

Bed bug (*Cimex lectularis*) outbreak: A cross-sectional study in Polour, Iran

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INTRODUCTION

According to Latreille in 1802, the *Cimex lectularis* (bed bug) insect belongs to the Cimicidae family, Cimicinae subfamily, Hemiptera order, and *Cimex* genus. This insect is also known as red stroller, brown wood, heavy dragon, and English soldier¹. These insects have no wings. They appeared 65 million years ago in the caves of the Mediterranean Sea and the Middle Eastern regions

Background: *Cimex lectularis* (bed bug) are insects abundantly found in hot, temperate areas. This study is related to the outbreak of *Cimex lectularis* in a construction site around Polour in Amol, Iran. This cross-sectional study has examined 182 prefabricated houses made of intermodal containers [Conex] converted to a temporary housing, in a construction site.

Methods: The studied population comprised 1434 men. We used a questionnaire to gather information. The bugs were collected from the floor of the room, beds, bed sheets, blankets, pillows, and mattresses in each surface meter over a fixed time with the help of forceps and a flashlight.

Results: From the 182 examined containers, 164 (approximately 90.1%) had evidence of contamination by bed bugs. From the examined people, 1243 (86.7%) had bug bites. Males between the ages of 35 to 44 (41.0 %) years had the most bites. The hands (38.3%) and abdominal area (23.7%) were the locations with the most bites.

Conclusion: The study has shown that the bugs entered the site on second hand objects such as wooden beds. Consulting health experts and training people in areas that are suspicious for these bugs can decrease the problems caused by the bites.

Keywords: *Cimex lectularis*, bed bugs, workers

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and have survived the Paleolithic, Pleistocene, and Neolithic periods. The morphological evidence and the geographical distribution of the bugs that feed on bats show that from 8000 B.C. to 5000 B.C., these bugs have gradually chosen their main host from a more stable and available community - the village farmers². Bed bugs can feed on a person for 5 minutes non-stop by piercing the skin of the victim and injecting an anesthetic before biting³. A mature female bug lays 2 to 3 eggs per day, a total

of 200 to 500 eggs during its lifetime. The stage in which an egg becomes completely mature and can oviposit is between 7 to 19 weeks, depending on the temperature of the environment. At 27°C, white, one mm eggs that resemble pearls open in less than 9 to 10 days⁴. Bugs are active during the night and blood-sucking is usually done at night, prior to sunrise, while people sleep. The two species of bugs important for human hygiene are normal bugs (bed bugs, *Cimex lectularius*) and tropical bugs (*Cimex hemipterus*). These two bugs are recognized from their prothorax which is the first part of the thorax. Bed bugs are found in houses, hotels, dormitories, prisons, canteens, hospitals, nursing homes, and other public places. These parasites hide in wall cracks, house floors, furniture, cartons, behind wallpaper, inside wooden doors and cabinets, in bookshelves, mattresses, and pillows. They are active at night in low light. When it is dark, they feed on their host who is sleeping or sitting and watching television. Although bugs have at least 25 human parasites there is still no evidence to prove the transmission of these parasites or infectious diseases such as Hepatitis B or C, or AIDS through biting. Because viruses are not multiplied in the body of bugs and in animal models, infectious diseases are not transmitted through bug bites⁵. Recently, bugs have played a role in the transmission of *Staphylococcus aureus* resistance to methicillin and *Enterococcus faecium* resistance to vancomycin in some hospitalized patients in Vancouver, Canada⁶. However, it has a small role in the transmission of diseases. The transmission of kala-azar, with the exception of its transmission through the sand fly, is attributed to bugs. Experimental evidence shows that bugs can keep *Trypanosoma cruzi* (causative agent of Chagas disease) inside them⁷. Bug bites appear as a red-colored rash on the skin. Scratching the skin causes infection and expansion of the wound⁸. Bugs bother humans and take away their comfort by sucking their blood. The bug's blood sucking causes allergic reactions along with urticaria. Additionally, they can cause asthma, exanthema, and dermatitis⁹. The most probable reason for the expansion of bug contamination is travel from contaminated countries by clothing and luggage¹⁰. In recent years, the presence of bugs in urban and rural residential places has been reported from different parts of Iran¹¹⁻¹³. However, there has been

no report of a high outbreak of bites or effects of these bites. This study examines the abundance of bites in a construction site in Polour, Mazandaran, Northern Iran.

METHODS

This survey was conducted from the beginning of June until the end of August, 2014. We investigated 182 containers in a contractor construction site with a population of 1434 men. All individuals were present in the site 24 hours per day. We used a questionnaire completed by the residents in order to gather the necessary information. The questionnaire consisted of personal questions such as age, occupation, education, living location, marital status, biting time, whether biting was during working hours or not, itching, skin redness, inflammation of skin, whether the person was bitten before, use of the bed, how many times the person had visited the doctor, and type of drugs used for inflammation and itching. The bugs were collected from the floor, beds, bed sheets, blankets, pillows, and mattresses in each surface meter over a fixed time with the help of forceps and a flashlight. The collected bugs were sent to Kashan Medical Science University, Environmental Health Department Laboratory in glass containers in 70% alcohol. The bugs were identified after examination under a stereomicroscope using Furman and Catts identification keys¹⁴. We extracted and categorized the data from these questionnaires. Frequency tables were used to summarize the findings.

RESULTS

We examined all 182 containers and the people who resided in the construction site around Polour, Mazandaran, Iran for contamination caused by the bugs and their problems. From 1434 residents, 1243 (86.68%) had evidence of bug bites. The bugs sucked the blood from the workers of this site. Workers were divided into five groups according to their ages, from 15 to 64 years old. We observed the highest abundance of bites among the group between 35-44 (41.0%) years of age. The lowest abundance of bites was among the group 15-24 (3.4%) years of age (Table 1). As seen in Table 2, the most bites were located on the hands (38.3%), abdomen (23.7%), dorsum (17.1%), feet (14.4%),

neck (3.9%), and face (2.6%). All who were bitten had inflammation and redness of the skin. From the 1243 people who were bitten, 180 were bitten during the day when they were at rest. The other 1063 people worked during daytime hours and rested at night. A total of 957 had not been previously bitten. The other 286 people had been bitten for the second time. There were 172 people who visited the doctor once, 302 people went twice, and 769 people visited the doctor three times or more. A total of 295 people used 1% dexamethasone ointment to alleviate their itching, 895 people received muscular injections of dexamethasone, and the other 53 had not used any medications. The people who had less irritation were cured by the application of 1% dexamethasone ointment, whereas those with strong irritations were cured by the injection of dexamethasone. We collected 163 samples of viable and nonviable bed bugs after spraying. These bugs were determined to be normal bed bugs according to the Entomology Laboratory (Figure 1). People who were bitten experienced itching, redness of the skin, papules, vesicles, and sleeplessness (Figures 2 to 4). The affected individuals were impatient and aggressive because of severe itching. After recognizing the exact reason for the contamination, all of the containers and beds were sprayed with Carbaryl or Sevin insecticide wetttable powder at a 1% suspension. Spraying was repeated after 15

days. All bed sheets and blankets were carefully removed from the contaminated area and washed. The results showed that spraying completely eliminated the contamination caused by these bugs. There were no additional reports of blood sucking. It was determined that all the beds were secondhand wooden beds bought from Qom, Iran.

DISCUSSION

The main host of *Cimex lectularius* (Hemiptera: Cimicidae) is human. However, if this bug does



Figure 1. The bugs collected from containers and beds.



Figure 2. Redness and papules caused by bug bites and blood sucking on the thigh.

Table 1. Distribution of the abundance of bites and blood sucking by bed bugs in residents of the construction site according to age.

| Age group (years) | Bite | | Total |
|-------------------|-------------|------------|------------|
| | Yes (%) | No (%) | |
| 15-24 | 42 (3.4) | 16 (8.4) | 58 |
| 25-34 | 412 (33.1) | 51 (26.7) | 463 |
| 35-44 | 510 (41.0) | 42 (21.9) | 552 |
| 45-54 | 181 (14.6) | 56 (29.3) | 237 |
| 55-64 | 98 (7.9) | 26 (13.6) | 124 |
| Total (%) | 1243 (86.7) | 191 (13.3) | 1434 (100) |

Table 2. Distribution of the abundance of bites and blood sucking by bugs in residents of the construction site according to age and location.

| Age group (years) | Bite site | | | | | | Total (%) |
|-------------------|------------|------------|------------|------------|----------|----------|------------|
| | Feet | Abdomen | Dorsum | Hands | Face | Neck | |
| 15-24 | - | - | - | * | - | * | 42 (3.4) |
| 25-34 | * | * | - | * | * | * | 412 (33.1) |
| 35-44 | * | * | * | * | * | - | 510 (41.0) |
| 45-54 | * | - | * | * | - | * | 181 (6.14) |
| 55-64 | * | * | * | * | - | - | 98 (7.9) |
| Total (%) | 179 (14.4) | 295 (23.7) | 212 (17.1) | 476 (38.3) | 32 (2.6) | 49 (3.9) | 1243 (100) |



Figure 3. Redness and papules caused by bug bites and blood sucking on an arm.



Figure 4. Redness, papules, and vesicles caused by bug bites and blood sucking on the hand.

not find its main host, it can also feed on birds and bats¹⁵. The results of this survey have shown that in case of suitable conditions, bed bugs can bite humans, suck their blood, cause irritation, and psychological. Bug bites can also cause problems in the daily activities of the bitten person. According to the results of our survey, 86.7% of the workers have been attacked by bed bugs. This report has shown that the bugs are arthropoda and should be considered hygiene problems at any time, despite the use of different pesticides and hygiene methods. Iran, like other countries, is not safe from this pest.

These insects can travel long distances in clothing, luggage, and furniture where they remain viable and cause contamination. Therefore, the immigration of people from contaminated areas should be considered as warning sign, because it may cause an outbreak¹⁶. A survey conducted by May has indicated that the number of attacks doubled in San Francisco from 2004 to 2006. He stated that the main reason was the inhabitation of travelers from other countries in hotels in San Francisco¹⁷. Moore and Miller believed that eradication of bugs from contaminated areas

was one of the most important challenges due to resistance of these insects to insecticides¹⁸. Lu stated that low income families with more than four children were more likely to be attacked by bugs^{19,20}. In the present study, the contamination rate was considerably high. Boase *et al.* showed that bugs (75%) were one of the most important house pests in Britain²¹. In recent years, there are fewer reports of bed bug bites in humans due to improved hygiene. In recent past decades, fewer reports of these arthropods accompany humans because of pesticide use. Boase and Krueger's studies both showed that in developed countries the reports of contamination by bugs declined and have been eliminated because of the improvements in hygiene and poisons that remained in the environment^{22,23}. Before 1999, the contamination with this insect was ten times more common than 2006 in the US and Great Britain²¹. Few studies have been undertaken on these bugs in Iran. Dehghani *et al.* examined an outbreak of these bugs in 1998 in villages west of Kashan. Out of 495 houses in 10 villages there was 6.7% contamination^{12,24}. In that year, the National Association of Managing World Pests announced the contamination in New York at 6.7%²⁴. Shahraki *et al.*, in 2000, examined an outbreak of bugs in university dormitories among 180 boys and 145 girls in Yasuj, Western Iran. They reported 28.9% contamination which approximated the current study after taking into consideration that the numbers of individuals were not close to our study¹¹. Haghi *et al.* reported that in Bahman Amir, Mazandaran, Iran most bugs were found in bedrooms (56.54%), living rooms (31.25%), and kitchens (8.59%). This finding has shown that bugs mostly lived in areas with easier, more available access to hosts¹³. Methods to decrease the danger of contamination by bugs have included cohesive traps, pesticides by professionals²⁵, regular examination, and attention to hygiene²⁶. Adjustment of the room temperature, eliminating bird nests that live in the surroundings, restoring walls and the floors, and the restoration of old furniture are among other methods of prevention²⁷.

The results of this study have shown that bed bugs can be considered both urban and rural pests in households or sleeping areas of workers or farmers. They can harm people and decrease their working efficiency, in addition to causing skin problems or other difficulties. Therefore, people should

pay attention to hygiene when using secondhand wooden furniture and examine them carefully prior to use. The beds and furniture can be put in the sunlight for a number of days. Insecticides such as pyrethroid compounds can be used for control. People who work in contaminated areas can use ointment on their skin to stop bites and blood sucking from bed bugs.

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