7]. Residents throw away their furniture and other household items trying to curb bedbug infestations.

Previous studies have shown that bed bugs migrate and spread via exchange of infested furniture among the residents, home visits, social

interactions between residents and are dispersed actively [8,9]. Bedbugs are most common in multi-unit homes compared to single unit dwellings due to the closeness to each other within a building structure. In addition to that, distribution of bedbugs in apartments tends to be clustered with one unit having multiple bedbug infestations and the other free from bedbug infestation [10,8].

Bedbug infestations prevalence is highly associated with socioeconomic status of the residents. Past surveys have indicated that communities with low income in the United States are more burdened with bedbug infestation issues than middle income as well as upper income communities. [11,12]. Limited income has crippled the ability of residents to hire the best pest control service; ineffective pest management plans and lack of resident cooperation in these societies contribute to bedbug infestations [11,9].

In the recent past, there has been resurgence of bedbug infestation in Kenya. Bedbugs are not known to transmit any diseases, but are classified under neglected tropical diseases. On the other hand, bedbug infestation is a public health nuisance as their bites causes itching and skin breaks which can lead to secondary infections [13]. Bedbug infestation can also lead to sleep loss and stigmatization leading to loss of respect among peers. Nakuru County in Kenya has been hit by quite a number of bedbug resurgence which has been in the public domain. This study aimed to establish socioeconomic factors and cultural practices influencing to the resurgence of bedbugs in Nakuru Town. Been a metropolitan city, Nakuru hosts people of all socio economic blocks. Low income communities hinder the eradication of bedbugs and some residents in Nakuru town estates are living under very impoverish conditions which could in turn

lead to resurgence of bedbugs as most people cannot even afford the basic insecticides to kill and eradicate bedbugs in their households.

This paper reports on socioeconomic factors and cultural practices influencing the resurgence of bedbugs in Nakuru Town, Kenya. Level of education, sources and levels of income among the households interviewed indicate that bedbug resurgence is influenced by these factors.

## 2. METHODS

### 2.1 Study Setting

The study setting was in seven estates in Nakuru Town Kenya, Nakuru Town is the capital City of Nakuru County and the fourth largest city in Kenya. It is in North-West of Nairobi in the Rift Valley. The estates included Kivumbini, Flamingo, Bondeni, Lakeview, Rhoda, Kaptembwa and Mwariki which had as estimated population of 32,856. The households' heads both male and female were the target population.

### 2.2 Sampling Design

This study adopted the analytic epidemiological study design using cross-sectional descriptive survey approaches for data collection. The sample size of this study was 422 households using the formula [14] in determining the sample size.  $n = z^2 pq / d^2$  where  $n$  = Population desired sample >10000,  $z$  = standard normal deviate,  $p$  = target population proportion as per characteristics,  $q = 1 - p$ ,  $d$  = statistical significance level. Therefore;  $n = (1.96)^2 (.50)(.50) / (.50)^2 = 384 + 10\%$  for non-respondents (38) = 422 households.

### 2.3 Survey Instruments

Questionnaires, Focus group discussions and Key Informant Interviews were the instruments used to collect data.

### 2.4 Statistical Analysis

SPSS Statistical social science package version 22 was used for analyzing data and generation of themes for the FGDs. The study instruments were used in such manner that the results were consistent and stable. Data was thoroughly cleaned throughout the data collection period and research assistants were trained effectively and supervised to make sure consistent results were collected. Descriptive analysis was done

and data represented inform of graphs, Figures and pie charts.

## 3. RESULTS

### 3.1 Social Economic Factors Affecting Resurgence of Bedbugs in Nakuru Town

#### 3.1.1 Number of rooms occupied in the house

The study found out that the houses that were available in the estates were not spacious enough for the families therein. One hundred and fifty six study participants lived in two roomed houses which was 37% of the total respondents. Also, 143 respondents lived in one roomed houses which accounted for 34% of the study participants. Only about 20% (84 out of 422) and 7% (30 out of 422) live in three and four roomed houses respectively.

#### 3.1.2 Type of home owned

This study found that 354(84%) respondents lived in rented homes while only 68(16%) respondents owned homes.

#### 3.1.3 Level of education among the respondents

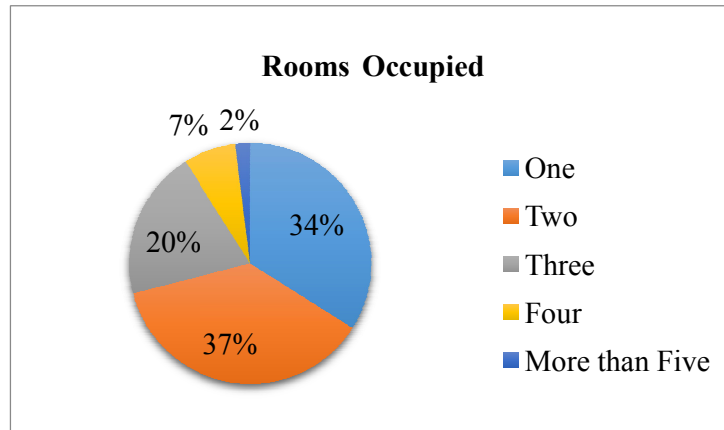
253 (60%) respondents had attained up to secondary level of education while 84 (20%) had attained primary level of education. The study also found out that only 76(18%) had attained tertiary level of education and above Eight (2%) respondents had not attained any level of education.

#### 3.1.4 Main source of income

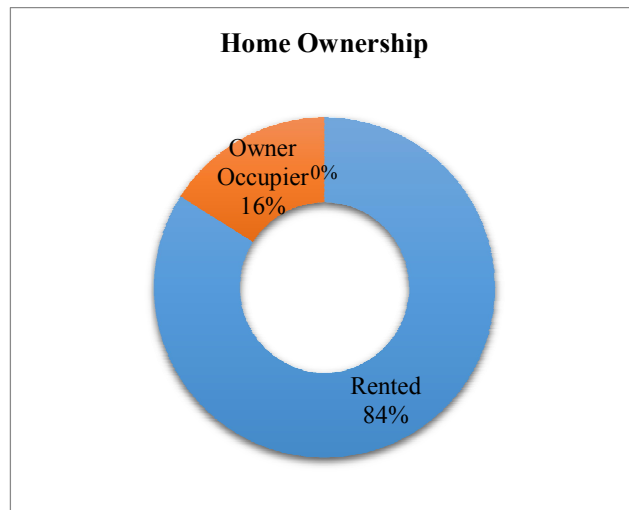
The sources of income among the study participants were based on their level of income as was evident in about only 144 (27%) respondents having formal employment. 224 (53%) were self-employed and 59(14%) Respondents had businesses as their source of income. A notable number is the 25(6%) respondents who depended on others for their sources of income.

#### 3.1.5 Monthly income

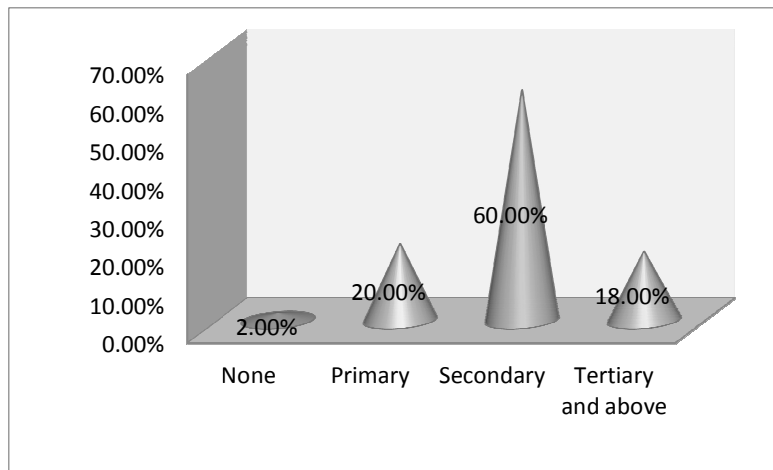
The level of income among the study participants highly depended on the socioeconomic activities been undertaken by the respondents.



**Fig. 1. Number of rooms occupied**



**Fig. 2. Type of home owned**



**Fig. 3. Level of education**

This study finds that 13(3%) respondents did not have any income. Also, 55(13%) study participants were earning less than KES 1000 per month which makes it really difficult for survival in such tough economic times.

One hundred and one (24%) respondents were earning between KES 1001-5000 at the time of this study and the majority of the residents interviewed 31% (131 out of 422) were earning between KES 5001-10000. This means that 71% (300) of the residents interviewed, were earning

below the minimum wage of KES 13,500 in Kenya (Kenya Revenue Authority).

### 3.1.6 Main monthly expenditure

The main monthly expenditure of the residents mainly depended on the socio economic activities at the time and the level of monthly income. The biggest priority as this study finds is food, where 58% (245) of the study respondents considered it as their main monthly expenditure. Bedbug eradication falls under healthcare where

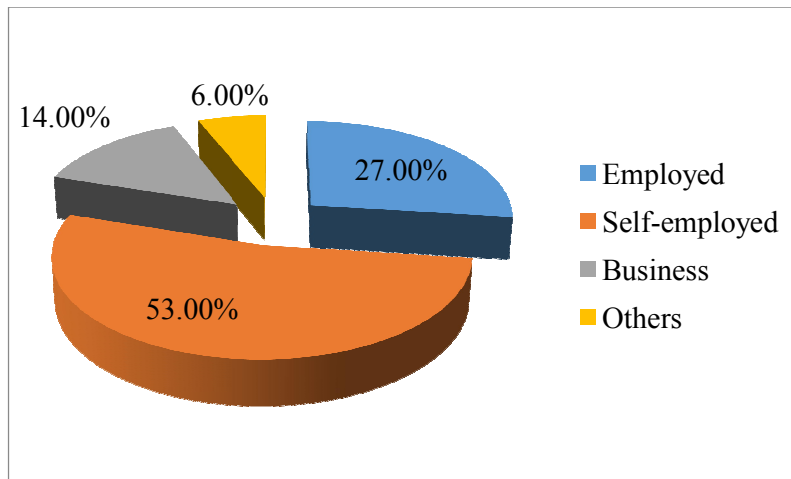


Fig. 4. Main source of income

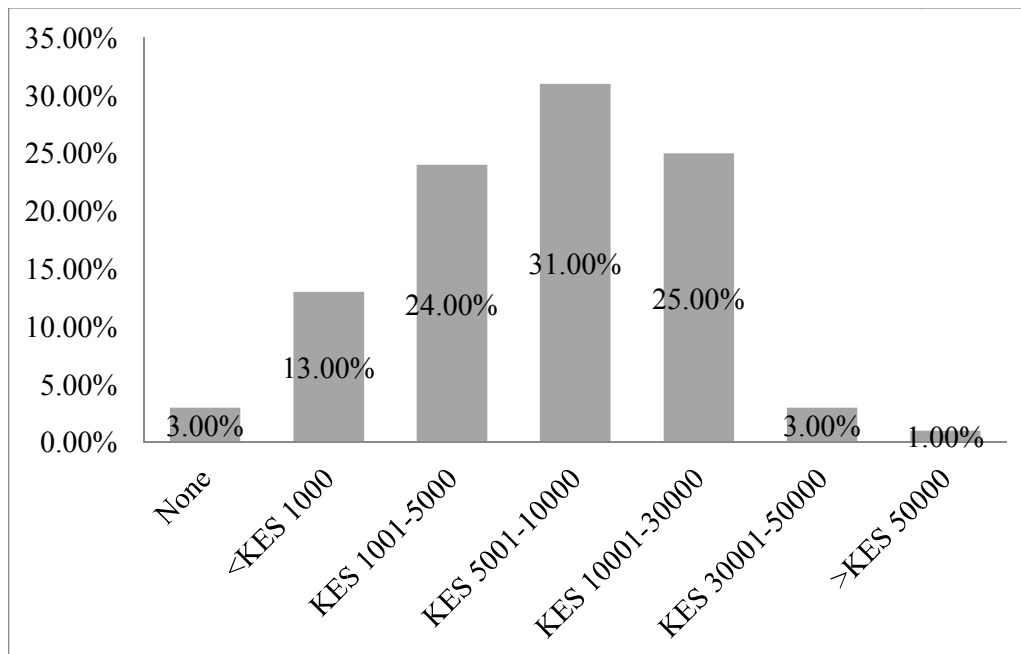


Fig. 5. Monthly income

on 4% (17) of the study respondents considered it their main monthly expenditure.

### **3.2 Cultural Practices Influencing Resurgence of Bedbugs in Nakuru Town**

This study found that 33% (139) of the study respondents at the time were still using traditional methods to eradicate bedbugs in their homesteads. Traditional methods are not quite effective as this study later found out and this leads to resurgence of bedbugs. On the same outcome, it is noted by this study that 67% (282) of the respondents were not using traditional methods as they believed they are not effective and this would lead to resurgence of bedbugs in their homes.

### **3.3 Methods Currently being used to Control and Prevent Bedbugs**

At the time of this study, 40% (169 out of 422) of the households had bedbugs present in their households. 69% (291) of the residents interviewed reported that they had experienced bedbug infestation in the last three months before this study took place. Only 45% (190) of the households reported to have been using current methods to control and prevent bedbug infestation. 55% (232) of the households reported that they were not using any methods to control and prevent the bedbug infestation and they gave their reasons. Among the 45%(190) respondents that had reported to be using the current methods to control and prevent bedbugs, 33% (139 out of 190) reported that the methods were effective in eradicating bedbugs in the households. However, 12% (51 out of 190) of the respondents reported that the methods were not effective and were in turn leading to bedbug resurgence in the estates in Nakuru, Town.

## **4. DISCUSSION**

This study finds that low socio economic status among the residents interviewed has led to the resurgence of bedbugs in Nakuru Town, over the years. Estate wide inspections of this study revealed a number of interesting socio economic characteristics among the residents of Nakuru Town, Kenya. Many residents were living in multi-unit houses and Bedbugs are most common in multi-unit homes compared to single unit dwellings due to the closeness to each other within a building structure [15]. In addition to that,

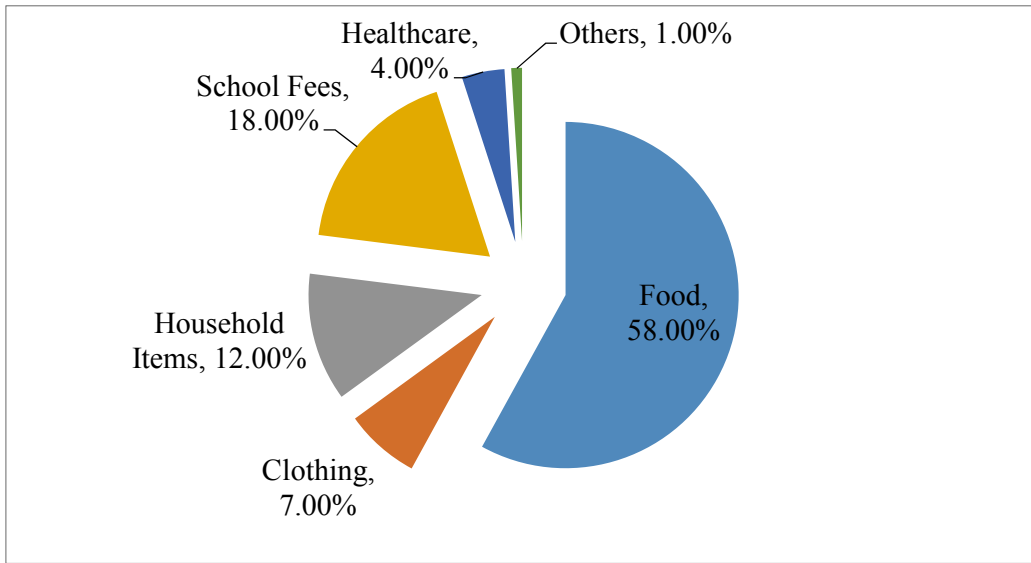
distribution of bedbugs in apartments tends to be clustered with one unit having multiple bedbug infestations and the other free from bedbug infestation [10,11].

Bedbug infestations prevalence is highly associated with socioeconomic status of the residents. Past surveys have indicated that communities with low in-come in the United States are more burdened with bedbug infestation issues than middle income as well as upper income communities. [11]. Limited income has crippled the ability of residents to hire the best pest control service; infective pest management plans and lack of resident cooperation in these societies contribute to bedbug infestations [6,9,11].

The majority residents earned between Kenya shillings 1,000-30,000 which makes it hard for them to balance their priority needs in terms of monthly expenditure. Many of the residents in Nakuru town made food a priority and health care services was least sought after where bedbug prevention and control lies. The cost of chemicals used is a limitation in the fight against bedbug infestation among the residents interviewed leading to resurgence of bedbugs in most estates. Controlling bedbugs is quite expensive [6,7]. This study finds that low income communities are more susceptible to the burden of bedbug resurgence due to financial constraints.

Cultural beliefs are hindering the eradication of bedbug infestation in Nakuru Town and this is contributing to the resurgence of bedbugs in the area. The findings of this study about cultural practices influencing the resurgence of bedbugs among the residents of Nakuru Town were very interesting. A notable section of the residents 22% believed their culture did not allow modern methods of bedbug eradication. This posed a challenge in bedbug control and prevention which leads to resurgence of bedbugs.

Beliefs like witchcraft, curses and spirits from under world brought bedbug infestation. However, recent studies revealed that bedbugs spread through active dispersal, social interactions between residents, home visits or exchange of furniture [6,9]. This shows there is no relation between bedbug infestation and witchcraft and this is a cultural belief that could highly lead to resurgence of bedbug infestation.



**Fig. 6. Main monthly expenditure**

**Table 1. Cultural practices**

Questions	Responses	Yes {Count}	%	No {Count}	%	Don't know	Refused to answer
Do you use any traditional method to eradicate bedbugs?		140	33	282	67	0	0
Does your culture allow modern methods of eradicating bedbugs?		348	83	22	5	52-12%	0
Do you currently have pet animals in your house?		108	26	311	73	0	3- 1%
Do you think pet animals harbor bedbugs?		87	21	251	59	82-19%	2- 1%
Have you changed any traditional lifestyle that in your opinion lead to resurgence of bedbugs?		25	6	397	94	0	0

Use of traditional methods like sun drying and hot water treatment was common among the residents interviewed but this is not effective enough to completely eradicate bedbugs. This can lead to more resurgence. However previous literature has noted that Non-chemical application methods such as laundering infested beddings, vacuuming, heat treatment and freezing [16] have given some of the best bedbug-eradication results. When the infested area is vacuumed with a gadget that contains air-filter which are efficient, bedbug debris and allergens are removed. However, there are always chances that bedbug eggs remain on the surface as they glued on the surface by glue-like substance produced by the female egg-laying bedbug [17].

Heat treatments are used as alternate bedbug treatment methods to insecticide application but should be applied by a professional to avoid burn accidents. With the right gadgets, there are high chances of heating the rooms to temperatures that are deadly to the bedbug: at all its developmental stages, the bedbug dies when exposed to temperatures exceeding 50°C (122°F) for 90 minutes minimum. Laundering of infested clothing's or beddings should be done on the hottest available washer and dryer settings and the highest possible temperature that the fabrics can sustain. This process can easily kill bedbugs compared to disposing the fabrics; however, it doesn't prevent further resurgence. Freezing is only effective in less infested items and it should be done for at least

four days [17]. The freezing and heating gadgets are used by trained professionals; however, many residents cannot afford the \$500 to \$1500 to hire such professionals [5]. The alternative way due to the cost is disposing of the infested items to avoid re-occurrence of the infestation.

The study found out that 169(40%) respondents were experiencing bedbug infestation during to this study. Since the 1980's bedbugs resurgence has been there but for reasons not well established by scientists but various factors influencing this surge could be socio-economic, resident practices, resistance to insecticides and non-compliance. In the years between 2000 and 2005 the USNPMA (United States National Pest Management Association) indicated a 71% rise in bedbug infestation.

Modern day methods are effective in controlling and preventing bedbugs but only 190(45%) were using such methods which included spraying with insecticides like Bamaco and Diazonal and sevin dudu dust. Globally, the main insecticide groups currently are the insect growth regulators (IGRS), pyrethroids and silicates. In some parts, some organophosphates and carbamates are still in use and more recent, arylpyroles and neonicotinoids are been used. Due to the bedbugs infesting the sleeping areas in residences, treatment methods other than application of insecticides are on demand by residents. Some of these methods can be expensive, exhausting, shameful, time consuming and pose a great risk to the health status of the residents. Heat treatment is one popular method among residents. Recent reports from University of Minesota Department of entomology, insecticide application is important and to achieve effectiveness it is recommended that residents high professional pest management individuals [18].

Previous literature finds that, implementation of chemical and non-chemical methods should be done to make sure these chemicals are gotten rid of. The chemical method may pose challenges as some bedbugs have proven resistant to insecticides recently [19].

In the 1970s, Dichlorodiphenyltrichloroethane (DDT) was used to treat bedbug infestation as other less toxic methods used at the time were as effective. Eucalyptus oils and mosquito repellents have been proposed but their use in bedbug treatment has not been successful [15].

Other Nakuru residents preferred use of household methods like laundry cleaning and sun drying but previous studies have found that most of these household control methods are ineffective for controlling bedbugs due to bedbug resistance [20,21]. However, other literature done on the same have noted that fumigants used on bedbug hiding places do not penetrate fully and their application can harm susceptible humans. Normal bug sprayers can kill roaches and kill bedbugs instantly but it is advised that these chemicals are applied directly on the infested areas for good results [19] but in spite of these measures, bedbug resurgence can occur.

This study found out that most residents were not using any control methods since they were not infested at the time. Bedbug control should be consistent whether infested or not as presence of bedbugs in such multi-unit dwellings bedbugs can rapidly spread to neighboring units and cause high infestation rate [22,6].

An interesting finding is that quite a number of the respondents said that they were not using the modern control methods since they did not have the purchasing power. Challenges like this often slow down the fight to eradicate bedbugs in the estates hence bringing about resurgence of the bedbugs. Efforts have been made to reduce the cost of this chemicals with locals suggesting that the public health department should come up with a budgetary allocation towards bedbug eradication in the county.

## 5. CONCLUSION

This study concludes that current socioeconomic status among the residents of Nakuru Town is inhibiting the fight against bedbug elimination. The residents don't have socio economic power to cater for expenses that comes with modern bedbug prevention and control methods.

People of Nakuru Town still believe that bedbugs are brought about by witchcraft and super natural spirits. These cultural beliefs are limiting the eradication of bedbugs and leads to the resurgence in some of the households.

Respondents are not well sensitized to modern control methods which can lead to resurgence of bedbugs. A good number of the respondents believe that if one doesn't have bedbugs in their household's then prevention and control is not necessary which leads to bedbug resurgence in the area.



## CONSENT AND ETHICAL APPROVAL

This study sought approval from Mount Kenya University Ethical Review Board (Ref.No. MKU/ERC/0890) and the Kenya National Commission for Science, and Technology and Innovation –NACOSTI (NACOSTI/P/1821614/23855) and consent to participate in this study was sought from all the households and confidentiality was observed.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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