

Original Research Article

The epidemiological investigation of bed bugs, *Cimex lectularius* in Jeddah governorate, Saudi Arabia

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ABSTRACT

Background: Bed bugs are small insects that feed on animal blood at all stages of their life cycle, with the most common species, *Cimex lectularius*, preferring to feed on human blood. In recent years, it has reappeared in many countries around the world.

Methods: Samples of bed bugs were collected from Jeddah governorate neighbourhoods from 4th December, 2018, to 1st May, 2019, to determine the infected neighbourhoods and the degree of insect infestation. The study was conducted by random selection of individuals in the Jeddah community; data were collected through the completion of 1000 questionnaires, which were then statistically analysed.

Results: The current study monitored the presence of bed bugs in many neighbourhoods of Jeddah governorate; their presence percentage varied according to the different neighbourhoods, and they were arranged in descending order according to the percentage of their presence as follows: Al-Safa >Bani-Malik >Al-Sherafiya >Al Jamaa >Al Nuzula. The prevalence of bed bugs related to the population density, random neighbourhoods, low level of hygiene in the neighbourhood, and moving from one residence to another. 98% of the residents of Jeddah in the sample agreed that bed bugs were a disturbing pest and an environmental problem which needs to be researched and studied to reach the best ways to control it, as 99.6% of them agreed the necessity of including bed bugs in the list of disturbing pests and vectors of diseases that must be controlled by the concerned authorities in Jeddah governorate.

Conclusions: The necessity of including bed bugs as one of the pests that need to be considered and must be controlled by the relevant authorities.

Keywords: Bed bugs, Blood-sucking insects, Ectoparasite, Insect, Survey

INTRODUCTION

Bed bugs are insects of the phylum Arthropoda, class Insecta, order Hemiptera and family Cimicidae, which have over 90 species around the world.^{1,2} Members of Hemiptera are generally recognized by their modified piercing and sucking mouth parts.

Although infestations had disappeared for more than half a decade, increasing numbers of cases have recently been reported in many countries around the world, leading to it being termed as the pest of the twenty-first century. Bed bugs are good vectors of many pathogens, such as plague bacteria, rickettsia, typhoid, yellow fever virus, and trypanosomiasis (Chagas disease).^{3,4}

The medical interest in bed bugs lies behind the fact that they are obligatory blood-feeding insects throughout all stages of their lifecycle. They have a proboscis-shaped piercing and sucking mouth part, which sucks the blood of the host from exposed areas, leading to a condition commonly known as 'prickles' (Cimicosis). The common dermatological presentations of prickles are reddish, erythematous rashes, swelling, and allergic reactions of varying levels according to the host's immune response.^{5,6} Symptoms present as itching, abscesses, bullous rashes and inflamed blisters; fevers may also occur. Asthma patients suffering from bed bugs may experience difficulty breathing and increased wheezing in the chest.⁷ The medical importance of the bed bug extends to include impacts on mental health and psychosocial behavior, the most important symptoms of which are anxiety, insomnia, and panic as a result of Cimicosis; feeling ashamed of the presence of the pest may lead to depression and social isolation.⁸

The ramifications of the presence of bed bugs insects beyond their health implications can extend to economic losses when they spread into recreational areas, tourist villages, ports and coastal cities. This makes this pest a real environmental, hygienic and economical problem.⁹ Recently, the prevalence of bed bugs has seen a vigorous international resurgence, attributed to the increasing need of people for travelling due to education, employment or recreation, especially when targeted places were infested by this pest. Bed bugs can spread from infested areas to other areas through different means; for instance, transportation, ventilation ducts, passive dispersal through travel, and the relocation of furniture from infested areas to new locations.¹⁰⁻¹⁴

The most important steps in controlling bed bugs include conducting regular epidemiological investigations, thorough insect exploration, awareness of the concerned individuals, and thorough examination of the infested sites and adjacent areas. Additional steps include implementing protective measures, such as using chemical and non-chemical means; the eradication process must be monitored and evaluated closely.^{15,16} Due to the scarcity of previous studies on bed bugs in Jeddah governorate, it was important to carry out this study to determine the epidemiological situation of bed bug pest and the extent of its prevalence and to make scientific recommendations to control it with a scientific method which causes the least harm to humans and the environment. The present study aims to define the epidemiological investigation of bed bugs in Jeddah governorate, Saudi Arabia.

METHODS

Study area

The Jeddah governorate is located on the west coast of the Kingdom of Saudi Arabia. It lies between (latitude 29.21 North and longitude 39.7 East), in the middle of the

eastern shore of the Red sea south of the tropic of Cancer. The study included 53 neighbourhoods that were classified into the northern, central, and southern neighbourhoods.

Research methodology

The field survey was conducted, and random samples of bed bug insects were collected to identify the infected districts and to determine the degree of bed bugs infestations in Jeddah governorate from the 4th December, 2018, to the 1st May, 2019. The epidemiological investigation of bed bug prevalence in Jeddah governorate was attained using Descriptive analytical method. An electronic questionnaire was designed and distributed among the residents of Jeddah on social media; the percentage of responses was calculated and the data represented graphically.

Sample properties

An electronic questionnaire was designed and distributed among the residents of Jeddah on social media. The sample was A random stratified (1000 questionnaires) included males (36%) and females (64%), Saudi (95%) and non-Saudi (5%) persons of different levels of education. 75.5% of respondents were residing in apartments, and 16.7% resided in villas, while 5.6% lived in popular mud houses; 2.07% resided in group housing.

Statistical methods

An infestation index was calculated using how and Lee method by following the equation: Infestation index = $\frac{\text{distribution frequency}}{\text{highest distribution frequency}}$.¹⁷

RESULTS

In this current study, a total of 1000 buildings were examined; 72% of the buildings were found to be infested with bed bugs. The results have identified the most prominent neighbourhoods in Jeddah governorate, whose residents' homes were infected with bed bugs, as shown in Tables 1-3), which illustrate the degree of infestation with bed bugs from highest to lowest, respectively. The first table is for the Northern governorate; the second depicts the middle governorate and the final table shows the Southern governorate. After investigation and insect exploration, the results showed the prevalence of the insect in most of the city districts covered by this study with a varying degree of infestation, where the highest infestations were found in Al-Safa district (infestation index=1), followed by Bani-Malik, Al-Sherafiya (infestation index=0.95 and 0.85 respectively) then, Al Jamaa district (infestation index=0.76). The fewest infestations were found in Alhamra, Alandalus districts (in the North), Albghdadiya (in the Middle), King Fahad and Alqurayat (in the south) with 0.001 for each.

Table 1: Northern neighbourhoods of Jeddah.

The neighborhoods	Distribution frequency (%)	Infestation index*
Alsafa	14.3	1
Bawady	3.4	0.2
Tayba	2.3	0.2
Alsalama	2.1	0.1
Alasala	2.1	0.1
Alfaisalya	2	0.1
Alsalya	1.7	0.1
Alzahra	1.4	0.1
Almohammadya	1.2	0.1
Alhamadanya	1.2	0.1
Arabwa	1	0.1
North ubhur	0.9	0.1
Almarwa	0.9	0.1
Albasateen	0.8	0.1
Almurjan	0.7	0.04
Alshatei	0.6	0.04
Alrawda	0.6	0.04
Alkhaldiya	0.2	0.01
Alnaeem	0.2	0.01
Alnahda	0.2	0.01
Alrawaby	0.2	0.01
Alandalus	0.1	0.001
Alhamra	0.1	0.001

*Infestation index=distribution frequency/highest distribution frequency.

Table 2: Central neighbourhoods of Jeddah.

The neighborhoods	Distribution frequency (%)	Infestation index*
Bni malek	13.7	0.95
Alsharafya	12.1	0.85
Alaziziya	3.7	0.26
Alrehab	1.2	0.1
Alnaseem	1	0.1
Alsulaimanya	0.7	0.04
Mushrifa	0.5	0.03
Alsuhaifa	0.4	0.03
Alrowais	0.2	0.01
Alnakheel	0.2	0.01
Albughdadiya	0.1	0.001

*Infestation index=distribution frequency/highest distribution frequency.

The statistical analysis of the questionnaire responses, which targeted about one thousand residents in Jeddah governorate, showed that 99% of the residents had confirmed their knowledge of bed bugs and stated they had noticed it in different places, whether in their own homes or their relatives' houses (42%), or in furnished apartments and hotels (28%). Other respondents saw it in the houses of migrant workers (11%), or in public places such as mosques (5%), or in schools and hospitals (2%) (Table 4).

Table 3: Southern neighbourhoods of Jeddah.

The places	Distribution frequency (%)	Infestation index*
Aljamaa	10.9	0.76
Althaghr	5.9	0.41
Madaen alfahd	1.5	0.10
Alnozla alyamanya	1.1	0.08
Alnuzha	1	0.1
Alwazeriya	0.9	0.1
Onykish	0.7	0.04
Albalad	0.6	0.04
Prince Fawaz	0.6	0.04
Alhindawiya	0.6	0.04
Alfayhaa	0.5	0.03
Aljawhara	0.5	0.03
Prince Abdul Majeed	0.5	0.03
Almahjar	0.4	0.03
Alajaweed	0.4	0.03
Alsabeel	0.3	0.02
Muntazahat	0.2	0.01
Alqurayat	0.2	0.01
King Fahd	0.1	0.001

*Infestation index=distribution frequency/highest distribution frequency.

Table 4: The distribution frequency of types of places infested by the bed bugs.

The places	Distribution frequency (%)	Infestation index*
Homes	42	1
Hotels	28	0.7
Foreigners compound	11	0.3
Non specific	10	0.2
Mosque	5	0.1
Schools	2	0.05
Hospitals	2	0.05

*Infestation index=distribution frequency/highest distribution frequency.

Figure 1 shows the different approaches adopted by the population to get rid of the bed bugs. The results showed that 58.4% of the population used private control companies; 26.7% purchased specific bedbug pesticides from public sanitation suppliers in the market; while 13.5% disposed of infested furniture, cleaned and ensured there was good ventilation of the sites. The lowest percentage (1.4%) were those respondents who used natural alternatives such as basil, lavender oil, vinegar, red pepper powder, and hot steam.

When the population was asked about the time it took to completely eradicate the infestations after using insecticides, the majority (76.8%) confirmed this time to be between two weeks and two months; 18.4% stated that it took only one week; whereas for 4.8% of the

population, it took more than two months to be rid of the infestation. 74.6% of the people in this study reported that, for multiple reasons, they disposed of the infested furniture. Reasons for removing the items included the perception that the pest did not disappear completely and they were afraid its appearance again; feelings of disgust and discomfort created by the presence of the bugs; and fear of the furniture having been treated with the pesticides (Figure 2). The results also showed that 77.4% of the houses were re-infested one month following the date of the pest control campaign; 19.9% reported re-infestation within three months or more, whereas 2.7% reported recurrence occurred after only two weeks.

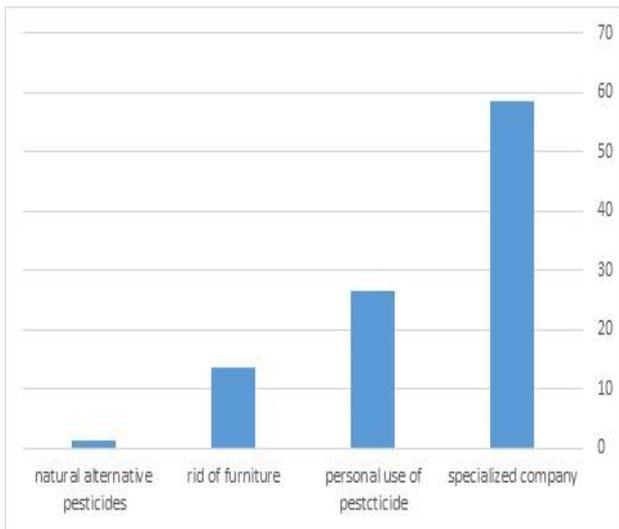


Figure 1: The methods that used by residents to control the bed bugs.

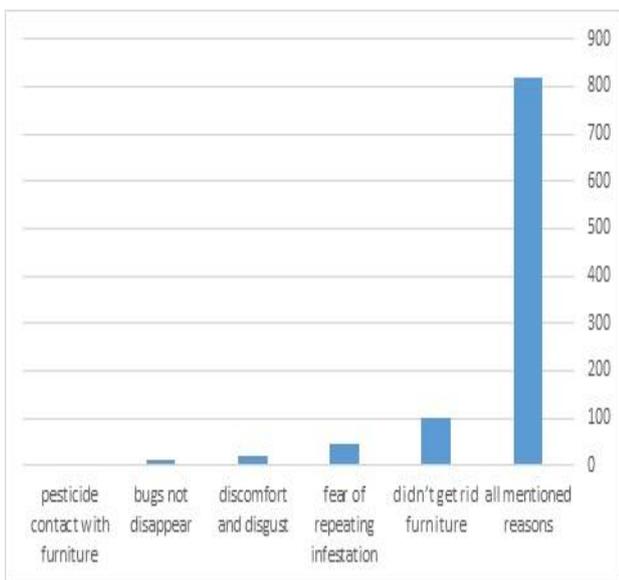


Figure 2: Reasons for respondents disposing of furniture upon detection of a bed bug infestation.

The present study concluded that 98.3% of the population agreed that bed bugs posed a real environmental problem

and a disturbing pest in Jeddah governorate and that more research was needed. 99.6% agreed on the necessity of including bed bugs in the troublesome pests and vectors of diseases that must be controlled and addressed by the relevant authorities.

DISCUSSION

Due the scarcity of previous studies on bed bugs at local levels, the results of this study were compared with previous international studies, and were consistent with studies exploring and monitoring the prevalence of bed bugs in Korea, Ethiopia, America, Canada, and others.¹⁸⁻²² The study also confirmed that 99% of people residing in Jeddah city had a good knowledge of bed bugs, and reported seeing them in their houses and other places, which matches reports of Potter and Doggett et al on the global resurgence of bed bugs since the beginning of the twentieth century.^{23,24}

The results also confirmed that there was a relation between the population density within the residential unit and recurrences of infestations by bed bugs; these were similar with the results of Doggett and Russell; Wang et al.^{25,26} Also, the results of the present study indicated that the highest districts infested by bed bugs were those with the highest population densities in Jeddah; those inhabited by a diversity of populations in terms of levels of living standards, their nationalities and of varying social habits and behaviour, including the districts in which migrant workers of various nationalities had settled or districts which had low levels of sanitation. These findings were compatible with outcomes reported by Copper and Wang et al and reflected the study of Sheele et al who had stated that bed bug infestations increased in cases of group housing.^{15,26,27} This study showed the different methods adopted by Jeddah residents whose homes were infested by bed bugs to combat this pest and the results matched findings by Copper and Harlan who recommended diversification in combating this pest, ranging from physical methods, such as suction, heating and high pressure steam, to chemical pesticide control, in addition to the study by Naylor and Boase which indicated that hot water washing was an effective way to get rid of bed bugs.^{15,28} Koganemaru and Miller, however, explained that chemical pesticides which had long-lasting effects such as Pyrethroid and Phosphorous pesticides may be effective.²⁹ 98% of Jeddah residents, who were participated in the questionnaire during the sample in this study agreed that bed bugs were a troublesome pest and a real environmental problem that needs more research and study to reach the best ways eliminate the infestations; these results were consistent with recommendations by Goddard and Meek.^{30,16} The results also showed that 99.6% of the sample population in Jeddah agreed on the necessity of including bed bugs in public health pest control programs. These findings matched many previous studies supporting the need to design integrated programs based on scientific principles to ensure safe and effective

control against the prevalence of bed bugs, and that these programs should be implemented and regularly evaluated.^{20,3,4}

CONCLUSION

The results of the study highlighted the spread of bed bugs in many neighborhoods of Jeddah, and it is therefore recommended that bed bugs are incorporated as one of the pests that need to be monitored and controlled by the relevant authorities.

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