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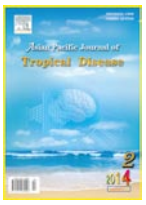

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Prevalence of bed bug (*Cimex lectularius*) in human settlement area of Bahnamir, Iran

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ABSTRACT

Objective: To survey the factors concerning with bed bugs epidemiology among human settlement area of Bahnamir, Iran in 2012-2013.

Methods: Bed bugs were collected from 500 households which lived in eight villages in suburban areas. After random cluster classification, we checked their houses to collect information on presence of bed bugs. When bed bugs infestation revealed, they were preserved in properly labeled specimen containing 70% alcohol. Bugs were transferred to the Faculty of Health and identified by stereomicroscopy. A questionnaire was filled by the owners. The recorded data were coded and analyzed statistically using the *Chi*-square test.

Results: In the study area, 14 from 500 families were infested by bed bugs which revealed almost 2.8% of infestation in that area. Five infested villages had shown 62.50% infestation. From the total of 256 caught bugs, 56.45%, 31.25%, 8.59%, and 3.91% was separated from bedroom, setting room, kitchen and other parts of the infested houses, respectively. Regarding to 256 trapped bugs in the bedroom, 33.2% were immature (nymph) and 66.8% were mature.

Conclusions: The results illustrated the role of education and guidance of the owners towards improving personal hygiene and public health with using insecticides to control by professional persons, not using secondhand instrument in the home and washing sheets and blankets and drying on suitable hot drier in order to reduce the infestation rate of bed bug among human settlement.

1. 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 sucking/piercing mouthparts, known as beaks. Anatomically, a beak consists of the labrum extending ventrally, anteriorly to the labium (which ventrally encloses the long, pointed maxillae and mandibles). Bed bugs are parasites of bats, birds, or humans. Twelve genera are strictly associated with bats, one genus with bats and humans, one genus with bats, humans, and birds, and ten genera strictly with birds[2].

Bed bugs and their relatives are wingless, blood-feeding parasites of animals. The common bed bug (*Cimex lectularius*) is a pest of humans. This species has recently become a problem in the countries all over the world[3]. In recent years, bed bug infestations have been increasingly reported in the United Kingdom and other countries, such as Denmark, Norway, Sweden, Switzerland, Australia, and the United States[4-8]. The reason for this increase is unknown. However, several factors such as an increase in international travel, reduction in the use of residual insecticides indoors, and insecticide resistance, may be contributing to the resurgence[9]. Bed bugs tend to gather together in hidden and undisturbed places where a person sleeps, or sits for an extended period of time[10-12]. They are usually found

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in the bed, along the seams and sides of the mattress and box spring, the headboard, and bed frame[13]. Bed bugs must bite to feed on blood. They have pointed mouth parts and feed for a few minutes at a time. The most common symptom of bed bug bites is itchy welts on the skin of most bites and may develop secondary infections through scratching[14]. Clinically, reactions to bed bug bites vary from unapparent, or small (<5 mm) maculopapular lesions to large wheals (2-6 cm); other reactions include bullous rashes, dermatitis, and asthma[15]. The most likely reason for the recent bed bug spread is increased world travel, especially from commonly-infested countries. Bed bug resistance to insecticides along with targeted insecticides (*i.e.*, cockroach baits) also likely played a role. Bed bugs possibly did not entirely disappear from developed countries, but were limited to poultry houses. Movement from poultry to humans also could have spread bed bugs, which is genetically supported by mitochondrial DNA analysis[2]. Recently, bed bugs have been implicated in the transmission of methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant *Enterococcus faecium* in some patients hospitalized in Vancouver, Canada[16]. Pesticides alone, or the use of any single method, will not eliminate bed bugs. The following steps are needed for effective bed bug control: accurate identification to be sure it is a bed bug and not another pest, identification of the source, cleaning and organization of the living area, bagging and removal of bedding and clothing from the affected area, washing sheets and blankets and drying on hot setting, careful and targeted use of insecticides[17]. Residents should not attempt to do their own pest control. Bed bugs are developing resistance to pesticides used against them. When bed bugs appear in a communal living facility, it is best to hire a pest management professional and work closely with their technician to manage bed bugs safely and effectively[18]. Adult bed bugs live for 6 to 12 months and are able to survive a year without feeding. Female bed bugs lay on average five eggs per night which hatch within a couple of weeks. Bed bugs are present in both tropical and temperate zones, mainly in dark environments with an availability of warm blooded hosts. Bed bugs pierce the skin of the victim and inject a chemical that numbs the area before biting, allowing uninterrupted feeding up to 5 min[19]. The Mazandaran Province, located in the north of Iran, due to its humidity and dense population provides proper condition for multiplication of the bed bug. Since contamination to the bed bug is a good indication of public unhygienic condition, determination of infestation and the prevalence could be a proper health index of the society. The epidemiological study could determine the contamination condition and its relationship with the environmental circumstances. This study was designed and performed in order to determine the bed bug prevalence rate and the effective factors in the home in the Bahnamir City, north of Iran, during 2013. The aim of this study was to find data to control the problem in the home across Iran.

2. Materials and methods

Bed bugs were collected from 4th April-23rd September, 2013, twice a month. In each of the 8 suburban areas, the 500 selected households after cluster classification were selected randomly to collect information on presence of bed bugs. Prior consent of the household heads was taken for the inspection of their housing units. Bed bugs were checked by searching mattresses, cracks and crevices of walls and furniture (settees, armchairs and cane chairs). When bed bugs were present, they were handpicked using rubber hand gloves and broomsticks. The bed bugs were preserved in properly labeled specimen containing 70% alcohol. Bugs were transferred to the Faculty of Health and identified under a stereomicroscope. Bed bug identifications were based on the key of Furman and Catts[20]. A questionnaire was filled by the household heads. The data were on residence, homeownership, number of people in the house and *etc*. The recorded data were coded and analyzed statistically using the *Chi*-square test.

3. Results

In the study area (Bahnamir), there were 16 villages with 5 485 family population. We collected 500 families from 8 villages which included 3 235 family population of the Bahnamir area. A total of 14 from 500 families were infected with bedbug which revealed almost 2.8% of infection in that area (Table 1). Five infected villages had shown 62.50% infestation with bedbug. In the area, most infected villages were Arbkhil, Kaleh, and the lowest infection villages were Darabdin and Galeshkola, and Bazar Sar (Table 2). From the total of 256 caught bugs, 56.45%, 31.25%, 8.59%, and 3.91% was separated from bedroom, setting room, kitchen and other parts of the infested houses, respectively. All trapped bugs in the infected houses lived inside of the hole, gap and wooden walls and ceilings. They were even trapped from inside of the electrical key powers (Table 3). From 256 trapped bugs, 33.2% were immature (nymph) and 66.8% were mature ticks; the highest number of immature bugs (nymph) was trapped in the bedroom. The relationship between social factors and bugs infection are mentioned in the Table 4. All the 14 infested bedbug families owned and lived in their houses. The population of 78.56% families were more than 4 person and 85.71% traveled to infestation area. About 64.28% families didn't use hot drier for blanket and 85.71% used insecticide spray to control bedbug. About 78.57% families did not use the professional person to control infestation and 71.42% used secondhand instrument in the home (Table 4).

Table 1

Number of family infested with bed bug in different areas of Bahnamir, Mazandaran Province, Iran.

Area	Number of family	Prevalence (%)
Arabkhail	90	35.15
Kaleh	55	21.48
Bazar Sar	40	15.62
Galeshkola	41	16.01
Darabdin	30	11.74
Total	256	100.00

Table 2
Bedbugs infection in different areas of Bahnamir, Mazandaran Province, Iran. *n* (%).

Area	Positive	Negative	Total family
Arabkhail	4 (6.66)	56 (93.34)	60
Balamahaleh	0 (0.00)	40 (100.00)	40
Bazar Sar	2 (2.22)	88 (97.78)	90
Aghozin	0 (0.00)	45 (100.00)	45
Darabdin	2 (2.63)	74 (97.37)	76
Kaleh	4 (5.00)	76 (95.00)	80
Helibagh	0 (0.00)	60 (100.00)	60
Galeshkola	2 (3.33)	58 (96.67)	60
Total	14 (2.80)	486 (97.20)	500

Table 3
Bedbugs collected from different parts of houses in Bahnamir, Mazandaran Province, Iran. *n* (%).

Parts	Number of nymph	Number of adult
Kitchen	7 (8.23)	15 (8.77)
Sitting room	27 (31.76)	53 (30.99)
Bedroom	48 (56.47)	96 (56.14)
Other parts	3 (3.52)	7 (4.09)
Total	85 (100.00)	171 (100.00)

Table 4
The relationship between social factors and prevalence of bedbug infestation in Bahnamir, Mazandaran Province, Iran.

Factors		Number of infestation	Prevalence %
Residence	House	14	100.00
	Apartment	0	0.00
Home ownership	Rent	14	100.00
	Own	0	0.00
Number of people in the house	1	1	7.14
	2		
	3		
	4	11	78.57
	More than 4	2	14.30
Travel certain places	Yes	12	85.71
	No	2	14.28
Washing sheets and blankets	Yes	5	35.71
and drying on hot setting	No	9	64.28
Use insecticides for control	Yes	12	85.71
	No	2	14.28
Use secondhand instrument	Yes	4	28.57
	No	10	71.42
Control with professional	Yes	1	7.14
person	No	11	78.57
	No control	2	14.28
Your neighbor is infested	Yes	0	0.00
	No	14	100.00

4. Discussion

Despite the improvement of the hygienic level of the society, bed bugs infestation still remained health concern in the poor and the developing countries[5,21,22]. In the present study, the prevalence of bed bug in the studied regions was about 2.8%. During the survey of 6 months, a total of 500 families were examined for bed bug infestation. Overall, 14 (2.8%) of the total family were infested with highest infestation in Arabkhail (6.66%) and Kaleh (5.00%) followed by Galeshkola (3.33%), Darabdin (2.63%), Bazaar sar (2.22%).

The low rate of infestation could be due to the proper health from prompt treatment by people in the region. Similar studies from different regions of Iran and other countries reveal the presence of bed bug as follows: Kashan (6.7%), New York (6.7%)[23]. Bed bugs were once a common public health pest worldwide, with estimates of up to 75% of homes in Britain infested[24]. In developed nations, the incidence declined through improvements in sanitation and increment in use of residual insecticides, so infestations became a rare event. However, this downward trend is now starting to reverse globally. There have been recent reports of an increase in bed bug numbers[25,26]. Some areas in Britain and the United States have reported a tenfold increase since 1999[21,24,26,27]. The maximum number of bed bugs was collected from bedroom followed by sitting room and kitchen and other parts. This reflects the fact that the more bugs live in the areas which have easily access to the host. The results of the study had revealed that more than 85.71% of infected families were announced that the source of their pollution may travel to infected areas which reported by Australian Bugs Control Center[24]. Bed bugs can also travel longer distances by being transported by humans in clothing, luggage, or furniture; this is called ''passive dispersal.'' Hence, the rapid turnover of residents' uncertain locations is a risk factor for bed bug infestation. Furthermore, overcrowding and deprived conditions are factors that facilitate the bedbug burden. Finally, the infestation risk reflects rapid turnover and high human density but not specific geographic areas or climatic conditions[28,29]. Additionally, from 2004 to 2006, the reported number of infestations doubled in San Francisco. Many of these cases were noted by travelers staying in "upscale hotels"[30]. Bed bug eradication from an infested site is a challenge. Insecticide resistance has been demonstrated experimentally and is an increasing problem[31]. Our findings do suggest other potential health disparities that could result from this distribution of infestation. For example, in low-income housing, more infestations may augment the burden of pesticide exposure. While, families with four children and more were at elevated risk, and they did report a high prevalence infestation[32,33]. The reason for bugs infection was that the owners recruited unprofessional persons to combat the bugs (also resistance to pesticides has observed). Our findings showed high prevalence of infection observed in four children families. Also, similar results have been reported by other researchers[32,33]. Some methods can minimize the risk of infestation or expansion: attractive traps, use of pesticides, recruiting of professional person, regular inspections, hygiene procedures, and general education of the population. Complementary measures include modifying room temperature, destroying nearby bird habitats, eliminating peeling paint and plaster, and caulking cracks and crevices in walls and furniture[29,34-36].

Conflict of interest statement

We declare that we have no conflict of interest.

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