DETERMINANTS OF BEDBUG INFESTATION AND PERCEPTIONS OF AFFECTED PARTICIPANTS AMONG THE HEADS OF HOUSEHOLDS IN NAKURU COUNTY, KENYA

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DECLARATION AND APPROVAL

I declare that this is my original work and has not been presented for a degree in any other university or any other award.

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We confirm that the work reported in this thesis was conducted by the candidate under our supervision.

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I wish to dedicate this research project report to Uncle Mr. Ahmed Elmi who has inspired and supported me throughout my research.

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ABSTRACT

Bedbugs are small insects that feed on human and small animal blood; bedbugs are generally lively at nighttime when people are sleeping. People bitten by bedbugs reported lack of sleep, depression, stress, and clinical symptoms such as skin rashes and allergic reactions. 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. Assessing the factors that contribute to bedbug infestation and the opinions of those who are impacted among the heads of households in Nakuru County, Kenya, was the aim of the present investigation. A cross-sectional descriptive research design was used in the investigation. Selected participants and household heads in seven estates in Kenya's Nauru County were the study's target population. For this investigation, a sample size of 422 respondents was employed. Key informants, focus group discussion guides, and questionnaires given by the researcher were used to gather data. The data was analyzed using statistical software for social science (SPSS) and tools for analyzing themes and sub-themes. Tables, graphs, and pie charts are used to display the results. Bedbug prevalence in Nakuru was 53.3%. Nakuru West Sub County had more bedbug infestation compared to Nakuru East Sub County 68% and 32% respectively. Most households had been infested by bedbugs more than once in the last 3 and 6 months 239(57%) and 143(34%) respectively. Purchase of second-hand furniture and clothes was associated with bedbug prevalence (p value=0.002 and 0.007 respectively). There was no specific season/ time for bedbugs. Most respondents reported seeing bedbugs in the dry/ hot seasons because bedbugs reproduce more eggs and hatch. Further, bedbugs are able to move around since there is no rainwater. Bedbugs had negative effects on health; mostly of respondents suffer from Lack of sleep 307(73%), itching 199(47.2%) and stress and allergic reaction 92(23%), 71(17%) respectively. Many respondents changed their behavior to avoid bedbug infestation. Changed behaviors included keeping off areas and items likely to be infested with bedbugs, that is, not purchasing second-hand items such as clothes, and furniture and not traveling to certain places among others. Only 14% of the respondents reported bedbug infestation to the public health department. The study concludes that the prevalence of bedbug infestation was 53.3% and declined within a period of six months from 84%. The study recommended that the Nakuru County Government should run a campaign to sensitize the locals on bedbugs spreading and breeding to aid reduce the levels of isolation among residents. Further, the campaign should fight stigma and encourage residents to report bedbug-associated issues to relevant authorities.

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LIST OF ABBREVIATIONS AND ACRONYMS

CDCP	Centers of disease and center prevention
CHV	Community health Volunteers
DDD	Dichlorodipheny trichloroethane
EPA	Environmental Protection Agency
FGD	Focus Group discussion
NACOSTI	National commission for science, technology, and innovation
NC	Nakuru County
NGM	National Group Media
NPMA	National Pest Management Association
PW	Pest World
SPSS	Statistical package for social science
WHO	World Health Organization

CHAPTER ONE

1.0 Introduction.

Background information, statement of problem, objectives, research questions, justification, investigation significance and scope, limitations, and delimitation are all included in this chapter.

1.1 Background to the study

The tiny insects known as bedbugs (Cimex lectularius) are dependent on human and small animal blood to survive. They are most active at night when people are unconscious, and during the day they hide in furniture holes, bangs, wall cracks, bedding, and other crowded areas of homes (Sheele et al., 2021). People bitten by bedbugs reported lack of sleep, depression, stress and grow clinical symptoms such as skin rashes and allergic reactions (CDCP, 2010 and Pauland Bates, 2000), Under normal circumstances bedbug can live around one year, During this female of bedbug can reproduce 200-500 eggs (Sheppard et al., 2022). Reproduction of bedbugs regularity depend on number of things such as environment(Sheppard et al., 2022), Normally, developed bedbug could need blood each four days and an adult can live without of food up to one year.

Bedbugs are nightly, reddish brown parasite that normally depend on human blood for their food and other small animal blood, these insect which are wingless have flattened body shaped that enable them to hide in spaces like bed, carpet, upholstered furniture, floor cracks. The life cycle of a bedbug begins with a grain-like, milky-white egg. In their lifetime, female bedbugs can lay 500 eggs on average, with one to five eggs laid each day. These eggs can be lied in either singly or in cluster in an area with tight crevices or cracks. The eggs is

approximately one millimeter (M) long and can be compared in size to two grain of salt. In a span of two weeks, the eggs hatches to immature bedbugs that start feeding immediately (Erin Doman, 2016).

Bedbugs cannot fly, however they can move very fast on the floors, walls and even on the roofs ceilings. Immature bedbugs, also known as nymphs, shed off their skins for up to five after which the reach maturity and in time of shedding skin they always feed on blood. Under ideal conditions the bedbugs can grow fully in as short as one month they can produce three or generation for every year. In spite of the fact that they are an annoyance, they do not transmit disease. They most target parts of the body for example the face, shoulders, arms, and legs. These are areas which are normally not covered while a person is asleep. Small, indistinct red macular sports are typically the first sign of a bedbug attack or bite, and they always progress to the traditional bedbug wound. Usually measuring between 1 and 20 mm across, the wounds are followed by itching and irritation. They typically turn red and can linger for a few days(Chebbah et al., 2021).

Bedbugs are big public health challenges since they are environmentally communicable, cause sleepless and itchy according (Aultman, 2013), people who suffering from bedbugs reported symptoms such as itchy, allergy lack of sleep and other psychosocial problems (Rieder. E., G. Hamalian. 2012). People affected by bedbugs reported sometimes they denied access of health services due to care providers fear bedbugs (Aultman 2013). Scientists never agreed causes of bedbug infestations but some of them claim it caused by people's movement and resistance of pesticides(Sharififard et al., 2020). Bedbug infestations are more common in lower economic status classes; for instance, they are more prevalent in homeless people, immigrants, and guest workers because they are more inclined to move

around and bring bedbugs with them. Only socioeconomic variables are included here, along with other relevant factors like housing, immigration, transportation, and residence (Ali H. Alalw, 2014).

Nakuru is situating in former Rift valley province in Kenya with estimated population of 1.603 million according (NC, 2013-2017). Bedbugs has become an increasingly vital because their bite cause sleep deprivation because of irritation, unfavorably susceptible excessive touchiness, hemoglobin iron inadequacy and cutaneous weal development and they considerably trigger an auxiliary skin disease (Sharififard et al., 2020).

Globally, it is not clear why bedbug infestation came back such as number in developed world, in 19th century 75% of the houses in British were infested by bedbugs. Introduction of widespread of Dichlorodipheny and trichloroethane (DDT), Vacuum cleaners and efficient measures to pubic hygiene are donated to the effective eradication of bedbugs in developed world in 1980s. Bedbug infestation in developed world remained high(Samiei et al., 2020). Regionally, bedbug prevalent reported in sub-Sahara Africa, about 36 countries and projected population of 5,070,000 people are suffering bedbugs currently(Samiei et al., 2020).

Locally, According to health workers in the area have confirmed prevalence in Nakuru. 5,000 households in Nakuru town were suffering from bedbug infestation and using hot water as treatment of bedbugs and they reported itchy and loss of seep during nighttime according to (NMG, 2017).

1.2 Statement of the Problem

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(Lai et al., 2016). The onset of widespread In the 1980s, bedbugs were successfully eradicated in the industrialized nations thanks to the use of vacuum cleaners, dichlorodipheny and trichloroethane (DDT), and effective public hygiene measures. The advanced world's bedbug invasion rate remained high (Akhoundi et al., 2022). The 1970s saw the end of DDT use (Akhoundi et al., 2022). There have been numerous reports of bedbug infestations in African nations (Du et al., 2023).

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(Penn & Hu, 2020). 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(Bandyopadhyay et al., 2015). The utilization of mosquito nets treated with pyrethroids has been linked to bedbugs acquiring resistance to this insecticide, according to studies conducted in East Africa (Mbuta et al., 2022). Bedbugs may have unintentionally benefited from changes in the pest control industry (Mbuta et al., 2022).

The usage of mosquito nets treated with pyrethroids has been linked to bedbugs developing rebellion to this insecticides, according to research conducted in East Africa (Deku et al., 2021). It's also possible that changes in the pest control industry unintentionally contributed to the growth of bedbugs. With approximately 1.603 million residents, Nakuru is located in

Kenya's former Rift Valley province (KNBS, 2019). There have been numerous bedbug revivals in Nakuru that have been made public.

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(King'ori et al., 2020). Therefore, identifying bedbug prevalence and factors linked to bedbug infestation among household members in Nakuru County, Kenya, was the primary goal of the study.

1.3 Justification of the study

There have been numerous bedbug outbreaks in Nakuru that have been made public. 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(King'ori et al., 2020). Bedbug infestation, particularly *Cimex hemipterus*, is a growing public health concern in urban areas like Nakuru Town, Kenya. This study was critical due to the health, socio-economic, and environmental impacts of infestations. Bedbug bites cause physical discomfort, allergic reactions, and secondary infections, while prolonged infestations lead to psychological stress, including anxiety, sleep disturbances, and social stigma. Although not confirmed as disease vectors, bedbugs exacerbate health challenges by affecting sleep and overall well-being.

Nakuru Town's rapid urbanization, high population density, and inadequate housing infrastructure create conditions conducive to bedbug spread. Financially, infestations impose a significant burden on households, particularly in low-income areas, due to costs associated with pest control, replacing infested items, and seeking medical care. Despite the expanding

issue, the development of focused interventions is hampered by the lack of local information on infestation prevalence and related factors.

This investigation aimed to fill this knowledge gap by exploring the prevalence of bedbugs and the factors influencing infestations among household heads. The findings provided critical insights into community knowledge, attitudes, and practices, empowering residents to adopt proactive control measures and reduce stigma. Additionally, the data-informed public health authorities and policymakers in designing sustainable and cost-effective pest management strategies tailored to Nakuru's unique context. Ultimately, this study addressed a pressing urban health issue, contributing to improved public health planning, enhanced community engagement, and better management of bedbug infestations.

1.4 Purpose of the study

The main objective of this research was to ascertain the prevalence of bedbugs in Nakuru, the variables that affect infestation, and the opinions of impacted heads of households.

1.5 General objective

Determinants of bedbug infestation and perceptions of affected participants among the heads of households in Nakuru County in Kenya.

1.5.1 Specific Objectives of the study

1. To determine the situation on the ground of bedbug infestation in seven estates in Nauru County in Kenya.
2. To Major socio-economic factors that influence bedbug infestation in seven estates in Nauru county, Kenya.

3. To investigate environmental factors that influence bedbug infestation in seven estates in Nauru county, Kenya.
4. To explore the perceptions of participants/heads of households affected by bedbugs infestations in seven estates in Nauru county, Kenya.

1.6 Research Questions

1. What is the situation on the ground of bedbug infestation in seven estates in Nauru County in Kenya?
2. What are the major socio-economic factors that influence bedbug infestation in seven estates in Nauru county, Kenya?
3. What are environmental factors that influence bedbug infestation in seven estates in Nauru county, Kenya?
4. What are perceptions of participants/heads of households affected by bedbug infestation in seven estates in Nauru county, Kenya?

1.7 The scope of the study.

1.7.1 Geographical Scope

Seven chosen sub-counties in Kenya's Nakuru County served as the study's sites. In both the Nakuru East and Nakuru West sub-counties, seven estates in Nakuru town were the sites of the investigation. The UN report (2018) states that Nakuru West had three estates, including Phoda, Kaptembwa, and Mwariki, while Nakuru East had four estates, including Kivumbini, Bondeni, Lake View, and Flamingo. The conditions in these estates are similar to those of a slum household, which was defined by the United Nations in 2002 as a group of people living in one room without access to sanitary facilities, a suitable living space, decent

housing, a greater supply and quality of water, and education, according to a World Bank report (2018). The majority of the homes in the estates are made of plaster, semi-permanent, mud and earth, and the majority of them have tapped water and electricity. According to KDS (2022), the majority of the residents relied on part-time employment at the time of gathering information, either as employees on flower farms or in small businesses like riding motorcycles.

1.7.2 Content Scope.

According to a UN report from 2018, the study was mainly concerned with subjects and the heads of households who were infested with bedbugs in four estates in Nakuru East—Kivumbini, Bondeni, Lake View, and Flamingo—and three in Nakuru West—Phoda, Kaptembwa, and Mwariki. Determining the causes of bedbug infestation and the opinions of impacted subjects among the heads of families in Kenya's Nakuru County were the main goals of this investigation. The objectives of this study were to:

1. To determine the situation on the ground of bedbug infestation in seven estates in Nauru County in Kenya.
2. To Major socio-economic factors that influence bedbug infestation in seven estates in Nauru county, Kenya.
3. To investigate environmental factors that influence bedbug infestation in seven estates in Nauru county, Kenya.
4. To explore the perceptions of participants/heads of households affected by bedbugs infestations in seven estates in Nauru county, Kenya.

1.7.3 The time scope of the study.

The study span from the period covering data collection to the phase of data analysis and will took of six (6) months. The study took place from the month of September 2019 to the month of February 2020. This time was convenient as access to some parts of the study area improves and the research team could easily move to collect the data.

1.8 Limitations of the study

1.8.1: Reaching the Participants in the households: The study was experienced a challenge of getting all respondents (heads of households) as some would be out on their own business for daily life routine.

1.8.2: The Unpredictable weather conditions: For the to reach team to reach all target of participants in the households was expected to hinder data collection process.

1.8.3: The Bias in information from participants: The study also was limited by information bias by the participants and the head of households.

1.9: Delimitations of the study.

The study was carried out in 7 estates Nakuru town with in Nakuru County. The target population of the study was heads-households and community health Volunteers. The study was delimited 422 households out of 32,856 households in the estates by solving the above three cited challenges in 1.8.0 above.

1.10 Significance of the study

The research's consequences for public health, socioeconomic conditions, and urban management make it extremely important to examine the prevalence of bedbug infestation (Cimex hemipterus) and related factors in Nakuru Town, Kenya. Bedbug infestations cause physical discomfort through bites, leading to allergic reactions, skin infections, and sleep disturbances. These health effects, coupled with psychological stress and social stigma, highlight the urgent need to address this issue.

The spread of bedbugs is made worse in Nakuru Town by fast urbanization, crowded housing, and insufficient pest control measures. Households are financially burdened by infestations, especially those in low-income areas, because of the expenses associated with replacing infested items, paying for medical care, and controlling pests. Despite the expanding issue, it is challenging to create efficient interventions due to the lack of local data on bedbug prevalence and the variables affecting infestations.

This study provided essential data to inform targeted public health strategies, community education, and integrated pest management programs. It also enhanced community awareness and engagement, empowering residents to adopt proactive measures against infestations. Policymakers and public health authorities can use the results to allocate resources efficiently and implement sustainable interventions tailored to the specific needs of Nakuru Town. By addressing a significant yet under-researched public health issue, this study contributed to improved urban health outcomes and the well-being of affected populations.

1.10 Operational definitions

Prevalence- is number of households in the population that have had bedbug infestation at one point during last six and three months.

Bedbugs, are small, brownish, redness insect that feed on human and animal blood. The mature bedbugs contain a flat shaped body of about the size of an apple seed. After feeding the body of the insect swell and becomes reddish in color. Bedbugs cannot fly but they move quickly on floor, ceilings and walls.

Heads of households are the people who are heads of the family and responsible for their expenses

Environmental Factors are factor that influences living of bedbugs; this includes climate and availability of food.

Second hand items- is pieces of personal belongs or property that is being purchased or transferred later to another user. A used item can also mean it is no longer in the same condition as it was when bought from shop. Used item might transferred between family and friends for free or sold them, this includes used furniture, cards and so on.

Infestation- refers to a situation where a significant number of bedbugs (tiny, parasitic insects) have colonized a specific environment, such as a home, hotel, or workplace. Bedbugs feed on human and animal blood, typically at night, and their presence can cause discomfort, allergic reactions, and psychological distress.

Social isolation is a condition of comprehensive or near comprehensive lack of interactions between a person and a community due to an issue facing the individual. Social isolation

includes poor communication with family and friends and avoiding any social interaction with other.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction.

This chapter consists of a review of the literature under the following headings: scientific literature, study objectives, theoretical literature, theoretical framework, conceptual framework, and conceptual framework summary, in that order.

2.1 Background of Bedbug.

Cimex lectularius, the bedbug, is 5-7 mm long, flat, wingless, and reddish brown in color. Since they typically feed at night while people are asleep, they are typically found in bedrooms. Insects frequently hide during the day in places like bed mattress seams, crowded areas, behind loose wallpaper, between wall and floorboard fractures, behind furniture, behind images, and under electrical fixtures (Coghlan, 2002).

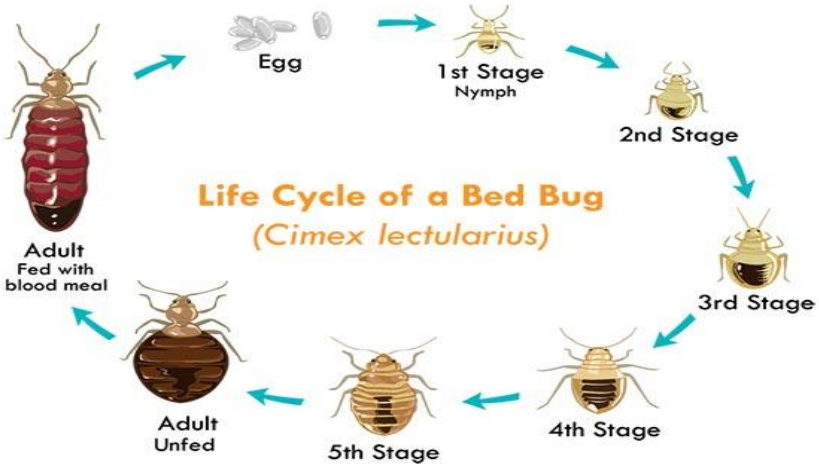


Figure 1: Life cycle of bedbugs

Source: Primary data by the researcher.

Bedbugs are nightly, reddish brown parasite which suck on human blood for food and other small animal blood, these wingless insect have dorsoventrally flat bodied shaped that enables them to hide in spaces such as bed, carpet, upholstered furniture, floor cracksThe life of a bedbug begins with a grain-like, milky-white egg. Female bedbugs can lay anywhere from one to five eggs every day, and they may lay as many as 500 eggs in their lifetime. In an area with tight cracks or crevices, eggs are laid individually or in clusters. The eggs are about one meter (M) long and about the size of two grains of salt. Eggs hatch in two weeks, and young bedbugs start feeding right away (Erin Doman, 2016).

There are essentially seven stages that bedbugs go through (Erin Doman, 2016)

Stage 1 the Eggs, bedbug's star their lives in eggs, which has a milky white in color, these eggs are about 1 millimeter (mm) in lengths and is difficult to see in necked because they are like grains of salt in size.

Stage 2 the Nymph 1, in this stage bedbugs are 1.5 millimeter (mm) in length. As soon they come out of their eggs, they can star feeding immediately. In this stage bedbugs are not mature, so they will not begin to bread until they are fully adults.

Stage 3 the Nymph 2, this when a bedbug has gone through its first peeling, which is about two millimeter in length.

Stage 4 the Nymph 3, after peeling, in this stage they are around 2.5 mm long.

Stage 5 the Nymph 4, bedbugs comes 3 mm in length

Stage 6 the Nymph 5, this is the final nymph stage and when it reached this level bedbug can get up 4.5 mm in length

Stage 7 the adult, it takes about five weeks for a nymph to become an adult, in this stage they are able to breed, the lifespan of a bedbug is generally about four to six months. However, it is not unheard for the pests to live up to a year.

2.2. Theoretical literature review.

2.2.1 Health Belief Model History

Focusing on people's attitudes and perceptions of health issues, the Health Belief Model (HBM) is a model of psychology that aims to explain and forecast behaviors associated with health. Self-efficacy, perceived obstacles, perceived advantages, perceived seriousness, perceived vulnerability, and cues to action are its six main components. The decision-making process regarding health behaviors and interventions can be better understood thanks to these constructs. Understanding the variables affecting the frequency of bedbug infestation (Cimex hemipterus) and associated behaviors among Nakuru Town household heads is made easier with the help of the HBM.

A psychological framework called the Health Belief Model (HBM) focuses on people's attitudes and perceptions of health issues in order to explain and forecast health-related behaviors. It consists of six main components: self-efficacy, perceived obstacles, perceived advantages, perceived seriousness, perceived vulnerability, and cues to action. These concepts shed light on the decision-making process people use when choosing health interventions and behaviors. The HBM is especially pertinent to comprehending the variables affecting the frequency of bedbug infestation (Cimex hemipterus) and associated behaviors among Nakuru Town household heads.

Application of HBM Constructs to the Study

PerceivedSusceptibility

This construct examines the extent to which individuals believe they are at risk of a health issue. In the context of bedbug infestation, household heads may vary in their perception of vulnerability. Factors such as housing conditions, cleanliness, and prior exposure to infestations influence susceptibility perceptions. If residents believe they are unlikely to experience infestations, they may neglect preventive actions, perpetuating the problem.

PerceivedSeverity

This construct focuses on how individuals view the seriousness of the issue and its potential consequences. Household heads in Nakuru Town may differ in their understanding of the health, economic, and psychological impacts of bedbug infestations. Educating communities about the adverse effects, such as allergic reactions, sleep disturbances, and the financial strain of pest control, can help elevate the perceived severity and motivate action.

PerceivedBenefits

The perceived benefits of adopting preventive or control measures play a vital role in shaping behavior. For instance, household heads may recognize that regular cleaning, early reporting of infestations, or using integrated pest management strategies can reduce infestations and associated burdens. Highlighting the positive outcomes of compliance, such as improved health and reduced stigma, can encourage behavior change.

PerceivedBarriers

Barriers to action, such as the high cost of pest control, lack of knowledge, or cultural misconceptions, may deter households from addressing bedbug infestations. Identifying and

addressing these barriers is critical. For example, community-based education can dispel myths, while subsidized pest control services can reduce financial obstacles.

CuestoAction

Cues to action refer to external or internal triggers that motivate individuals to take action. In this study, cues may include visible signs of infestation, peer influence, or health campaigns highlighting the dangers of bedbugs. Regular communication through local media, community gatherings, and health volunteers can serve as effective prompts for action.

Self-Efficacy

Self-efficacy is the belief that one can carry out an action successfully. It is crucial to equip Nakuru Town's leaders of households with the information, abilities, and tools they need to stop and manage bedbug infestations. Access to reasonably priced insect-control options, training programs, and demonstrations can all boost self-efficacy and empower locals to take decisive action.

Bedbug invasion prevalence and related factors can be studied using the model of health beliefs, which offers an organized method for comprehending and resolving the issue. This model can guide the creation of focused interventions by examining how family members view vulnerability, severity, advantages, and obstacles as well as the function of cues and self-efficacy. By lowering infestation rates and empowering communities to take preventative action, these interventions can enhance Nakuru Town's general health and well-being.

2.2.2 Social Cognitive Theory (SCT)

According to the social cognitive theory (SCT), which is applied in education, communication, and psychology, observations of other people's behavior in social situations, experiences, and external media impacts can all directly contribute to an individual's knowledge. This theory was developed as an expansion of Albert Bandura's theory regarding how individuals learn from one another. A. Bandura (2008). According to the hypothesis, individuals remember the sequence of events and utilize this knowledge to direct their own behavior in the future when they observe a model acting in an appropriate way and the outcomes that follow. Seeing a model can also force someone to perform a skill they already know. To put it another way, people don't simply try novel practices and see if they work (Evanset al., 1990).

Human survival, on the other hand, depends on people imitating the behavior of others. An observer's decision to imitate a behavior can be influenced by the possibility that people receive rewards or punishment for their conduct and the results of those actions. In 1989, Bandura et al. People from all walks of life and in all kinds of settings can find models in the media. The social cognitive theory is a way of thinking about how people learn. It says that people learn by watching how other people act (Banduraet al., 2011).

These routines that a person picks up through time might become extremely significant components of their personality. Social psychologists are in agreement that a person's behavior is influenced by the environment in which they were raised. However, they also believe that the individual (and, by extension, what they know) is just as significant (Masoudiyekta et al, 2018). People learn by watching what others do. The environment, how people act, and what they know are the three most important things that affect development.

Each behavior a person sees can change the way they think (cognition). In a similar way, a person's upbringing can affect how they act as an adult. For example, a caregiver's way of thinking (also called cognition) affects how their children are raised (Banduraet al., 2011).

Albert Bandura created the Social Cognitive Theory (SCT), a framework for comprehending how people learn and adopt actions through the interplay of behavioral, environmental, and individual factors. This concept of reciprocal determinism highlights that behavior is influenced by the environment and individual characteristics while simultaneously shaping them. SCT's core constructs—self-efficacy, observational learning, reinforcements, expectations, and reciprocal determinism—make it an effective model for studying and addressing public health issues like bedbug infestations (Cimex hemipterus).

1. **ReciprocalDeterminism**:

   Bedbug infestation behaviors in Nakuru Town are shaped by the dynamic interaction between individual practices, personal beliefs, and environmental factors. For example, overcrowded living conditions and lack of access to affordable pest control services create environmental barriers that influence household behavior, while personal attitudes toward infestations may determine the likelihood of action.

2. **Self-Efficacy**:

   Self-efficacy, or a person's confidence in their capacity to take actions that result in desired outcomes, is an essential component in SCT. High self-efficacy owners of households are more inclined to take preventative action, hire a professional pest control company, and uphold hygienic standards when dealing with bedbug invasion. Strengthening self-efficacy through education and support can empower households to address infestations effectively.

3. **ObservationalLearning**:

   Observing peers or community leaders successfully managing bedbug infestations can motivate others to take similar actions. For instance, public demonstrations by pest control experts or testimonials from households that have eradicated infestations can serve as powerful motivators for behavior change.

4. **Reinforcements**:

   Positive reinforcements, such as improved living conditions and community recognition for pest-free households, can encourage proactive behavior. Conversely, the social stigma associated with infestations or financial penalties for untreated infestations can act as negative reinforcements, prompting households to take action.

5. **Expectations**:

   Expectations about the outcomes of actions influence behavior. If households believe that addressing infestations will improve health, reduce stigma, and save money in the long run, they are more likely to act. Educational campaigns should emphasize realistic and attainable benefits to motivate households effectively.

A thorough framework for comprehending and resolving the frequency of bedbug outbreaks in Nakuru Town is offered by the Social Cognitive Theory. By focusing on the interplay between individual beliefs, environmental factors, and observed behaviors, SCT enables the design of effective, community-based interventions. Enhancing self-efficacy, leveraging role models, and addressing systemic barriers can empower households to take action, fostering long-term solutions to bedbug infestations.

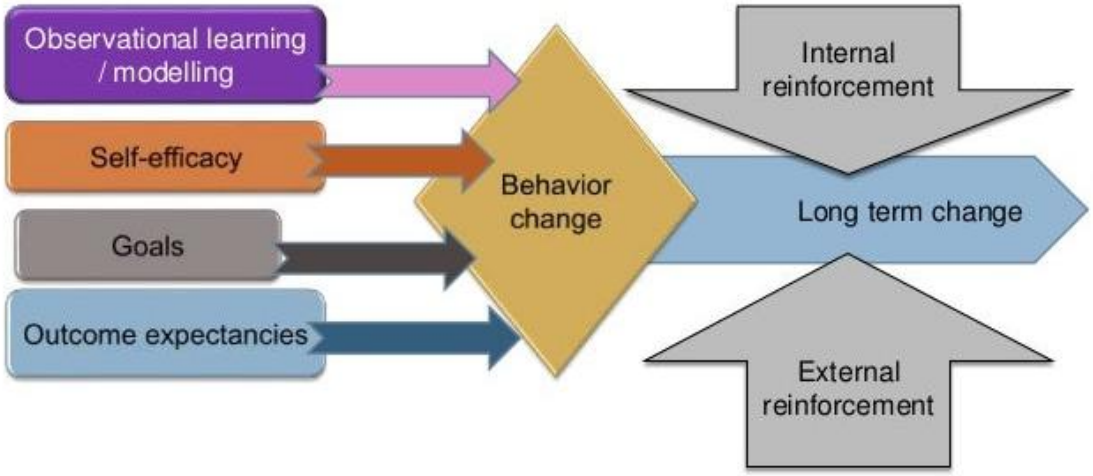


Figure 2: Social Cognitive Theory model

Source: (Bandura, 1960)

2.2.3: The Trans-Theoretical Model (Stages of Change)

James Prochaska and Carlo DiClemente created the Trans-Theoretical Model (TTM), also known as the Stages of Change Model, in the late 1970s and early 1980s while conducting research on quitting smoking. They observed that individuals undergoing behavior change progress through specific stages rather than making immediate, linear transformations. TTM integrates concepts from various psychological theories, including behaviorism, cognitive psychology, and social psychology, to create a comprehensive framework for understanding behavior change. This synthesis marked a departure from traditional models that viewed change as a singular event, instead proposing a cyclical process. It also recognized that relapses are common and can be part of the journey toward sustained change (Prochaska et al., 1970).

When applied to a study on the prevalence of bedbug infestation (*Cimex hemipterus*) and associated factors among household heads in Nakuru Town, Kenya, TTM can offer critical insights into how individuals perceive and act upon this issue.

Stages of Change in Bedbug Infestation Behavior

1. **Precontemplation**:

   In this stage, household heads may not recognize bedbug infestation as a significant problem or feel it is beyond their control. Cultural norms, misinformation, or normalization of infestation could contribute to this lack of awareness. Effective interventions at this stage involve raising awareness through community education campaigns and sharing information about the health, psychological, and economic impacts of bedbugs.

2. **Contemplation**:

   Here, individuals acknowledge the problem but may be uncertain about how to act. Factors like stigma, cost of pest control, or fear of failure can create hesitation. Public health initiatives can emphasize the benefits of taking action, such as enhanced health and reduced household stress, to move individuals to the next stage.

3. **Preparation**:

   During this phase, household heads intend to take action and may make initial steps, such as cleaning their homes or seeking pest control options. Practical guidance, such as low-cost interventions, local pest management services, or support from community health volunteers, is critical at this stage.

4. **Action**:

   At this stage, household heads actively implement measures to eliminate bedbugs,

such as engaging professional pest control, using integrated pest management techniques, or improving hygiene practices. Continuous support and monitoring by local health authorities or community organizations are essential to sustain these efforts.

5. **Maintenance**:

   This phase involves sustaining behavior changes to prevent re-infestation. Educating residents on long-term strategies, like routine home inspections, proper sanitation, and monitoring potential re-infestation sources, is key to ensuring success.

6. **Termination**:

   For some households, long-term adherence to preventive measures results in the elimination of bedbug infestation risk, marking the final stage of behavior change.

Benefits of Applying TTM to the Study

TTM offers a methodical way to comprehend how different household heads respond to bedbug invasions in terms of readiness and action. Public health programs can create focused interventions by grouping people according to their stage of change, guaranteeing that resources are used effectively and efficiently.For instance:

- In precontemplation and contemplation stages, awareness campaigns and education are critical.
- In preparation and action stages, providing access to affordable pest control and practical tools is necessary.
- In maintenance and termination stages, reinforcing positive behaviors and offering follow-up support can prevent relapse.

TTM's focus on the individual's readiness for change and its application to dynamic, cyclical behavior makes it highly relevant for addressing bedbug infestations in Nakuru Town. By tailoring interventions to specific stages, the study can enhance household engagement, improve the adoption of pest control measures, and contribute to long-term solutions for managing bedbug infestations in urban settings.

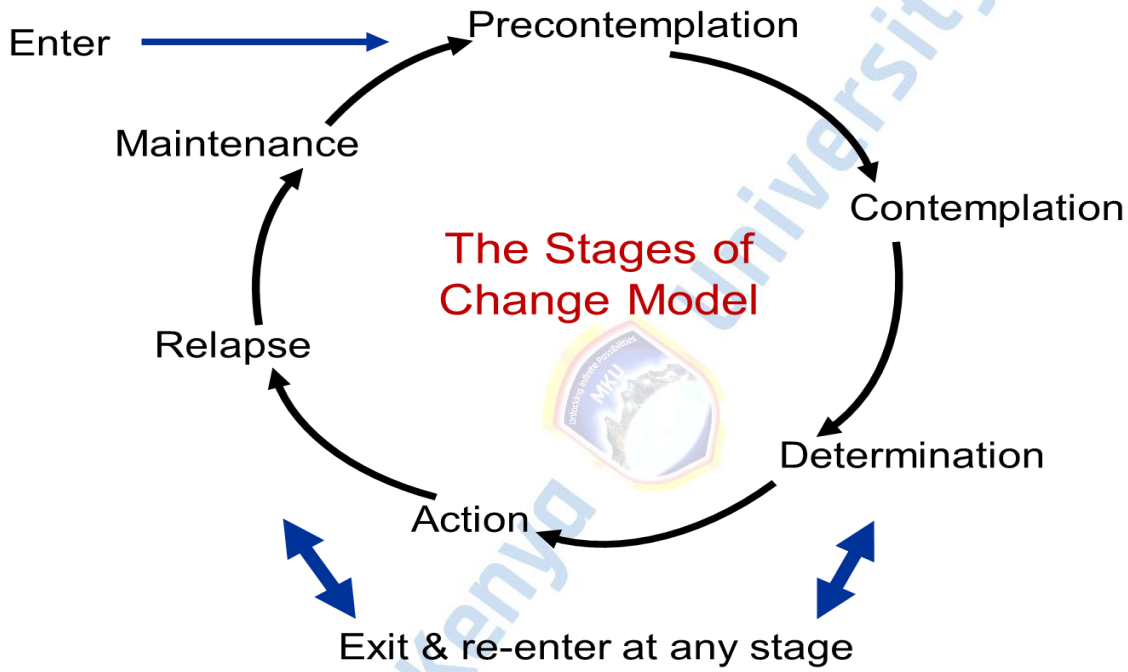


Figure 3: The Trans-theoretical Model

Source: Prochaska and DiClemente in the late, (1970).

2.2.4: The Triad Modelling.

The epidemiologic model is another name for the conventional model of spreading an infection causation. Figure 4 shows a triangle or triad. An external agent, a host, and an environment where the host and agent are brought together to cause the illness to occur in the host (human or animal) make up the epidemiological three-piece or triangle. The bedbugs in Kenya's Nakuru County may be a component of the process of transmission. A vector is

an organism that spreads infection by moving the pathogens from one host to an additional host without actually causing disease. A number of intricate interactions between the agent, host, and environment can result in disease. These three elements must interact and be balanced differently in various medical conditions. All three elements and their interactions must typically be evaluated in order to develop suitable, workable, and efficient health policies for controlling or avoiding disease. Susanto and Surya, 2023.

A common conceptual framework in epidemiology and public health, the Triad Model looks at how three important elements—host, agent, and environment—interact with one another. Because it emphasizes the interaction of various aspects that contribute, this model is especially useful for comprehending and resolving complicated health issues, like the frequency of bedbug infestations (Cimex hemipterus). Applying the Triad Model to an investigation on bedbug infestations in Nakuru Town, Kenya, offers an organized method for determining the causes, danger indicators, and possible management measures.

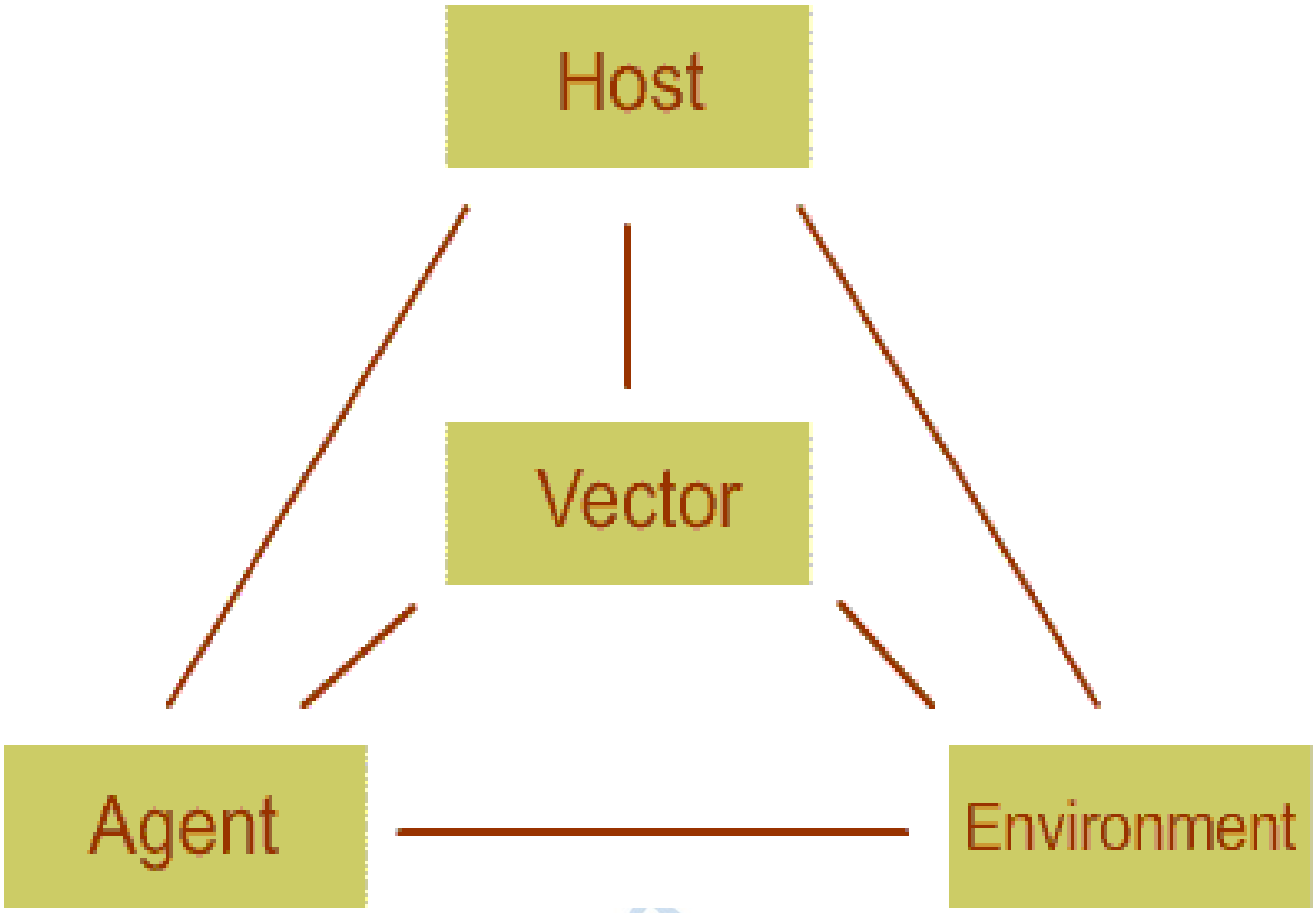


Figure 4:Epidemiologic Triad of Disease Causation (Historical)

Source Thomas L (2002)

Agent

The agent in this model is the bedbug (*Cimex hemipterus*), a parasitic insect that feeds on human blood. Factors related to the agent include:Bedbugs' rapid reproduction and resistance to certain pesticides make infestations difficult to control.Bedbugs spread through shared furniture, clothing, and luggage, especially in crowded urban environments like Nakuru Town.These pests can survive in a wide range of environments, increasing their prevalence in households with suboptimal sanitation or overcrowding. Addressing the agent requires the use of effective pest control measures, including safe and targeted pesticide

applications, and breaking the cycle of transmission through public awareness and behavior change.

Host

The bedbug parasite life cycle is involving FEEDING on the blood of human beings. During the bloodsucking meal, human skin is damaged and the effects of attack is caused by the bedbugs into the human host. (HS, Rubin DB. (2018). The host in the context of bedbug infestation is the human population, specifically the heads of households who directly experience the effects of infestations. Key factors include: Many household heads may lack sufficient knowledge about bedbug behavior, reproduction, and control methods, limiting their ability to take preventive measures.Hosts suffer physical effects, such as skin irritation, allergic reactions, and secondary infections, as well as psychological impacts, including anxiety and sleep disturbances. Practices like poor hygiene, infrequent cleaning, or reluctance to report infestations contribute to the persistence of the problem. Interventions targeting the host focus on education, behavior change, and empowering households to adopt effective pest management practices.

Environmental

The "environment" refers to outside factors that affect the agent and being subjected opportunity. Environment-related variables include biological elements like disease-transmitting insects, physical elements like climate and geology, and social and economic variables like population density, hygienic conditions, and access to medical care (Garrec, MF (2003)). Environmental factors create conditions that facilitate the survival and spread of bedbugs. In Nakuru Town, key environmental contributors include; Overcrowded, poorly

ventilated, and unhygienic homes that provide ideal habitats for bedbugs. Low-income households may lack access to pest control services or the resources to replace infested furniture. High population density and mobility in urban areas increase the likelihood of infestations spreading between households. Interventions targeting the environment include improving housing infrastructure, ensuring access to affordable pest control services, and promoting community-based sanitation programs.

According to this theory, the smell of organic materials decomposing is what causes disease. It stems from the Hippocratic notion that climate change is linked to illness. Additionally, because it conceptually separated the source of the illness from its victim, it stood in stark contrast to the other three theories. The first scientific theories regarding bedbug invasion were put forth by those who maintained that miasma and bedbug invasion were unrelated. The introduction and defense of the concept of germs as the cause regarding illnesses in the late 19th century started to throw new light on Johnson's theory, even though it was forgotten.

The Triad Model offers a thorough framework for researching and controlling Nakuru Town's high bedbug invasion rate. By examining the interactions between the host, agent, and environment, this model identifies the key drivers of infestations and informs targeted interventions. Addressing knowledge gaps, improving pest control methods, and enhancing living conditions can significantly reduce the burden of bedbug infestations and improve the health and well-being of affected households. The Triad Model’s holistic approach ensures that solutions are sustainable, equitable, and tailored to the specific needs of the community.

2.3 Prevalence of Bedbugs from a global to a local perspective

It is unknown why bedbug outbreaks have increased to such a high level in the industrialized nations, despite the fact that 75% of British homes had bedbug outbreaks in the 19th century (Lai et al., 2016). In the 1980s, bedbugs were successfully eradicated in the industrialized nations thanks to the widespread use of Dichlorodipheny and Trichloroethane (DDT), vacuum cleaners, and effective public hygiene measures. Countries with developed economies continued to have a high bedbug infestation rate (Akhoundi et al., 2022). In the 1970s, DDT use ceased (Akhoundi et al., 2022). According to reports, bedbug infestations are common in African nations (Du et al., 2023).

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(Penn & Hu, 2020). 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(Bandyopadhyay et al., 2015). The application of nets that have been treated with pyrethroids has been linked to bedbugs developing rebellion to this insecticide, according to research conducted in East Africa (Mbuta et al., 2022). Bedbugs may have unintentionally benefited from changes in the pest control industry (Mbuta et al., 2022).

Bedbugs infect every region of the world, rate of infestation are fairly common in some region, following the rise of bedbugs as from 1990s. Although the exact cause of the spike is unknown, some theories include increased international travel, a substantial rise in the frequency of second-hand goods exchanges, a greater emphasis on controlling other pests, and growing resistance to pesticides. For thousands of years, bedbugs have been recognized as human parasites. Bedbugs are found all over the world; in the United States, they were

present in around 30% of homes prior to the 1950s. Prior to the 1980s, they were widespread in countries that were developing but rare in developed ones; rates of prevalence in industrialized nations decreased between 1939 and the 1980s, but have since increased dramatically (Reins & Miller, 2011).Bedbug have been reported from USA according to (NPMA, 2010), in Asia (Hirao, 2010), some parts of Europe (Bencheto Al.2010), bedbugs were a problem in Australia (Doggett, 2014) as well as in Africa according to (Omudu & Kuse , 2010).

Bedbugs had almost eliminated in The USA between 1980 and 2004 but it came back with low number and has started increasing promptly from 2004. The cause for this resurgence possibly was international migration from developing world to developed countries less use of insecticide and less use of insecticides according to (Goddard & deShazo, 2009).

Bedbugs are major global problem, in New York bedbug cases numbers rose from520 in 2003 to 10,985 in 2011 and in Australia people have been experiencing a big increase and the same appears true in China and France.

Bedbugs were a major problem at US military installations during World War II. Fumigation, which used a somewhat dangerous Zyklon discoid that released hydrogen cyanide gas, was initially thought to be the solution (Heather Lynch, 2017). Cimex lectularius is found all over the world, but invasions are most common in nations that are developing where there are inadequate sanitation and excessive swarming. During the second half of the 20th century, blood sucker invasions became rare in Western Europe and North America and were thought to be a condition that affected travelers returning from countries that were developing. But according to episodic reports, blood suckers have

become more widespread in the United States, Canada, and the United Kingdom (Mbuta et al., 2022).

Bedbugs prefer to hide in containers, bags, and other places near their food source. They can hide behind floorboards, as well as in bed, bedding, and furniture folds, cracks, and crevices, especially box springs and falling asleep cushions. Bedbugs can likewise stow away in electrical switch plates, picture casings, and backdrop and about anyplace inside a home, vehicle, transport, or other haven. Bedbugs ordinarily turned out during the night for a blood sucking. Nonetheless, they are opportunistic pest and can start sucking blood during the day, particularly in heavily plagued places (NPMA, 2018). Bedbugs normally like to live in crevices and crack in households and other dark places.

Bedbugs are adept at hiding from everything; during the day, they hide in places like box springs, bed structures, headboards, sleeping surface seams, cracks, beneath wallpaper, dresser tables, and beneath any clutter or objects near a bed. Even without a blood feast, their small, flat bodies allow them to live in even the smallest spaces and remain there for extended periods of time. They can travel over 100 feet in a single night, but they typically reside within 8 feet of people's sleeping quarters (CDCP & EPA, 2010).

These insects are always found in or close to places where people sleep or spend significant amounts of time. According to the CDCP and EPA (2010), these locations include hotels, housing, homeless shelters, living houses, nursing facilities, trains, buses, cruise ships, dorm rooms, and healthcare facilities. In the United States, bedbug infestations have been on the decline since 1940, but since 2004, they have returned with a renewed vigor. Bedbug infestation has no specific time and occurs any point of time during the year but recurrent

bedbugs differ from season to season, in hot season bedbugs become more active, especially between August and September when bedbug occurrence reach it is highest level, in cold season January and February bedbugs reach their lowest level (Richard,et.,al. 2009).

Bedbugs increase during the summer between Junes through October this is because of the increase in travel during the summer months allows bedbugs spread from place to place very quickly, creating new infestations in so many homes and hotels. The opportunity to hop onto people and luggage, bedbugs also increases as families welcome students to home, plan getaways and host out of town guests. As peoples continues to travel, the bedbugs become more embedded into home, hotels, apartments and other well populated areas (Benoit J. 2011).

The usage of mosquito nets treated with pyrethroids has been linked to bedbugs developing resistance to this insect repellent, according to research conducted in East Africa (Deku et al., 2021). It's also possible that changes in the pest control industry unintentionally contributed to the growth of bedbugs. With around 1.603 million residents, Nakuru is located in Kenya's former Rift Valley province (KNBS, 2019). Numerous bedbug an upsurge that have been in the general public domain have affected Nakuru. 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(King'ori et al., 2020).

2.4 Environmental factors that influence bedbug prevalence

2.4.1 Overcrowding Environment

Overpopulation environment has major influence on ability to control bedbug or eliminate from population. Overpopulating environment is the one of most hindering problem on eradication efforts of bedbugs. Such an environment help bedbug to hide easy and lay eggs everywhere. Bedbugs love to live dirty and overcrowded area in the households or hotels but bedbugs enter/ invade both clean and dirty area although other insects invade with dirty environment. Bedbugs found worldwide but more infestation have reported in the delivering world, particularly in unsanitary living condition and severe crowding. Bedbugs do not discriminate anybody that means bedbugs able to affect everybody and are not directly associated to socioeconomic status, However community issues surrounding bedbugs do exist and society need to work to provide resources to those who are needed in order to fight and treat bedbugs. According to (NPMA, 2010) reported 71% increase in call for bedbug infestation since 2001.

Bedbugs affect all types of housing and at all income levels, in addition, bedbugs might have a disproportionate impact on poor people. Bedbugs are great travelers which means the more individuals who move in and out of housing the bigger the opportunities for them to catch ride in. highest density of housing means more apartments units that might be affected and need treatment. Since bedbugs can be found in every walk of life, they are incredibly equitable species. Because of their high population density and lack of funding for effective extermination methods, bedbugs are more common in housing for the poor than because they prefer it. Bedbugs can infest any area (Denise Chrysler, 2011).

2.4.2 Climate

Bedbugs are insects that love to live worm situations and thrive in a temperature above 28 degree Celsius. Studies suggested that global warming can be one of the reasons that leading bedbug resurgence, in additional increase of global urbanization gives bedbugs more appropriate sittings to survive. Bedbugs are endemic in tropical environment (Reinhardt, Siva, Kempke and Naylor 2009). Bedbugs have season where they live throughout the year and can survive a variety of temperatures, but there is a special time and during this bedbugs thrive, bedbug's period starts at the end of April and beginnings in November each year (Potter Mf, 2010). Bedbugs can survive in extreme temperature (zero to 122 degree) making them harder to eradicate with a professional pest control service.

Since bedbugs reproduce and spread more quickly in warmer temperatures, conditioning and regulating the temperature may be able to slow downward the population's growth.Many homes in the Northeastern United States are kept at 66 degrees Fahrenheit in the winter and 740 degrees in the summer. Without air conditioning, homes can experience massive population detonations and rapid bedbug movement during the summer months (EPA, 2014).

2.5: Social Factors that influence Bedbugs prevalence

2.5.1: Immigration

The increasing incidence of bedbugs worldwide may be the cause of international migration, especially the travel industry, in which people from all over the world go to other countries to observe their customs and visit zoos. Simply because bedbugs travel with people and their luggage either an adult or eggs of bedbugs then spread where ever they go (Romero et al.,

2007) and (Delaunay and Pharm, 2012). The insect can enter cleanest households and hotel but consistent checking and proper cleaning can help to control and prevent bedbugs.

Some people are not sure that bedbugs able to spread through human, when someone goes to an affected environment, normally bedbugs hide out the individual and individual's items and affected a new environment, all houses are vulnerable of getting bedbugs no matter how clean is the household but is not sign of dirtiness. Migration and new guests is the key for bedbug spread, particularly big cities where human migration is very frequently such busy Public transport and hotel (Patter, M.2008). Bedbugs are primarily spread by immigrants and temporary employees, conferring to Ali H. Alalawi (2014). This is particularly evident in large cities where people move around a lot and live. There are two ways that bedbugs can spread: actively and passively. While bedbugs move from a single space to another while they are sleeping, passive bedbugs are those that are carried with objects like clothing, shoes, and furniture (CDCP and EPA, 2010).

Bedbugs were previously only found in impoverished homes, dilapidated hotels, asylum-seeking refugees, and crammed dorms; however, in recent years, they have also been found in upscale hotels and neighborhoods. One of major factors that increase bedbug infestation is international immigration of people from one place to other. Evidently, bedbugs spread throughout the entire globe and do not distinguish between business and tour travelers by snagging a ride in luggage. Anyone who visits an area where bedbugs are present runs the risk of getting bitten. However, there is a higher chance of getting bitten and propagating a bedbug invasion for anyone who travels frequently and contributes living and sleeping spaces with others who have previously slept there (CDCP & EPA, 2010).

2.5.2 Second hand items

Bedbugs transported with items such as clothes, shoes and furniture, Bedbugs come to household and other places when individual get used beddings, mattress and furniture (CDCP and EPA, 2010). According to some reports, bedbugs have been connected to home furnishings brought into the United States from tropical nations (Paul and Bates, 2000). One potential way that infestations of bedbug propagate is through the sale of used clothing, books, and furniture that may contain bedbugs or their eggs, particularly at car reboot sales and junk shops (Coghlan, 2002). Additionally, bedbugs can travel between properties and floors through wall cracks.

Bedbugs have nothing to do with dirt, everyone can get them and they are carried into houses via second item or someone, picking up discarded mattress, beds or sofas from outside people's house is extremely high risk for bedbugs, often the first reaction for people when they realize that they have bedbugs in their house is to throw away furniture and other items (WHO, 2009). Bedbugs are excellent travelers and can be found in thrift stores on clothing, furniture, and other secondhand goods from areas where bedbugs are present. Bedbugs are adept at hiding, making them occasionally very challenging to locate. Bedbugs hide in cracks, seams, and tiny holes in upholstery. Without a blood meal, bedbugs can survive for up to a year. According to the Centers for Disease Prevention and Control (2013), picking up salvaged furnishings from thrift stores may put you at high risk for bedbugs. A used a mattress, box springs, or upholstered pieces of furniture should never be taken or purchased from the side of the road. You should also carefully inspect any secondhand furnishings you are thinking about buying (Desai, R., 2011).

2.6. Perceptions of heads of households affected by bedbugs

Bedbug infestation are associated with negative psychosocial problems such isolation, stigmatization, distress and shame to have bedbugs. Shame might interrupt of people to get help from service providers that can give bedbugs a chance to invade new hosts and control of bedbugs would difficult. When people discover they have bugs like bedbugs usually after making numerous and unsuccessful attempts to identify the primary cause of the issue, they feel embarrassed, afraid, and completely perplexed. Individuals who have bedbugs may experience a severe degree of isolation (McDonald and Zavys, 2010).

2.6.1 Psychological distress

Bite of bedbugs can lead physical and psychological problems to the affected individuals and this includes itchy, lack of sleep and anxiety. Bedbugs contribute to psychosocial issue to the population such as embarrassment to have other know, lack of sleep, allergic and fear of transmitting the insect to families and friends (McDonald and Zavys, 2010). A bedbug invasion is linked to a number of issues, such as sleep deprivation and emotional and psychological distress from the sigma of pests in society. Despite not being connected to the spread of illness, bedbugs have been found to carry the organism that causes the plague, severe discomfort, itching, inflammation, and fever. Severe skin irritation, inflammation, redness, swelling, and itching are all symptoms of their bites. The imposing finding depends on collecting and differentiating evidence of bedbugs, which often necessitates extraordinary nighttime searches (Omudu Edward Agbo and Kuse, C.N, 2010).

One part of the medical impact of bedbug bites that is never address is the noteworthy mental trouble brought about by the bites. This is a noteworthy medical issue and ought not be

disregarded. Even five-star hotels cannot escape an invasion because of the clear stigma associated with bedbugs, which links the insect to inadequate cleanliness and maintenance. People become scared and ill as soon as they realize that they have bedbugs in their house that bite them at night. Bloodsuckers also cause harm from the cost of devastation, which can range from a few hundred to several thousand of dollars for each infestation (Doggett Sl, 2010).

Bedbugs create a situation where is difficult to rest because of the fear of being bitten and absence of sleep can now and then trigger depression. Substantial rates of finding have been known to cause noteworthy blood loss and in the long run lead to anaemia other complication, children are most helpless to these additional challenges, and these complications includes sleep deprivation and itchy (Anderson 2011).

Figure 5: Photo of Skin reactions of bedbug bites (Dr. Horold Harlan).

Source: Primary data by the researcher.

2.6.2 Social Isolation

People who are suffer from bedbug infestation, they had not been only affected physically but also they have been isolate by their friends and families. People stop going people's houses; stop their children to play with affected people's kinds because of fear of traditions. People affected by bedbugs reported sometimes they denied access of health services due to care providers fear bedbugs (Aultman 2013).

Bedbugs cause an assortment of negative physical wellbeing, psychological and financial problems. Numerous individuals gintle to extreme unfavorably susceptible response to bites with impacts running from non-reaction to a little bites marks to in uncommon, hypersensitivity (Severe reaction), this can likewise cause to auxiliary infection of skin such ecthyma, impwtigo and lymphanigitis. bedbugs can likewise influence the emotional well-being of the populace living invaded place and reported effects includes tension, a sleeping disorder and fundamental reaction (CDCP &EPA, 2010). Emotional distress and insomnia, patients who had experienced bedbug infestation might have emotionally distressed because of prolonged reaction to the bites, scratching or discoloration, discomfort in the presence of insect or the social stigma associated with infestation. Distress can lead to an inability to fall or remain asleep, anxiety and nervousness (Rossi and Jennings, 2010).

The reaction of bedbug bites depending on immune response to the injected salivary fluid. A bite reaction can occur immediate for example with in an hours or may be a week later. The bite reaction usually presents as a red wound ranging in size from a few millimeters to 1 centimeter and with the absence of a red puncture mark in the middle. The bites could be

extremely itchy and are susceptible to secondary skin infections with repeated scratching that breaks the skin (Rossi and Jennings, 2010).

2.7 Critical view of the study.

Bedbugs are nocturnal, reddish-brown parasites that consume human and other blood from animals. Their wingless bodies flatten out dorsoventrally, which enables them to conceal themselves in places like beds, couches, carpets, and crevices in the floor. Doman, Erin (2016). The reddish-brown parasites known as bedbugs feed on the blood of humans and other small animals. They are insects that lack wings with dorsoventrally widened bodies that enable them to conceal themselves in places like beds, carpets, upholstered furniture, and cracks in the floor.Doman, Erin (2016). The seven phases that bugs like bedbugs go through are as follows: the egg stage, where the eggs are about 1 millimeter long and hard to see with necked eyes; the Nymph 1, Nymph 2, Nymph 3, Nymph 4, and Nymph 5; and the adult stage, which takes roughly five weeks for a nymph to mature into an adult (Erin Doman, 2016).

There are bugs like bedbugs all over in the world. Prior to the 1950s, approximately 30% of homes in the United States of America had them. The rate of bedbug invasion in advanced nations decreased from the 1939s to the 1980s, but it has since sharply increased. Prior to the 1980s, bedbugs were prevalent in underdeveloped countries but uncommon in developed ones (Reis Miller Dini, M., and Matthew D. (2011).

There have been reports of bedbugs in the USA (NPMA, 2010), Asia (Hirao, 2010), some parts of Europe (Bencheto Al., 2010), Australia (Doggett, 2014), and Africa (Omudu EA, Kuse CN, 2010). Bed bug infestations prefer to hide in boxes, bags, and other locations near

their food source. They can hide behind the baseboards and in crevices, clefts, and folded areas of furniture, bedding, and beds, especially box springs and falling asleep cushions.
. bedbugs can likewise stow away in electrical switch plates, picture edges, and backdrop and about anyplace within a home, vehicle, transport, or other sanctuary (NPMA, 2018). In term of time, Bedbug infestation has no specific time and occurs any point of time during the year but recurrent bedbugs differ from season to season, in hot season bedbugs become more active, especially between August and September when bedbug occurrence reach it is highest level, in cold season January and February bedbugs reach their lowest level (Sharififard et al., 2020).

A Summary of Environmental factors, Overpopulating environment is the one of most hindering problem on eradication efforts of bedbugs. Such an environment help bedbug to hide easy and lay eggs everywhere. Bedbugs affect all types of housing and at all income levels. (Denise Chrysler, 2011). In climate, Bedbugs are insects that love to live worm situations and thrive in a temperature above 28 degree Celsius. Air conditioning and temperature rules could slow down the growth of bedbug population (Reinhardt, Siva, Kempke and Naylor, 2009) and (EPA, 2014).

A summary of social factors, Resurgence of bedbugs in the world it might be a reason for global movement, particularly the travel trade where individuals from the world travel to visit others places to see their traditional and visit animal zoo. Simply because bedbugs travel with people and their luggage either an adult or eggs of bedbugs then spread where ever they go (Romero et al., 2007) and (Delaunay and Pharm, 2012). In second hand items, Bedbugs transported with items such as clothes, shoes and furniture (CDCP and EPA, 2010). Bedbugs

come to household and other places when individual get used beddings, mattress and furniture (Rossi and Jennings, 2010).

A summary for perceptions of heads of households, Bite of bedbugs can lead physical and psychological problems to the affected individuals and this includes itchy, lack of sleep and anxiety. Bedbugs contribute to psychosocial issue to the population such as embarrassment to have other know, lack of sleep, allergic and fear of transmitting the insect to families and friends (McDonald and Zavys, 2010) In social isolation, People who are suffer from bedbug infestation, they had not been only affected physically but also they have been isolate by their friends and families. People stop going people's houses; stop their children to play with affected people's kinds because of fear of traditions. People affected by bedbugs reported sometimes they denied access of health services due to care providers fear bedbugs (Aultman 2013). Emotional distress and insomnia, patients who had experienced bedbug infestation might have emotionally distressed because of prolonged reaction to the bites, scratching or discoloration, discomfort in the presence of insect or the social stigma associated with infestation. Distress can lead to an inability to fall or remain asleep, anxiety and nervousness(Akhoundi et al., 2022).

2.4: Conceptual framework

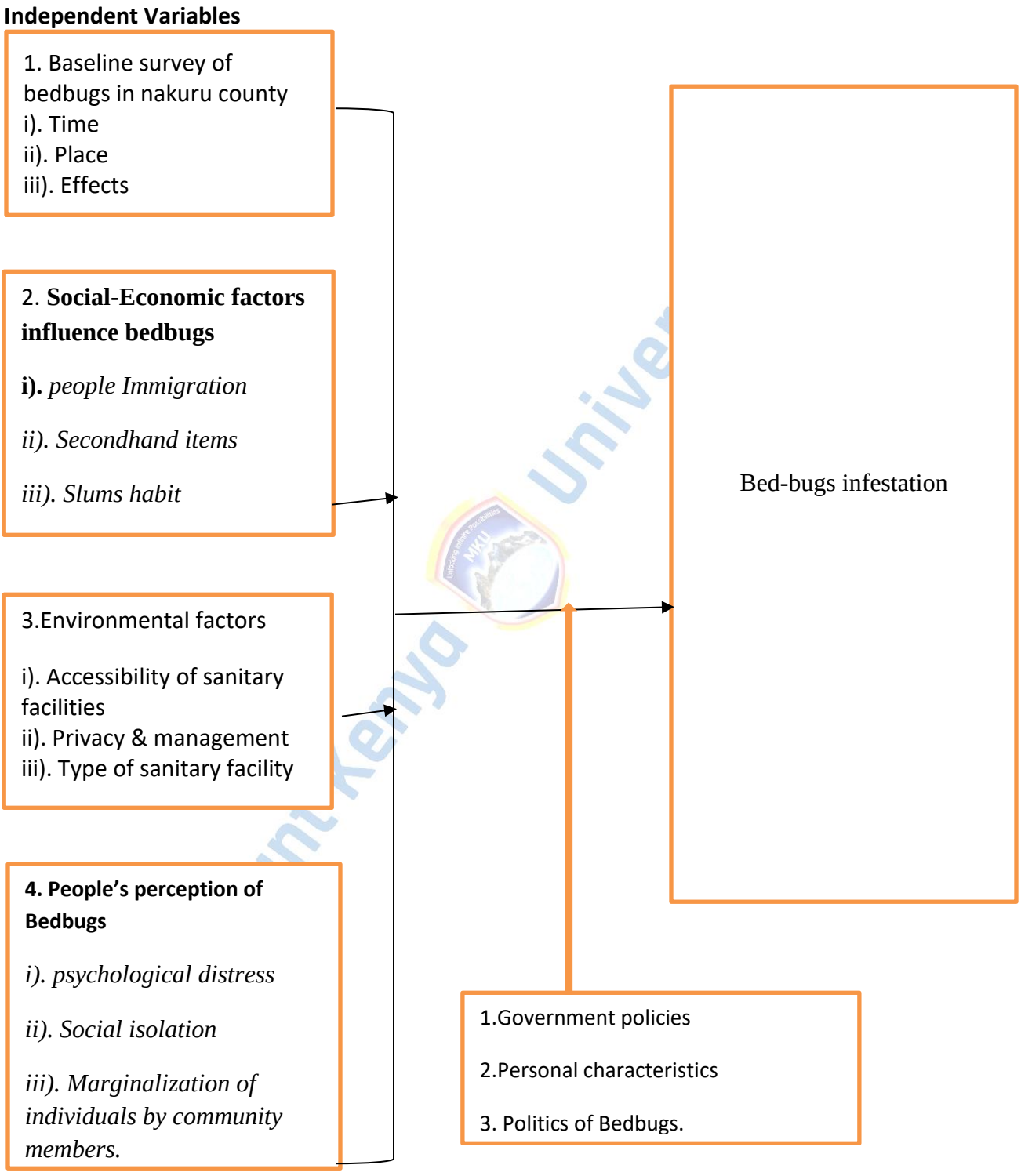


Figure 6: Conceptual framework

Source: Primary Data by researcher

CHAPTER THREE: RESEARCH METHODOLOGY

3.0: Introduction

This chapter describes the investigation's methodology. The investigation's location, method of investigation types, target population, size of the sample, research tools, sampling methods, validity and reliability testing, analysis of data, and ethical considerations are all covered. Data for the present investigation were gathered using a mixed methodology.

3.1 Study design

To ascertain the prevalence of bedbugs and the perceptions of impacted heads of family units in Nakuru town, the investigation employed a descriptive cross-sectional design for gathering data.

3.2 Study variables

3.2.1 Independent Variables

The independent variable: included bedbug baseline survey characteristics as determined by; Time in season for the year such (summer, winter etc) and place where bedbugs hide themselves such as Cracks and crevices.

The Second independent variable was Social factors influence bedbugs characteristic as determined by; immigration for international movement of people from one place to another and bedbugs go with them and second hand items such as second furniture if they influence bedbugs.

The third is Environmental factors influence bedbug prevalence characteristics as determined by; climate for favorite weather the insect such as hot, sunny, cold etc and overcrowding environment for congested environment and bedbug infestations.

The forth independent variable was perceptions of heads of household characteristics as determined; psychological distress and social isolation due to bedbug infestation

3.2.2 Dependent variable

The dependent variable in this investigation was the rise in bedbug prevalence, which was the result of those independent variables followed by a surge in bedbug infestation.

3.3 Target population

Population is the total number of items from which an inference in made (cooper and schillers, 2006), target population of study was 32,856 heads of households who had experienced sleepless and itchy due to bedbug infestation.

3.4 Study location

Seven estates in Nakuru town, located in both the Nakuru East and Nakuru West sub-counties, were the sites of the investigation. Kivumbini, Bondeni, Lake View, and Flamingo were the four main estates in Nakuru East, while Phoda, Kaptembwa, and Mwariki were the three estates in Nakuru West. These estates' living conditions are consistent with the UN conference's 2002 definition of a slum household, which is defined as a group of people sharing a single room without access to adequate housing, sanitation facilities, a more adequate supply and quality of water, and education (World Bank, 2008). The majority of the homes in the estates are made of plaster, permanent in nature, and mud and earth, and

the majority of them have tapped water and electricity. By the time the data was collected, the majority of the residents relied on part-time employment, which included jobs on flower farms or in small businesses like riding motorcycles.

https://www.google.com/maps/d/edit?mid=1LvBfRr7NKTa3dqsd96ItHTHjmPDM52Im&usp=sharing

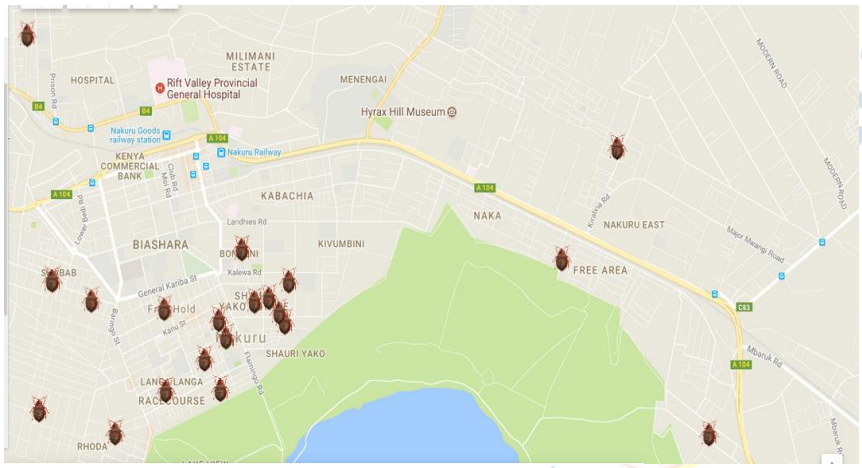


Figure 7: Nakuru Town Bedbug Infestation GIS map

3.5 Size of the sample calculation

The procedure that follows was employed in the investigation to calculate the size of the sample. W.G. Cochran (1997).

$$N=Z^2pq/e^2$$

Where;

N= the anticipated sample

Z= At a 95% confidence level, the standard normal deviation is 1.96.

P= 50% of the target population is the predicted proportion, or (0.5).

q=1-p (0.5)

e= is the intended degree of accuracy (also known as the error margin). 0.05

The samples thus;

$N= (1.96)^2(0.5)\ (0.5)/\ (0.05)^2$ = 384

384 plus 10% for non-respondents 38

Study samples size was 422 heads of households.

3.6 Sampling Procures and Techniques

Seven estates in Nakuru town were selected, the estates were both Nakuru east and west sub-counties. All heads of households with in the estates were enumerated. The 422 heads of households who participated in the study were selected using snow boiling sampling. The affected estates were chosen using cluster sampling techniques, as shown in table 3.1 below, where the list of estates was created. Probabilities proportional to population size -this sampling was generated number of households were listed per estate based on population size, large estates had better chance of probability of selected. See table 3.1 below Snow balling-this sampling was use to discovery households which were experiencing bedbug infestation and willing to interview until the needed sample was achieved.

Table 1: Distribution of study population and sample size

Sub-county	Estate/cluster	Number of households per cluster/ estates	Probability proportional to population size
Nukuru East	Kivumbuni (Cluster A)	1,231	14
	Flamingo (Cluster B)	2,426	28
	Lake view (Cluster C)	1,280	15
	Bondeni (Cluster D)	1,072	13
Nakuru west	Kaptembwa (Cluster E)	10,748	126
	Rhoda (Cluster F)	11,181	131
	Mwariki (Cluster G)	4,918	57
Total	**7 Estates**	**32,856**	**384**

Source: Primary data.

3.7 Data collection methods and procedures

The study used questionnaires and focus group discussion (FGD) to collect data from filed, in addition data was collected from literature view, reports, journal and other articles.

Data collection for this study was done between 9th of September to 15 of September 2018. 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 was sought consent and sign the forms by the heads of households then the questions were asked. Two focus group discussions were done at the end of the study after all the quantitative data had been done.

3.7.1 Quantitative data

During the home visits, heads of families were given a questionnaire just once in order to collect numerical information. Heads of households were questioned by the researcher or any one of the 7 investigators, who then recorded their responses. The duration of interrogations ranged from 10 to 18 minutes. Where necessary, the questions were translated into the local tongue.

3.7.2 Qualitative Data

In order to collect data that is qualitative, focus groups were used. The information gathered from focus group discussions (FGDs) was crucial for both explaining data that is quantitative and offering more insight into the opinions among family heads. The field visit concluded with two focus group discussions. The first Focus group discussion was held with Estate elders and second was done on community health volunteer (CHVs). Each group was consisted of 7-9 individuals. Community health volunteers (CHVs) assisted in the recruitment of the FGD individuals.All locations were appropriate for everyone present, and the conversations lasted between sixty and one hundred and twenty minutes. With the aid of a recording instrument, the researcher led the two FGDs. Everyone who participated gave their permission for all FGD data to be recorded. carried out by conducting FGDs using the following procedure.

i. The investigator introduced himself and research assistant who took a role of recording information and then allowed participants to introduce themselves.

ii. The investigator then explain the objectives of the discussion to the participants and welcomed them to freely participation and sough for their consent to participate.

iii. Investigator (facilitator) kicked off the discussion by asking the first question on the FGDs guide and the guide was carefully followed.

iv. Shy participate were encourage to fully participate while the facilitator tried to control of very outspoken participate.

v. At the end of the discussions the facilitator thanked all participants for their time to participation the study and gave them some fair as well as assured them that information given would not be disclosed with out of their knowledge.

Data on bedbug prevalence (time and location), environmental variables (climate and crowded environment), social variables (second-hand goods and immigration), and household heads' perceptions (psychological distress and social isolation) were gathered using an inquiry that included open-ended as well as closed-ended inquiries. Focus group discussion (FGD) guide was use to provide information on perception of heads of households on bedbug infestation and the factors influence bedbug prevalence. This information was intended to offer more understanding of bedbug prevalence as well as to provide an explanation of quantitative data. Key informant discussions guide (KI) guide was use to provide information on perception of heads of households on bedbug infestation and the factors influence bedbug prevalence. This information was intended to offer more understanding of bedbug prevalence as well as to provide an explanation of quantitative data.

3.8 Testing for Reliability and validity

In order to pretest the questionnaires on content, language and question wording, eight respondents (2%) of total sample) from all seven estates and one from public health department were interviewed. These was important on modifications on the questionnaires

by correcting mistakes, reinforcing some questions in a better ways and remove some questions due to sensitivity of the questions. This also confirmed that the investigator carried the interviews is a standardized way.

3.8.1 Reliability

Two supervisors reviewed the survey responses and suggested changes were made to certain items to better fit the purpose of the investigation.

3.8.2 Validity

During the pretesting of the questionnaires, it was evident that the investigation assistants had received adequate training in how to pose questions and document responses. Every day, every survey was reviewed to make sure it was completed correctly and that any infor that was missing was addressed before the interview the following day began. The data was simultaneously cleaned and checked, and its accuracy and comprehensiveness were verified at the end of each day. Data from focus groups and questionnaire responses were compared.

3.9 Data Analysis Techniques and Procedures

Data was collected from the filed via hard copies then entered in to a computer to ensure consistency and accuracy of data. In analysis data used themes and statistical package for social science (SPSS) version 23.Then analysis were interpreted and concluded tables, graphs and pie charts.

3.9.1 Quantitative data analysis

The statistical package for social science (SPSS) software was used to code, clean, and verify the data before it was analyzed. SPSS version 23 was used for the analysis of all data that

was quantitative. Bedbug prevalence (time and location) and family heads' perceptions (social isolation and psychological distress) were determined using descriptive summary statistics like percentages and frequency rates as well as cross-tabulations.

Bedbug-influencing factors (social isolation, crowded living conditions, used goods, and immigration) and the rise in bedbug invasion were compared using the t-test. The number of people residing in one or more rooms and bedbug outbreaks were found to be significantly correlated using the chi-square test. Additionally, a significant correlation between the second item—international migration or movement—and bedbug invasion was discovered using the chi-square test.

3.9.2 Qualitative data analysis

The input from two focus groups was recorded, and the responses were coded and arranged in broad categories found in the discussion guide. Common hypotheses were found, conclusions were drawn from each theme, and the information gathered from the survey responses was then cross-checked.

3.10 Ethical considerations

The ethical review committee and Mount Kenya University School of postgraduate studies were consulted in order to secure approval for the investigation's research permit. The National Commission for Science, Technology, and Innovation (NACOSTI) granted permission for the investigation to be conducted through an investigation permit. The Nakuru County Director of Education and the Director of Commissioner gave their approval for the study. The county public health officer was also informed by the investigation. All heads of family units chosen to take part in the investigation were asked for permission to

participate, and they were voluntarily given the option to withdraw at any moment. Everyone who participated received assurances that the data they provided would only be utilized for the study's objectives and that they would be informed of its conclusions. Additionally, the investigation assured participants that no names or other identifying information would be used.

CHAPTER FOUR

RESEARCH FINDINGS, ANALYSIS AND PRESENTATIONS

4.1 Introduction

This chapter presents study findings, presentations and analysis this study used a sample of 422 respondents of Quantitative data while qualitative was administered two focus group discussions. This implied that the response rate was 100%. Respondents were heads of households 198(47.0%), wives to household heads 187(44.3%), children headed household 29(6.8%), and relatives 8(1.9%).

4.2 Baseline survey of bedbug infestation

4.2.1 Bedbug hiding places

The prevalence of bedbug was 53.3% at the time of the study. Majority proportion 218(51.6%) households had noticed spots/ markings on or around beddings and mattresses. Bedbugs were commonly hid in furniture 196(46.4%), bed and beddings 293(69.4%), and wall cracks and dark places 115(27.3%), in the house, see Figure 8 below. In FDGs and estate elders reported bedbugs mostly hide in furniture, bed frames and pillow, mattress, clothes, wall cracks, sofa, Dark places and so on.

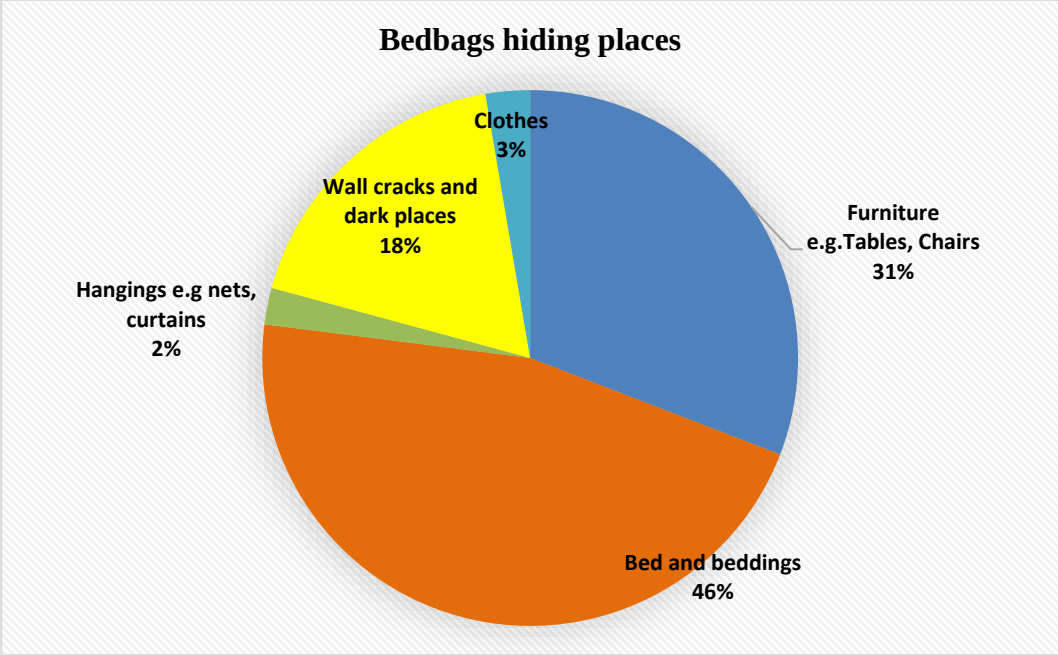


Figure 8: Bedbug hiding paces

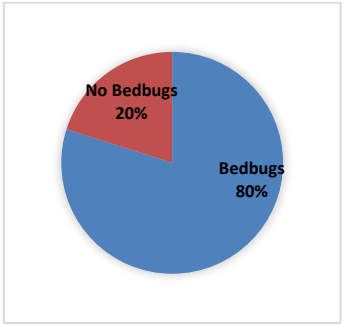
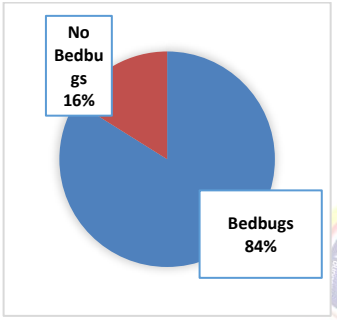
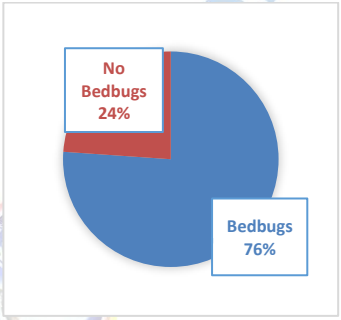
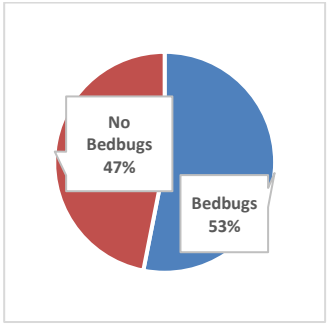
Source: Primary data.

4.2.2 Time

The prevalence of bedbug infestation was 354(84%) and 321(76.1%) in the last 6 and 3 months respectively. A section of 337(80%) households had bedbug infestation at one point in time, see Table 4.1 below. In addition, Nakuru West Sub County was more infested with bedbugs as compared to Nakuru East Sub County (68% and 32% respectively).

All participate of Estate Elders and Community health volunteers in the FGDs conformed that there were bedbugs in all their estates. One member of estate elders mentioned that the bedbugs were in high number in their estates, one participant from estates elders group mentioned that bedbugs have been disturbing residents. Two member from both groups reported that the bedbugs were problem or issue in Nakuru.

Prevalence of Bed Bugs

Ever had bedbugs	Last 6 months	Last 3 months	Currently have bedbugs
80% **337/422**	84% 354/422	76.1% 32/422	53.1% 224/422
			

The Baseline survey of bedbug infestation was declining in the last six months as shown in the graph below,

Figure 9:Bedbug prevalence from last six months.

Source : Primary data.

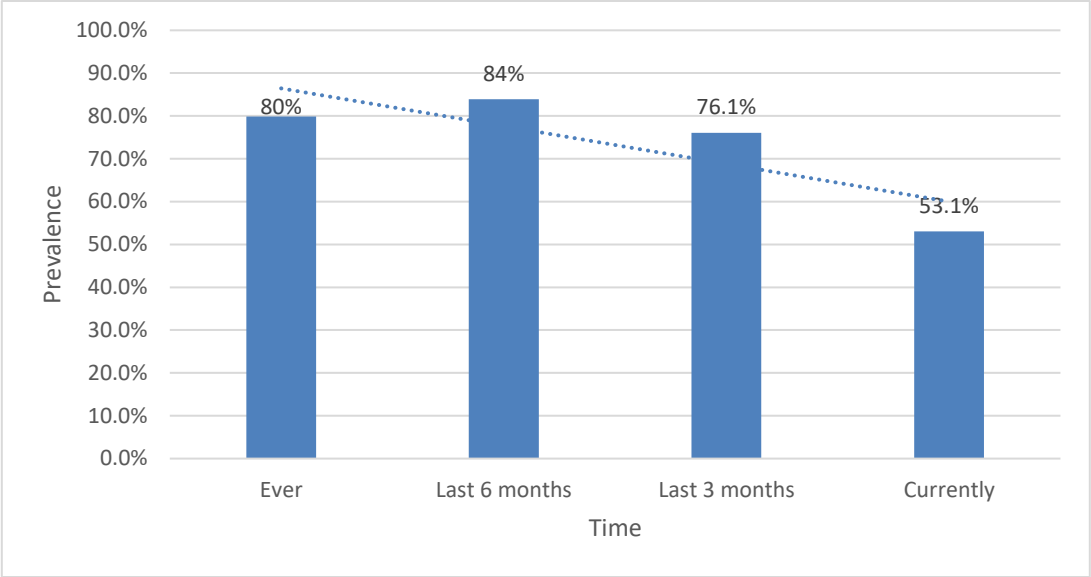


Figure 10: Bedbug baseline survey in the last six months.

Source: Primary data.

Most households had been infested by bedbugs more than once in the last 3 and 6 months 239(57%) and 143(34%) respectively as shown in Table 2 below

Table 2: Bedbug infestation in the last 6 and 3 months

Times infested by bedbugs in house	Last 6 months		Last 3 months	
	N	**%**	**n**	**%**
Once	115	27.2	178	42.1
Twice	110	26	64	15.3
Thrice	42	9.9	19	4.6
More than three times	87	20.7	60	14.3
Not infested	*68*	*16.1*	*101*	*23.9*
Total	**422**	**100**	**422**	**100**

Source: Primary data.

Number of households infested with bedbugs, only a section of 57(14%) respondents reported bedbug infestation to the public health department in the county administration, see

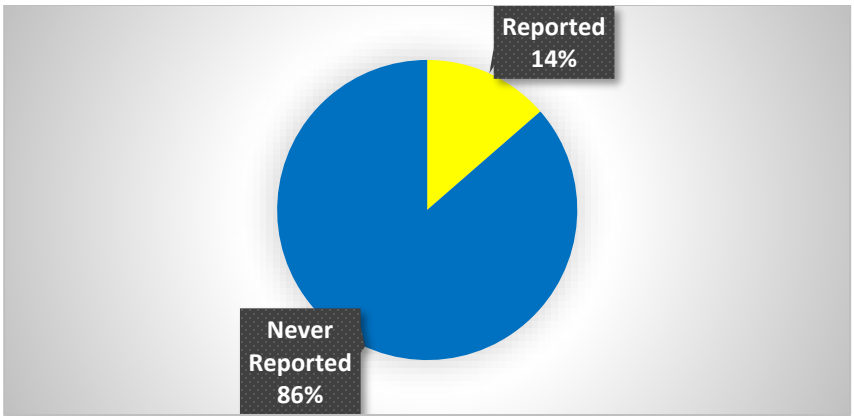


Figure 11: Reporting of bedbugs

Source: Primary data.

Lack of awareness on where to report, poor service delivery of public health department and need for confidentiality were the main reasons cited for failure to report, see Table 3 below.

Table 3: Reason for not reporting bedbugs

Reasons for not reporting	Count	Percent
Unaware if to report	121	28.7%
Confidentiality	51	12.1%
No help offered	24	5.7%
Won't help	21	5.0%
No bed bags	20	4.7%
Never bothered	19	4.5%
Unaware of offices to report to	12	2.8%
Too slow	11	2.6%
Reported elsewhere	5	1.2%
Not available	4	0.9%
Arrogant	4	0.9%
Not concerned	3	0.7%
No faith in them	2	0.5%
Corrupt	1	0.2%
Too many procedures	1	0.2%

Source: Primary data.

4.3. Social-economic factors that influence bedbug infestation in Nakuru County, Kenya.

4.3.1 Immigration

Most 223(53%) respondents had seen neighbors, relatives; friends and job mates within their estates have bedbugs in their homes. Presence of households with bedbugs was associated with prevalence of bedbugs in the study households (p value<0.001). Majority households with bedbugs had other households within their estate that had bedbugs. See table 4 below A section of 98(23.3%) households had guests staying in or visiting house before bedbug infestation. 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, travelling out, and staying out overnight were not associated with bedbug prevalence; p values = 0.630, 0.959, and 0.198 respectively, see Table 4 below. Migration of people influenced bedbug prevalence according to all FGDs participants in both groups. Migration occurred through visitors, luggage and public transport, sharing cloth-lines, moving from plot to another one and public places/events e.g. churches.

Table 4: Immigration and bedbug infestation in Nakuru County

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 house before bedbugs infestation	Yes	98	23.3%	78	18.4%	0.630
	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 or private home bedbugs infestation	Yes	21	5%	26	6.1%	0.198
	No	194	46.1%	162	38.5%	

4.3.2: Second hand items

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 of getting bedbugs upon buying second hand items. Visitors who had bedbugs in their houses were considered more risky by 397(94.1%) respondents. See table 5 below

Second hand furniture or other items influenced bedbug prevalence according to all FGDs participants. Second hand furniture or other items were the main source of bedbug infestation as bedbugs move with the items. Many people sell their items once they realize they have infested by bedbugs while buyers never discovered they were infested. One member from estate elders mentioned that buying any second hand item is like of bedbugs with out of your knowledge.

Table 5: Social factors that influence bedbugs

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

Source: Primary data.

4.4 Environmental factors that influence bedbug prevalence

4.4.1 Overcrowding environment

Number of rooms in households was associated with 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. Kind of house was associated with prevalence of bedbugs (p value<0.001). Semi-permanent and earth/mud houses were most infested by bedbugs. See table 6 below.

Seven participants from both FGDs groups highlighted that all houses were vulnerable or they can get bedbug infestation no matter sanitation of the house or cleanness of the house. Type of the house was reported to influence bedbug prevalence by 8 FGDs participants. Earth/mud, timber and plaster houses were most prone according to 6 participants. Other vulnerable houses included poor conditions houses and unhygienic houses

Table 6: Environmental factors that influence bedbug

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%	

Source: Primary data.

4.4.2 Climate

There was no specific season/ time for bedbugs. Most respondents reported seeing bedbugs in the dry/ hot seasons, especially between December and January. Weather season was

reported to influence bedbug prevalence by all FGD participants. Hot, dry and sunny season helps bedbugs to reproduce more as bedbug eggs hatch then and these conditions were suitable for bedbug survival and helps bedbugs invade new hosts. Further, bedbugs are able to move around since there is no rain water.

4.5. Perceptions of heads of households affected by bedbug infestation

4.5.1 Psychological distress

Majority respondents had negative feelings of embarrassment 263(62.3%) and shame to know 123(29.1%) but only 10(2.4) feel nothing when their have in their houses. See Table 7 below. Bedbugs had negative effects on health; mostly of respondents suffer from Lack of sleep 307(73%), itching 199(47.2%), stress and allergic reaction 92(23%), 71(17%) respectively. See Table 7 below. Respondents perceived neighbors/ friends who had bedbugs in their houses as dirty/ unhygienic 138(33%) and they feared that the bedbugs would be transmitted to them 110(26.1%). A section of 26(6.2%) respondents were not bothered by the bedbugs in neighbors households, see Table 4.6 below.

Table 7: Perceptions of heads of households affected by bedbugs

Feeling when you have bedbugs	Frequency	Percent
Embarrassment	263	62.3
Isolation	36	8.5
Shameful to know friends and family	123	29.1
Nothing	10	2.4
Negative effects of bedbugs		
Lack of sleep	307	73%
Itchy	199	47.2%
Stress	92	23%
Allergic Reaction	71	17%
Perceptions of neighbors/ friends on bedbugs in their houses		
Dirty/ unhygienic	138	33%
Risk of transmission/ concerned	110	26.1%
Bad/ annoyed/ sad/ unhappy	64	15.2%
Nothing/ normal/ okay	26	6.2%
Embarrassed	20	4.7%
Shameful	13	3.1%
Careless/ irresponsible	12	2.8%
Guilty/ helpless	11	2.6%
Scary/ fear	6	1.4%
Bad omen/ bad luck	3	0.7%
Uncomfortable	3	0.7%
Sympathetic	2	0.5%
Poor	2	0.5%
At risk of anemia and death	2	0.5%
Ignorant	2	0.5%
Low esteem	1	0.2%
Lazy	1	0.2%

Source: Primary data.

4.5.2 Social isolation

Respondents with bedbug infestation in their houses 74(17.5%) reported that people stop coming to their homes, 70(16.5) they felt guilty and dirty of having bedbugs, 43(10.2%) they stop going to others people's homes while 182(43.1%) never experience any social isolation because they feel that is to have bedbugs, see Table 4.7 below.

As a consequence of the negative effects, many respondents changed behavior to avoid bedbug infestation. Changed behaviors included keeping off areas and items likely to be infested with bedbugs, that is, not purchasing second hand items such as clothes, furniture and not traveling to certain places among others. See Table 8 below.

Table 8: Perceptions of heads of households affected by bedbugs

Any social isolation after bedbug infestation	Frequency	Percent
People stop coming to your home	74	17.5%
People stop send their kids to your home	20	4.7%
People stop their kids to play with your kids	7	1.7%
You stop going to others people's homes	43	10.2%
Feeling guilty and dirty of having bedbugs	70	16.6%
None	182	43.1%
Changed behaviors because of Bed Bugs		
Not travelling to certain places	54	13%
Not going to sleep in hotels	30	7.1%
Checking bed and sleeping area when away from home	37	9%
Inspecting items before purchasing	17	4.0%
Not using public transport vehicles	2	0.5%
Not purchasing second hand items such as clothes and furniture	56	13.3%

Source: Primary data.

Bedbugs affected all FGDs participants their social life. Participants experienced embarrassment, stress, itchy, no peace, shame, lack of comfortable, sleepless, and isolation/limited socialization e.g. no visitors

Thirteen FGDs participants reported changed behaviors since they discovery of bedbug infestation. Changes included avoiding: visitors, Sleep in lodges/hotels, buy second hand clothes/ Furniture, visit people's houses, share cloth lines and visiting some places. FGDs also conform come to homes through visitor, using public transports and second items.

4.6 Discussions of the study

4.6.1 Bedbugs baseline survey infestation in Nakuru county.

Most households in Nakuru County were infested with bedbugs. Nakuru West Sub County was more infested with bedbugs as compared to Nakuru East Sub County. Bedbug infestation occurred and sometimes re-occurred at different time intervals. Estate elders and community health volunteers reported that bedbugs in the estates were an issue. Study findings indicated that the prevalence of bedbug infestation was 53.3%. The prevalence of bedbug infestation had declined within a period of six months from 84% to 53.1% as at time of the study. Decline in the prevalence of bedbug infestation was attributed to residents' management and control initiatives including spraying and behavior change.

The slow decline in prevalence of bedbug infestation could further be attributed to meager support from the public health department in the county administration. Poor service delivery marred with 'arrogance', 'corruption', and 'too many procedures' distanced county residents from seeking public-health-department's aid to control bedbugs from breeding and spreading. Residents' individual factors are also presumed to have contributed to the increase in prevalence of bedbugs. Lack of awareness on where to report bedbug infestation and need for confidentiality contributed to failure to report to public health department for support in controlling bedbugs.

4.6.2 Social Factors

The study sought to establish Social factors that associated with the prevalence of bedbug infestation. Bedbug infestation was very rampant in the homestead locality including

neighbors, relatives, friends and job mates. Chi square test of association revealed an association between prevalence and presence of households with bedbugs in the locality (p value<0.001). 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 as a risk for bedbug transmission. Study respondent considered visitors who had bedbugs in their houses more risky in transmitting bedbugs. Bedbugs were also presumed to be transmitted from other sources. Other hypothesized sources of bedbug infestation including guests staying in or visiting households; household members travelling out; and household member staying out overnight in a hotel, motel, and hostel or private home did not significantly influence prevalence of bedbugs.

Purchase of second hand furniture and clothes before bed bugs infestation was associated with increase in bedbug prevalence. Study respondents felt that they were vulnerable of getting bedbugs upon buying second hand items. Second hand furniture or other items were the main source of bedbugs as bedbugs move with the items. Many persons sold their items once infested while buyers never discovered they were infested.

4.6.3 Environmental factors

Environmental factors including overcrowding environment and climate were also assessed. Number of rooms in households was associated with prevalence of bedbugs.

Houses with less than 3 rooms which are presumed to be more crowded were most infested by bedbugs. 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, beddings, dark places, curtains frame, door frame, ceiling cracks, woolen carpet, and traditional/ laundry basket.

Kind of house was associated with 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.

There was no specific season/ time for bedbugs. Most respondents reported seeing bedbugs in the dry/ hot seasons especially between December and January. 'Hot and dry season helped bedbugs to reproduce as bedbugs' eggs hatch then' and 'bedbugs were able to move around since there was no rain water'. Season/weather/months were not associated with prevalence of bedbugs. This implied that bedbugs were common all along.

4.6.4 Perceptions of affected heads of households

Bedbugs mostly brought about lack of sleep and itching, in addition to stress and allergic reaction. Presence of bedbugs in houses created negative feelings among the residents including embarrassment and shame that led to isolation. Neighbors/ friends who had bedbugs in their houses were mainly negatively perceived. The perceptions included 'dirty/ unhygienic', 'careless/ irresponsible', 'poor', 'ignorant', and 'lazy' among others. Moreover, neighbors/ friends with bedbugs in their houses were 'feared' and considered a risk factor since they would transmit bedbugs to others.

The negative feelings created by bedbug infestation including ‘guilty and dirty of having bedbugs’ and negative perceptions by neighbors and friends highly contributed to isolation. Isolation took different forms including reduced rates of visiting others, and minimal interaction among children while playing.

As a consequence of negative effects and perceptions associated with bedbug infestation, many respondents changed behavior to avoid bedbug infestation. Changed behaviors included keeping off areas and items likely to be infested with bedbugs, that is, ‘inspecting items before purchasing’, ‘not purchasing second hand items such as clothes and furniture’, and not traveling using ‘public means’ to certain places including hotels.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter gives the summary of the study findings, conclusions and recommendations made from the findings. Further, the chapter gives recommendations for further research.

5.2 Summary of result findings

Most households in Nakuru County were infested with bedbugs which occurred and sometimes re-occurred at different time intervals. Estate elders and community health volunteers reported that bedbugs were an issue. The prevalence of bedbug infestation was 53.3% having declined within a period of six months from 84%. Decline of bedbug infestation was attributed to spraying by residents and behavior change.

An assessment of social factors that influenced bedbug prevalence indicated that immigration and transportation increased prevalence of bedbug infestation. Existence of neighbors, relatives, friends and job mates with bedbugs in their homes, heightened chances of spreading the bedbugs to others. Situations that promoted transmission of bedbugs including visits, movement of luggage between houses, social gatherings, and children play grounds, clothe-lines, and use of public transport. Purchase of second hand furniture and clothes before bed bugs infestation increased the prevalence of bedbugs. Many persons sold their items once they got infested with bedbugs.

An assessment of environmental factors that influenced bedbug prevalence indicated that overcrowded environment increased the prevalence of bedbug infestation. 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 as they provided more breeding and hiding places including dark cracks for bedbugs. Crowded environments e.g. houses offered more breeding and hiding sites for bedbugs including shoes, clothes, joints of furniture, beddings, dark places, curtains frame, door frame, ceiling cracks, woolen carpet, and traditional/ laundry basket. There was no specific season/ time for bedbugs. Bedbugs were more common during dry/ hot seasons especially between December and January.

Bedbug infestation created Psychological distress and negatively influenced residents. Bedbug infestation brought about negative feelings including embarrassment and shame that led to isolation. Further, isolation was increased by negative perceptions of neighbors and friends with bedbugs. Isolation took different forms including no visits to others, and minimal interaction among children while playing. As a consequence of negative effects and perceptions associated with bedbug infestation, many respondents changed behavior to avoid bedbug infestation.

5.3 Conclusion

Most households in Nakuru County were infested with bedbugs. The prevalence of bedbug infestation was 53.3% having declined within a period of six months from 84%.

Social factors including existence of neighbors, relatives, friends and job mates with bedbugs in their homes, heightened chances of spreading the bedbugs to others. Situations that promoted transmission of bedbugs including visits, movement of luggage between houses,

social gatherings, and children play grounds, clothe-lines, and use of public transport. Purchase of second hand furniture and clothes increased the prevalence of bedbugs.

Overcrowded environment 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. There was no specific season/ time for bedbug; however, they were more common during dry/ hot seasons especially between December and January.

Bedbug infestation created psychological distress and negatively influenced residents. Bedbug infestation brought about negative feelings including embarrassment and shame that led to isolation. Negative perceptions of neighbors and friends with bedbugs were high. Isolation took different forms including no visits to others, and minimal interaction among children while playing.

5.4 Recommendations

i) Recommendations for practice to the Nakuru County Government for implementation

1. The Nakuru County Government should develop a policy document to manage and control the spread of bedbugs that negatively impact on Nakuru County residents. The policy should clearly define the key roles and players in the fight against bedbugs;

training of key personnel; provide road map for reporting and follow up of bedbug infestation; room for community/public engagement; and enhanced service delivery.

2. Nakuru County Government should mobilize resources and other stakeholders including management of social amenities, households heads, and landlords among others to develop a roadmap on how to united and cost effectively spray bedbugs and stop their spread.
3. Nakuru County Government should run a campaign to sensitize the locals on bedbugs spreading and breeding to aid reduce the levels of isolation among residents. Further, the campaign should fight stigma and encourage residents to report bedbug-associated issues to relevant authorities.

ii) Recommendations for practice to the Service users/ beneficiaries

1) Residents should unite through neighborhoods in spraying activities to reduce chances of bedbug migration and share costs.
2) Residents should discourage isolation and negative perceptions of others on basis of bedbug infestation.
3) Residents should not buy second futures and items in order to avoid bedbug remissions.

iii) Recommendations for further research in this field of study

The study recommends further research on bedbug management and eradication strategies which shall be applicable in Kenya at large.

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APPENDIXES

Appendix I: Consent Form

RE-TO WHO IT MAY CONCERN

Dear: Respondent

I'm a public health master's student at Mount Kenya University, and I wanted to let you know that I'm conducting an investigation to find out how common bedbug infestations are in your estates and what the impacted heads of households think about them. I am aware that bedbug infestation is a significant public health concern in Nakuru, and I am interested to learn more about the causes of this problem.

I would like to ask you to voluntarily participate in the research investigation by answering the questions honestly and letting the researchers look at a few items in your homes to confirm the prevalence if necessary. You can leave the study whenever you want without giving a reason, and it's crucial to understand that while there won't be any immediate benefits from your involvement, the community will. You will be informed of the results of the investigation for your benefit, and your personal information will remain anonymous.

If you accepted please sign here_____

Name of enumerator: _____

Sign_____Date_____

Any questions regards to the study shall be directed to principle investigator

MR: ABDIRIZAK SHIRE (0714397875)

Appendix II: Questionnaires

Name of Sub County:

_____

Name of estate:

_____

Name of Enumerator:

_____

Data: _____

Please answer all the following questions, put a tick where choices are given and write your explanation where needed.

SECTION ONE: PREVALENCE OF BEDBUG INFESTATIONS

1. What is your relation to the head of household?

1. Head of house/husband [ ] 2. Wife [ ] 3. Child headed household [ ]

4. Other [ ]

2. How many times have you been infested in the last 6 month in your house by bedbugs?

1. Once [ ] 2. Twice [ ] 3. Thrice [ ] 4. More than three times [ ]

5. Never [ ] 7. Refuse to answer [ ]

3. How many times have been infested in the last three months by bedbugs?

1. Refuse to answer [ ] 2. Never [ ] 3. Once [ ] 4. Twice [ ]

5. Thrice [ ] 6. More than three times [ ]

4. Do have currently bedbugs in your household?

1. Yes [ ] 2. No [ ] 3. Refuse to reply [ ]

5. Do you notice any kind of spots or makings on or around bedding and mattress?

1. Yes [ ] 2. No [ ] 3. Refuse to answer [ ]

b) If yes, When have you seen last?

1. A week ago [ ] 2. Two weeks [ ] 3. Three weeks [ ] 4. Four weeks [ ]

5. More than four weeks [ ]

7. Have you ever had bedbugs in your house?

1. Yes [ ] 2. No [ ] 3. Refuse to answer [ ]

b). If, yes when was the last time you had bedbugs?

1. Less than a month from now [ ] 2. Two months ago [ ]

3. Three months ago [ ] 4. More than three months [ ]

8. What are most common places where bedbugs hide in your house?

_____

_____

_____

SECTION TWO: ENVIRONMENTAL FACTORS THAT INFLUENCE BEDBUG PREVALENCE

9. How many rooms are in this house?

1) One [ ] 2. Two [ ] Three [ ] four [ ] More than five [ ]

10. Kind house you live in? _____

11. How many of people are living in this house?

1. 1-2 [ ] **2.** 3-5 [ ] **3**. 6-8 [ ] **4.** 9-11 [ ] **5**. More than 12 [ ]

12. What is favorite season/weather for bedbugs?

_____

_____

_____

SECTION THREE: SOCIAL FACTORS THAT INFLUENCE BEDBUG PREVALENCE

13. Have you seen anyone in your estate that now has bedbugs?

1) Yes [ ] 2) No [ ] 3) Refuse to answer [ ]

b) If, Yes who currently has bedbugs?

1) Friends [ ] 2. Relatives [ ] 3. Neighbor [ ] 4. Job Mate [ ]

5. Others [ ] 6. Refuse to answer [ ]

14. Did have any guest staying in or visiting your household before you had bedbugs?

Yes [ ] No [ ] Refuse to answer [ ]

b) If yes where are they come from?

_____

15. Have you traveled out before you had bedbugs?

1. Yes [ ] 2. No [ ] 3. Refuse to answer

b) If, yes where

_____

16. Do you stayed out overnight in private home or hotel before you had bedbug infestation?

1) Yes [ ] 2) No [ ] 3) Refuse to answer [ ]

b) If yes How long

_____

17. Have you purchased any second hand furniture before you had bed bugs?

1. Yes [ ] 2. No [ ] 3. Refuse to answer [ ]

b) If, yes what furniture have you purchased?

_____

18. Have you purchased any second-hand clothes before you had bed bugs?

1. Yes [ ] 2. No [ ] 3. Refuse to answer [ ]

b) If, yes what clothes have you purchased?

_____

SECTION C: PERCEPTIONS OF HEADS OF HOUSEHOLDS

20. Have you ever had any social isolation after bedbug infestation occurred in your house?

1. People stop coming to your house [ ] 2. People stop to send their kids to you [ ]

3. People stop their kinds to play with your kinds [ ] 4. You stop going to others people's homes [ ] 5. Feeling guilty and dirty of having bedbugs [ ] 6. None [ ]

7. Others; specify

_____

21. What do you feel when you have bedbugs in your house?

1. Embarrassment [ ] 2. Isolation [ ] 3. Shameful to know friends and family [ ] 4. Nothing [ ] 5. Other; specify

_____

22. What is your perception when your friends or neighbor have bedbugs?

_____

23. Do you report bedbugs to the department of public health?

1. Yes [ ] 2. No [ ] 3. Refuse to answer [ ]

22. Do you usually report bedbug infestation to the public health department?

1. Yes [ ] 2. No [ ] 3. Refuse to answer [ ]

b) If, Yes when do you report?

1) Immediately [ ] 2) in a week [ ] 3. In two weeks [ ] 3. In Three weeks [ ]

b) If, no Why not?

_____

23. What are negative health effects of bedbug bites?

1. Lack of sleep [ ] 2. Allergic reaction [ ] 3. Itchy [ ] 4. Stress [ ]

5. Others specify_____

24. Have you changed any behavior because of bedbug infestations?

1. Yes [ ] 2. No [ ] 3. Refuse to answer [ ]

b) If, yes what behaviors have you changed?

1. Not sleeping in hotels [ ] 2. Not Going certain Places 3. Checking bed and sleeping area when away from home [ ] 4. Inspecting items before purchasing [ ]

5. Not using public health transport vehicles [ ] 6. Not purchasing second items [ ]

7. Others [ ]

27. Do you think you are vulnerable of getting bedbugs when you buy second hand items?

1. Yes [ ] 2. No [ ] 3. Refuse to reply [ ]

b) If, Yes how?

_____

28. Do you think you are vulnerable of getting bedbugs when visitors who has bedbugs come to your home?

_____

The end of interview

Thank you so much for your time and honest

End

Appendix III: Focus Group Discussion Guide

Project title: Determining prevalence of bedbug infestation and perceptions of affected heads of households in Nakuru

Participants: Estate Elders

Venue: Kicking Boxing Hall in Kivumbini

THEME ONE: PREVALENCE OF BEDBUG INFESTATION IN NAKURU

Question 1: What are most common places where bedbugs hide in your house? List

P1-furniture

P2-Ceilling

P3-Bed frame and pillow

P4-Curain

P5-Matress

P6-cracks

P7-Door frames

P8-Clothes

Question 2: Do you currently have bedbugs in your estates? Yes/No

P1-Yes, it has been disturbing us

P2-Yes

P3-Yes, High number

P4-Yes, is normal in the area

P5-Yes, it is always there

P6-Yes

P7-Yes, in a big number

P8- Yes, bedbug it is a big problem these days

THEME TWO: ENVIRONMENTAL FACTORS THAT INFLUENCE BEDBUG PREVALENCE

Question 1: Does type of the house influence bedbug prevalence? Yes/No (Please explain)

P1-No, All types of houses can be infested by bedbugs no matter the structure the house

P2-Yes, Timber houses are mostly have bedbugs

P3-Yes, Plaster houses are more vulnerable to get bedbugs

P4-Yes, it does, Muddy houses can easily affected by bedbugs

P5-No, all types of house can get the insect regards it is cleanness

P6-Yes, poor condition houses are more vulnerable

P7-Yes, Bedbugs mostly invade unhygienic houses

P8-No, bedbugs is for every body

Question 2: Does weather season influence bedbug prevalence? Please elaborate

P1-Yes, hot season is suitable for bedbugs

P2-Yes, during hot season bedbugs produce more eggs

P3-Yes, Hot season is the season for bedbugs

P4-Yes, hot helps bedbugs to invade new house

P5-Yes, it is when the eggs hatched

P6-Yes, during dry and hot bedbugs reproduce highest number of eggs

P7-Yes, hot sunny is the perfect season for bedbugs

P8- Yes it does during rain period bedbugs cannot walk from house to house while hot period they can.

THEME THREE: SOCIAL FACTORS THAT INFLUENCE BEDBUG PREVALENCE

Question 1: Does second hand furniture or other items influence bedbug prevalence?

P1-Second furniture (beds, table) brings bedbugs into home

P2-second clothes brings bedbugs

P3-Often people sell their items when they discover they have been infested by bedbugs

P4-Bedbugs immigrates with luggage from one place to an other

P5- Second items is the sources of bedbug infestation

P6- It is influence due to bedbugs come with any second staff

P7- if you purchased infested item or furniture you are buying bedbugs with out of our knowledge

Question 2: Is the migrations of people influence bedbug prevalence? Explain

P1-Yes, people come with bedbugs and leave them into public places such as (Public transports, churches)

P2-Yes, bedbugs come with visitors and luggage

P3- Yes, public transport is the source of bedbugs

P4-Yes, Sharing of clothes

P5-Yes, Bedbugs bring by visitor and leave into homes

P6-Yes, people get bedbug from hotels

THEME FOUR: PERCEPTIONS OF HEADS OF HOUSEHOLDS AFFECTED BY BEDBUG INFESTATIONS

Question 1: Can you confirm whether there are any behaviors you have changed since you discovered that you were infested by bedbugs, if no why not? If yes which ones?

P1-Stopped to sleep hotels

P2-stopped to buy second hand clothes

P3-Stopped going people's houses

P4-Not buying second hand furniture

P5-Not sharing cloth lines with neighbors

P6-Not traveling certain places

Question 2: let us discuss about how bedbugs find their way into your homes?

P1-Via overcrowding places

P2-through visitors

P3-through second furniture

P4-Sharing clothes lines

P5-Using public transport

P6-Come with cockroaches

P7-Cultural believes

Question 3: How bedbugs affect your social life? Discuss

P1-Yes, embarrassment

P2-Yes, Stress

P3-Yes, Isolation

P4-Yes, it brings itchy which is bad

P5-Yes, it brings shameful

P6-Yes, I don't like people to see I have bedbugs

P7-Yes, I feel uncomfortable when I have bedbugs

P8-Yes, I feel unclean

End

Part two

Participants: Community health volunteers (CHVs)

Venue: Environmental club hall (Kivumbini)

THEME ONE: PREVALENCE OF BEDBUG INFESTATION

Question 1: What are most common places where bedbugs hide in your house? Discuss

P1-Sofa

P2-Joint of bed

P3-matress

P4-Furniture

P5-Darck places

P6-Cracks of wall

P7-Traditional basket

P8- curtains

Question 2: Do you currently have bedbugs in your estates? Yes/No

P1-Yes

P2-Yes

P3-Yes,

P4-Yes not much

P5-Yes, it have been there for long time

P6Yes, we have

P7-Yes, it is an issue here

THEME TWO: ENVIRONMENTAL FACTORS THAT INFLUENCE BEDBUG PREVALENCE

Question 1: Does type of the house influence bedbug prevalence? Yes/No (Please explain)

P1-No, all types of houses can have bedbugs

P2-Yes, Timber houses more susceptible

P3-No, Any house able to get bedbugs

P4-Yes, plaster houses are most likely to get it

P5-Yes, Earth and muddy houses can get easily

P6-it can affect any house

P7-No, Bedbugs don't know the cleanness of the house

Question 2: Does weather season influence bedbug prevalence? Please elaborate

P1-Yes, it does during hot season

P2-Yes, hot and sunny seasons influence bedbugs

P3-Bebug eggs hatch during hot season

P4-Hot season help bedbugs to reproduce more eggs

P5-Yes, sunny and dry is good for bedbugs

P6-Yes, dry and hot season is good for bedbugs

P7- Yes, it is influence bedbugs

THEME THREE: SOCIAL FACTORS THAT INFLUENCE BEDBUG PREVALENCE

Question 1: Does second hand furniture or other items influence bedbug prevalence? Yes/No

P1-Yes, people sell their item when become infested

P2-Yes, second furniture brings bedbugs

P3-Yes, Second clothes influence bedbugs

P4-Yes,

P5-Yes

P6-Yes

P7-Yes

Question 2: Is migration of people influence bedbug prevalence? No/Yes

P1-Yes, via visitor

P2-Yes, through migration of people

P3-Yes, through public transport

P4-Yes, through sharing clothes lines

P5-Yes, Migration from plot to plot

P6-Yes, New visitors

P7-Yes, through luggage

THEME FOUR: PERCEPTIONS OF HEADS OF HOUSEHOLDS AFFECTED BY BEDBUG INFESTATIONS

Question 1: Can you confirm whether there are any behaviors you have changed since you discovered that you were infested by bedbugs, if no why not? If yes which ones?

P1-Ye, not buying second clothes

P2-Ye, I don't sleep in lodges

P3-Yes, I don't like new visitors

P4-Yes, I don't to go people's house

P5-Yes, I don't like to buy second furniture

P6-Yes, I don't going some places (High risk places)

P7-Yes, I don't like sharing cloth line with neighbors

Question 2: let us discuss about how bedbugs find their way into your homes?

P1- via visitors

P2-through clothes lines

P3-Public transport

P4-Second furniture

P5- via migrations

P6-any second items (shoes, mattress, blanket)

P7-Via dryness

P8- luggage

Question 3: How bedbugs affect your social life? Discuss

P1-Embarassment

P2-uncomfortable

P3-itchy

P4-shame

P5-sleepness

P6-limitation of socialization

P7-Not going people's houses

End

Appendix IV: Letter of Introduction

Mount Kenya University

SCHOOL OF POSTGRADUATE STUDIES

MPH/2017/69426

02nd July, 2018

The Director, Research Coordination Division
National Commission for Science, Technology & Innovation
Utalii House, 8th & 9th Floor
P.O Box 30623- 00100
NAIROBI

Dear Sir/ Madam,

RE: ABDIRIZAK SHIRE ELMI – REGISTRATION NO. MPH/2017/69426

The purpose of this letter is to introduce the above named student who is pursuing **Master of Public Health (Epidemiology and Disease Control)** in the Department of **Epidemiology and Biostatistics** in the School of **Public Health.**

The title of his research is *"Determine Prevalence of Bedbug Infestation and Perceptions of Affected Heads of Households in Nakuru Town, Kenya."*

He has been cleared by the University's Ethics Review Committee (Certificate attached) and now has to proceed to the field to collect data for his research between **July and September, 2018.**

Any assistance accorded to him will be highly appreciated.

Thank you.

Mount Kenya University
Dean, School of Postgraduate Studies
P. O. Box 342 - 01000
Thika

Dr. Samuel Karenga, PhD
Dean, School of Postgraduate Studies
Enc.

Appendix V: Ethical clearance

Mount Kenya University

JUNE 25, 2018

Ref. No. MKU/ERC/0888

CERTIFICATE OF ETHICAL CLEARANCE

This is to certify that the proposal titled **"DETERMINE PREVALENCE OF BEDBUGS INFESTATION AND PERCEPTIONS OF AFFECTED HEADS OF HOUSEHOLDS IN NAKURU TOWN, KENYA"** Whose Principal Investigator is Mr Abdirizak Shire Elmi (MPH/2017/69426) has been reviewed by Mount Kenya University Ethics Review Committee (ERC), and found to adequately address all ethical concerns.

Mr Francis W. Makokha
Secretary, Mount Kenya University ERC

Sign: _____ Date: 25.06.2018

Prof. Francis W. Muregi
Chairman, Mount Kenya University ERC

Sign: _____ Date: 26/6/2018

The Chairman
Mount Kenya University
Ethics Review Committee
P. O. Box 342 - 0100, Thika

Appendix VI: Research permit from NACOSTI

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471, 2241349,3310571,2219420
Fax:+254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/18/31794/23904**

Date: **1st August, 2018**

Abdirizak Shire Elmi
Mount Kenya University
P.O. Box 342 – 001000
THIKA

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Determine prevalence of bedbug infestation and perceptions of affected heads of households in Nakuru Town, Kenya"*** I am pleased to inform you that you have been authorized to undertake research in **Nakuru County** for the period ending **30th July, 2019.**

You are advised to report to **the County Commissioner and the County Director of Education, Nakuru County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

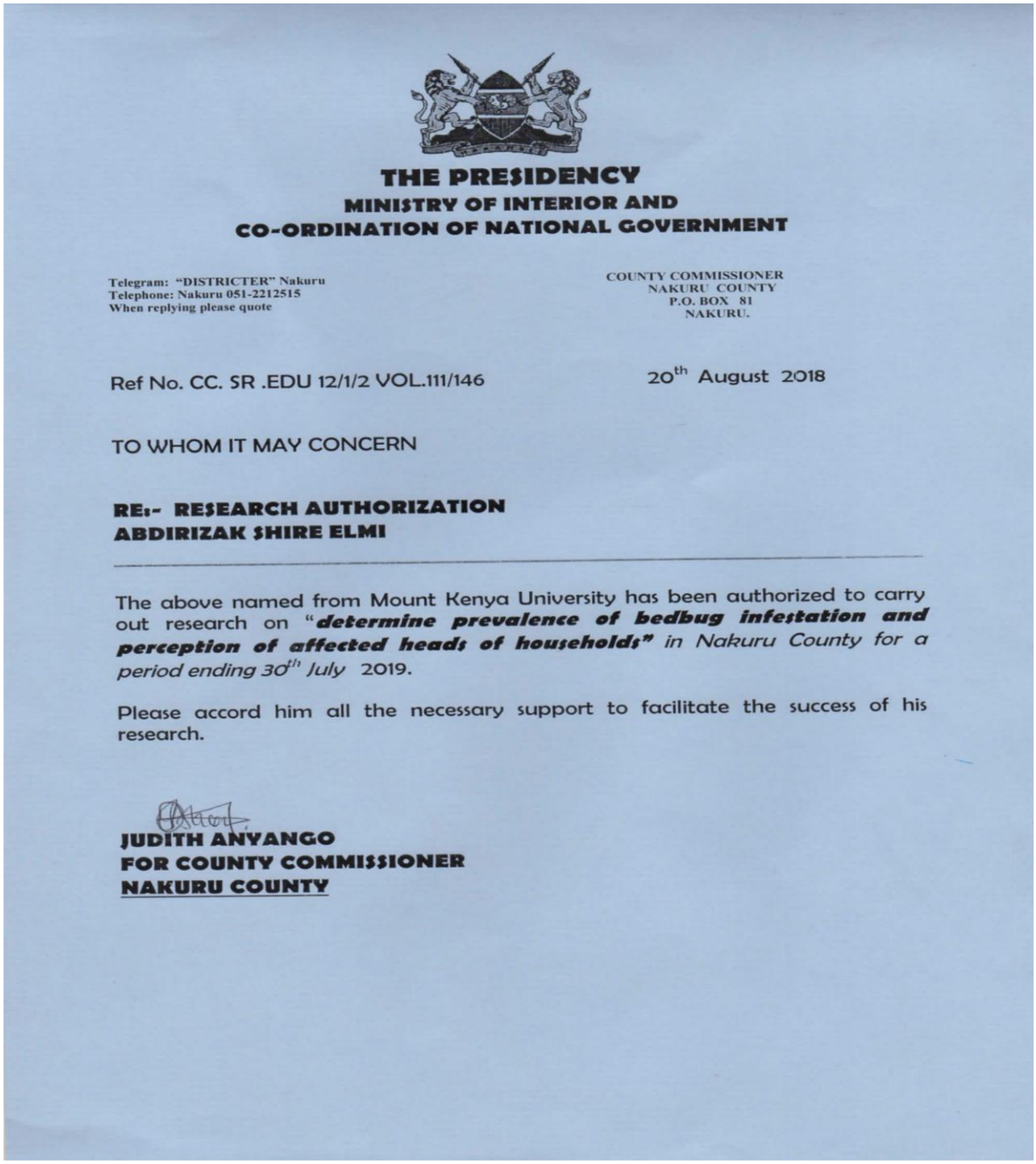
BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Nakuru County.

The County Director of Education
Nakuru County.

Appendix VII: Research permit from Nakuru County commissioner



THE PRESIDENCY
MINISTRY OF INTERIOR AND
CO-ORDINATION OF NATIONAL GOVERNMENT

Telegram: "DISTRICTER" Nakuru
Telephone: Nakuru 051-2212515
When replying please quote

COUNTY COMMISSIONER
NAKURU COUNTY
P.O. BOX 81
NAKURU.

Ref No. CC. SR .EDU 12/1/2 VOL.111/146

20th August 2018

TO WHOM IT MAY CONCERN

RE:- RESEARCH AUTHORIZATION
ABDIRIZAK SHIRE ELMI

The above named from Mount Kenya University has been authorized to carry out research on "***determine prevalence of bedbug infestation and perception of affected heads of households"*** *in Nakuru County for a period ending 30th July* 2019.

Please accord him all the necessary support to facilitate the success of his research.

JUDITH ANYANGO
FOR COUNTY COMMISSIONER
NAKURU COUNTY

Appendix VIII: Research permit from County Director of Education

MINISTRY OF EDUCATION

STATE DEPARTMENT OF EARLY LEARNING OF BASIC EDUCATION

Telegrams: "**EDUCATION**",
Telephone: **051-2216917**
When replying please quote
Email:cdenakurucounty@gmail.com
Ref.CDE/NKU/GEN/4/1/21 VOL.VII/78

COUNTY DIRECTOR OF EDUCATION
NAKURU COUNTY
P. O. BOX 259,
NAKURU.

20th August, 2018

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION –ABDIRIZAK SHIRE ELMI
PERMIT NO. NACOSTI/P/18/31794/23904

Reference is made to letter NACOSTI/P/18/21614/23855
26th July, 2018.

Authority is hereby granted to the above named to carry out research on ***"Determine prevalence of bedbug infestation and perceptions of affected heads of households" in Nakuru Town, Kenya"*** *for* a period ending ***25th July, 2019.***

Kindly accord him the necessary assistance.

FOR: COUNTY DIRECTOR OF EDUCATION
NAKURU COUNTY

GEORGE ONTIRI
FOR: COUNTY DIRECTOR OF EDUCATION
NAKURU

Copy to:

Mt. Kenya University
P.O Box 342 - 001000
THIKA

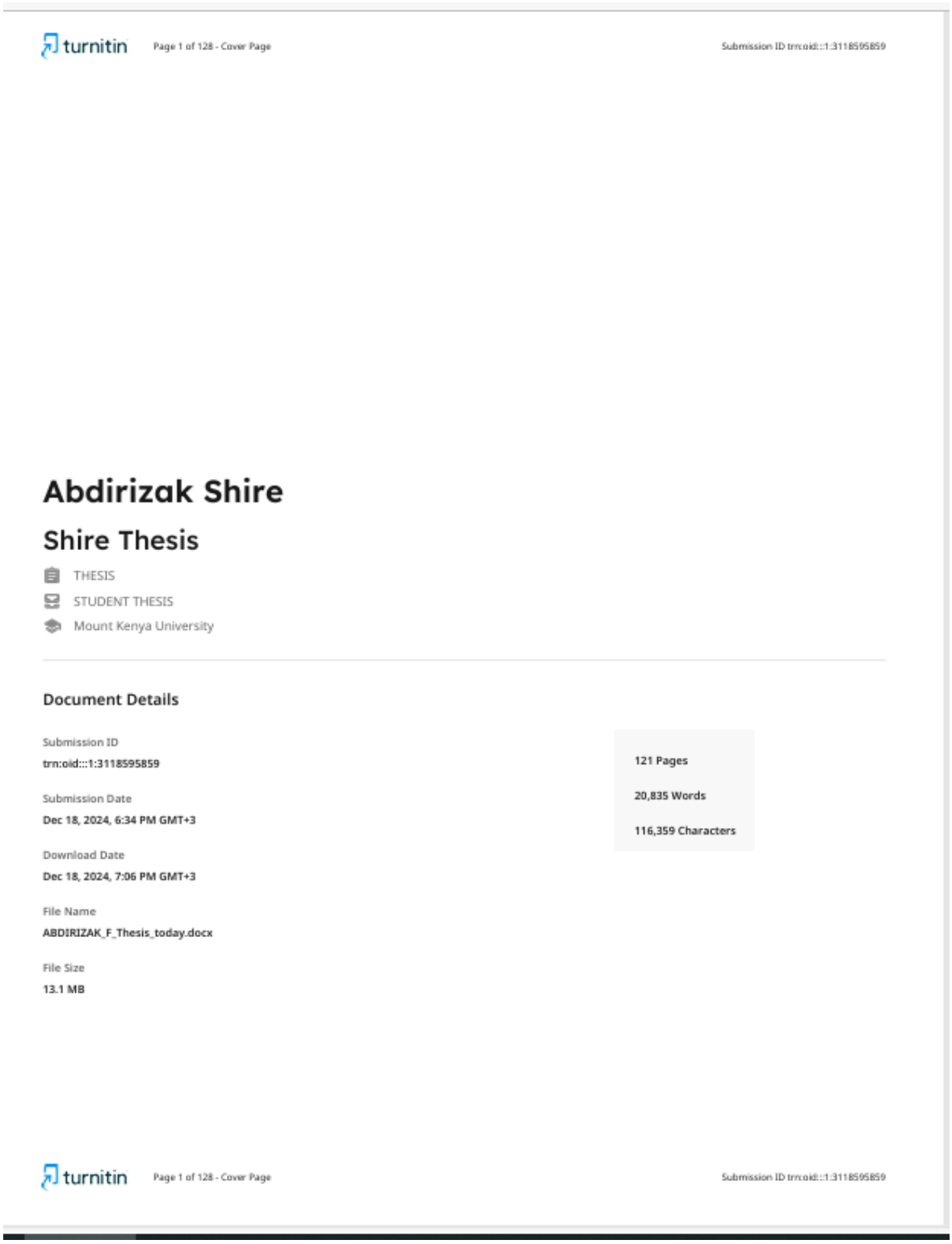
Appendix IX: Nakuru town map

Appendix X: Photo of bedbug; http//www.goog.com/images

Appendix XI: Photos of people bitten by bedbugs

People scrached excessively and color has changed

Appendix xii: Similarity Index



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Match Groups

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  Matches that are still very similar to source material
- 2 Missing Citation 0%
  Matches that have quotation marks, but no in-text citation
- 0 Cited and Quoted 0%
  Matches with in-text citation present, but no quotation marks

Top Sources

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2% Submitted works (Student Papers)

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A Flag is not necessarily an indicator of a problem. However, we'd recommend you focus your attention there for further review.