Original Article

Assessment of Knowledge, Attitude and Practice of Inmates, Prison Staff and Soldiers Regarding *Cimex lectularius* (Hemiptera: Cimicidae) in Mazandaran Prisons

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Abstract

Background: Bed bugs (*Cimex lectularius*) are blood-sucking insects that bite humans usually at night and cause nuisance, psychological and social problems. These insects are considered a health hazard in densely populated places such as prisons. The aim of this study was to evaluate the knowledge, attitude and practice of inmates, soldiers, and prison staff regarding bed bugs in Mazandaran prisons.
Methods: This is a descriptive-analytical study in which 450 inmates and 210 staff (105 personnel and 105 soldiers) from prisons of Mazandaran Province were included in the study. Data on knowledge, attitude, and practice of the participants regarding bed bugs were collected using a structured questionnaire. To determine the relative content validity coefficient, the questionnaire was assessed by 10 specialists in terms of difficulty, inappropriateness, and ambiguity of the phrases. The reliability of the questionnaire was measured using Cronbach's Alpha and then the data were analyzed using SPSS software version 20.
Results: The maximum mean scores of knowledges, attitude, and practice between the three target groups were 16.42%, 44.07% and 71.21% respectively. Prison staff had the highest knowledge and practice, and inmates showed the highest attitude regarding bed bugs. There was no significant difference between the knowledge and attitude of inmates, prison staff and soldiers (P> 0.05) but there was a significant difference in their practice (P< 0.05).
Conclusion: Results of this study confirmed that all three groups of people in the prisons need appropriate education regarding all aspects of bed bug including its control.

Keywords: Bed bug; Prison; *Cimex lectularius*; Knowledge, attitudes, and practices (KAP); Iran

Introduction

Bed bugs are blood-sucking arthropods belonging to the order Hemiptera (which represents 'true bugs'), the family Cimicidae, and the genus *Cimex* (1). Bed bugs (*Cimex lectularius*) have been associated with human life for millenia as from fossil remains in ancient Egypt; we know that they troubled humans in their sleep for at least 3550 years (2–4). Historical evidence shows that by living in villages and cities, bed bugs have been dispersed all over the world (5). Bed bug infestation has been reported in the past decade from almost

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all continents (6, 7). In Iran, bed bug infestation is reported in recent years in almost all provinces (8, 9).

Bed bugs are active nocturnal insects and need several blood meals for their development (10). Bed bugs hide under and inside mattresses, pillows and other bedding, sofas and furniture, seams and cracks in walls and floors, etc. (11, 12). The main factors that attract bed bugs to the host are human body heat and carbon dioxide, although different types of host chemicals, especially lactic acid, play a role in attractiveness (13). The first sign of bed bug infestation is itching because of bite followed by papules or macules. People who do not react to the bite, blood spots can be seen on their bed and clothes (14). Bed bugs are not vectors of any specific diseases, but they can cause problems such as anemia in children due to excess blood-feeding (15, 16). Other problems associated with bed bugs infestation include stress, anxiety, sleeping disorders and social stigma (17, 18). Bed bugs infestation transcends social and economic status (19).

One of the reasons for the increase in the prevalence and infestation of bed bugs is the increase in international trade and travel, migration, population density as well as the very important issue of insecticide resistance (4). Public health officials and the US Environmental Protection Agency declared bed bugs a major public health pest in 2010 (20). Eradicating bed bugs from an infested site has become a costly and time-consuming challenge due to the potential ability of bed bugs to hide and their resistance to insecticides (19, 21, 22). Lack of public knowledge about this insect, especially in places with high population such as prisons, dormitories, and barracks is another factor in the spread of the insect (20). Therefore, it is necessary to provide training to increase the level of knowledge, attitude, and practice of people in the field of morphology, biology, and understanding of behavior and control of bed bugs (21, 22).

In the prisons of Mazandaran Province, due to high population density, bed bugs are considered a health problem. Since there is no study on the knowledge, attitude, and practice of people towards bed bugs in the province, this study aimed to assess these among inmates, staff and soldiers in Mazandaran Province prisons. This data can be useful for the prisons and health authorities in planning and implementing appropriate control measures.

Materials and Methods

Study area

Mazandaran Province is located between 34° 47′ to 38° 5′ North latitude and 50° 34′ to 56° 14′ East longitude with a population of about 3,283,582 million and an area of 24,000 square kilometers. At present, the province has 22 counties and Sari is its capital. In this study, nine prisons in different cities of the province were selected and studied. The largest and smallest prisons were Nedamatgah and Sari, respectively. Noor, Nedamatgah, Nowshahr and Tonekabon prisons are situated in coastal counties and Behshahr, Sari, Babol, Amol and Ghaemshahr prisons are in non-coastal areas (Fig. 1).

Data collection and practice

This descriptive-analytical study was conducted using a researcher-made questionnaire that posed to the inmates, prison staff and soldiers regarding *C. lectularius* in Mazandaran prisons in northern Iran. The study was carried out from July 2015 to November 2017. It should be noted that due to the principle of confidentiality, the name of each prison was coded from A to I. A total of 34 questions in three groups of knowledge (10 questions), attitude (13) and practice (11) were developed based on various sources and literature in the field of bed bugs. The maximum score for the three target groups was 35 in knowledge (range 10–35), attitude 65 (13–65) and practice 42 (11–42). Likert scale was used for scoring the knowledge and attitude section (1–5) and prac-

tice (0–7). To standardize and validate the questionnaire, qualitative evaluation was performed using an expert panel and quantitative evaluation was performed using content validity ratio (CVR) and content validity index (CVI). After validity evaluation, the questions were corrected with CVI and CVR of less than the limit. The validation process was continued until the desired CVR value of 0.62 and CVI of greater than 0.79 were achieved. Cronbach's alpha method was used to confirm the reliability of the questionnaire using

$$\alpha = \left(\frac{k}{k-1}\right)\left[1 - \frac{\sum_{i=1}^{k} \sigma_{i}^{2}}{\sigma_t^2}\right]$$ formula. Where k is

the number of items in a scale σ_i^2 is the variance of ith item σ_t^2 is the variance of the scale (total) scores.

Before the interviewees were posed the questionnaires, they were informed about the research and assured them of the confidentiality of their details. The questionnaires were completed by the inmates, staff, and soldiers under the supervision of the project manager at each prison. The number of questionnaires allocated to different groups (inmates, prison staff and soldiers) at each prison is shown in table 1.

Statistical analysis

The data were entered into Excel software and were retrieved by SPSS software version 20. The mean and standard deviation of knowledge, attitude, and practice were calculated by non-parametric Kruskal-Wallis test. The Mann-Whitney test was also used to analyze the results of the post-test in each prison. Bonferroni correction was used to prevent the increase of type I error.

Results

In this study, 660 questionnaires were completed by 450 inmates, 105 staff and 105 soldiers and analyzed as shown in table 1. Cronbach's alpha coefficient of 0.82, which indicates a good reliability of the questionnaire.

The Kruskal-Wallis test revealed that there was no significant difference in knowledge and attitudes between inmates, staff, and soldiers about bed bugs in Mazandaran Province while the differences between their practice was significant. The mean knowledge scores were recorded 16.68%, 16.97% and 15.6% for inmates, staff, and soldiers, respectively. It was 44.86 %, 44.01% and 43.36% for attitude and 71.02 %, 72.94% and 69.67% for practice of inmates, staff, and soldiers, respectively. In comparison between the three target groups, staff had the highest mean level of knowledge and practice, and inmates had the highest mean level of attitude. In general, the maximum mean scores of knowledges, attitude and practice for the three target groups were 16.42, 44.07 and 71.21%, respectively (Table 2).

The results of the Mann-Whitney test assess the differences in the level of knowledge, attitude, and practice of the three target groups in each prison are shown in table 3. Prisons E and F showed a significant difference with more prisons in terms of inmates' knowledge, while in terms of attitude, only prison I differed significantly with a larger number of prisons.

There was a significant difference in the comparison of knowledge between the staff of prison an and in the comparison of the attitude of the staff of prisons A, E and F with many other prisons.

According to table 3, the knowledge of soldiers in prisons A and their attitudes in prisons A and I showed a significant difference with more prisons. However, this statistical difference was evident in the practice between inmates, soldiers, and staff in all prisons except prison E compared to prison I.

Table 1. Allocation of the questionnaire to different groups at prisons in Mazandaran Province

Code of prisons	Inmate	Soldier	Prison staff
A	40	10	10
B	65	14	14
C	85	20	20
D	45	10	10
E	65	15	15
F	40	10	10
G	25	6	6
H	40	10	10
I	45	10	10
Total	450	105	105

Table 2. Significance level of knowledge, attitude and practice between inmates, staff, and soldiers in the prisons of Mazandaran Province, 2017

Variable	Study group	Mean ranks	Mean (%)	Standard deviation	Confidence interval (%95)		P-value
					upper	lower	
Knowledge	inmates	339.46	16.68	1.79	5.67	6.01	0.06
	staff	298.44	15.6	1.78	5.12	5.8	
	soldiers	343.75	16.97	1.61	5.64	6.25	
Attitude	inmates	331.02	44.86	4.73	27.72	28.6	0.10
	staff	326.38	43.36	4.81	27.72	29.1	
	soldiers	350.97	44.01	4.52	27.75	29.48	
Practice	inmates	356.01	71.02	2.79	62.7	79.35	<0.001
	staff	295.75	69.67	1.36	67.04	72.3	
	soldiers	362.35	72.94	1.61	68.64	77.35	

Fig. 1. The location of the counties (marked in blue) and the prisons (marked in red) in Mazandaran Province in the present study

Table 3. Comparisons of the significant level of knowledge, attitude, and practice of individuals between prisons (I-A), 2017

Prison	Comparison	Inmates			Staff			Soldiers		
		Knowledge	Attitude	Practice	Knowledge	Attitude	Practice	Knowledge	Attitude	Practice
A	B	<0.001	-	<0.001	-	-	<0.001	<0.001	<0.001	<0.001
	C	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	0.002	<0.001
	D	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	-	<0.001
	G	-	<0.001	<0.001	-	<0.001	<0.001	0.007	<0.001	<0.001
	H	<0.001	-	<0.001	<0.001	-	<0.001	0.007	-	<0.001
	I	-	<0.001	<0.001	<0.001	<0.001	<0.001	0.015	<0.001	<0.001
B	C	<0.001	<0.001	<0.001	0.046	<0.001	<0.001	-	-	<0.001
	D	-	<0.001	<0.001	-	<0.001	<0.001	-	-	<0.001
	G	0.002	<0.001	<0.001	0.04	<0.001	<0.001	-	<0.001	<0.001
	H	-	-	<0.001	-	-	<0.001	0.006	-	<0.001
C	G	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.035	<0.001	<0.001
	H	<0.001	<0.001	<0.001	-	<0.001	<0.001	0.044	0.005	<0.001
	C	<0.001	0.005	<0.001	-	0.024	<0.001	-	-	<0.001
D	G	<0.001	<0.001	<0.001	0.003	0.042	<0.001	-	0.031	<0.001
	H	-	-	<0.001	-	-	<0.001	-	-	<0.001
E	A	0.002	-	<0.001	0.031	-	<0.001	<0.001	-	<0.001
	B	0.047	-	<0.001	-	-	<0.001	0.006	-	<0.001
	C	<0.001	<0.001	<0.001	-	<0.001	<0.001	-	0.012	<0.001
	D	<0.001	<0.001	<0.001	-	<0.001	<0.001	-	-	<0.001
	G	-	<0.001	<0.001	0.015	<0.001	<0.001	-	<0.001	<0.001
	H	0.002	-	<0.001	-	-	<0.001	-	-	<0.001
	I	0.002	0.002	-	-	<0.001	-	-	<0.001	-
F	A	0.007	-	<0.001	-	-	<0.001	-	-	<0.001
	B	-	-	<0.001	-	-	<0.001	0.004	-	<0.001
	C	<0.001	<0.001	<0.001	0.005	0.035	<0.001	0.005	0.003	<0.001
	D	0.007	<0.001	<0.001	0.019	0.002	<0.001	-	-	<0.001
	E	-	-	<0.001	-	-	<0.001	-	-	<0.001
	G	-	<0.001	<0.001	-	<0.001	<0.001	-	0.001<	<0.001
	H	0.011	-	<0.001	-	-	<0.001	-	-	<0.001
	I	0.006	<0.001	<0.001	0.002	0.011	<0.001	-	<0.001	<0.001
G	H	<0.001	<0.001	<0.001	0.022	<0.001	<0.001	-	<0.001	<0.001
H	B	<0.001	0.017	<0.001	0.031	<0.001	<0.001	<0.001	<0.001	<0.001
	C	<0.001	<0.001	<0.001	-	-	<0.001	<0.001	<0.001	<0.001
	D	<0.001	<0.001	<0.001	-	-	<0.001	-	-	<0.001
	G	-	0.001	<0.001	0.002	0.001	<0.001	-	0.001	<0.001
	H	<0.001	0.001	<0.001	-	0.001	<0.001	-	0.001	<0.001

Discussion

Bed bugs are ectoparasites with potential medical and public health hazards. In general, knowledge, attitude and practice studies are performed with the aim of educating the community and applying appropriate strategies to reduce the bed bug infestation rates in vulnerable communities (23, 24). Since there are no studies on knowledge, attitude, and practice on bed bugs in the country especially prisons, the present study was undertaken for the first time to determine the level of knowledge, attitude, and practice of inmates, soldiers, and staff on bed bugs in Mazandaran Province prisons.

In the present study, all target groups had the same level of knowledge and attitude towards the bed bugs. However, this significant difference was evident when the level of knowledge of the individuals in each prison compared to other prisons (P< 0.05). Probably performing different programs to increase the level of knowledge of individuals by the health expert in these prisons caused the statistical difference. In addition, factors such as prisons population, the presence of health experts in prisons, education and age of individuals can also be effective in the significance of knowledge differences of individuals in prisons. Perhaps it can be explained that educated people are expected to have more knowledge than illiterates, and this can directly reduce the amount of infestation in each prison section. In agreement with the present study, in a study conducted by Kaylor et al. (25) in private homes in the United States, about half of the people stated that their behavior has changed due to increased knowledge, and this has led to a decrease in infestation rates in their homes. It is important to note that a higher level of knowledge is one of the most important social factors in the health sector and can play a significant role in public health promotion measures against bed bugs. Seidel et al. (26) believed that even showing bed bugs to people could help improve their knowledge. In the present study, in comparisons between groups,

even though the soldiers were in prisons for two years, they showed less knowledge than the inmates and staff. Probably gaining long-term experience and paying attention to the training provided, can be an important factor in increasing the knowledge of the staff and inmates about bed bugs and the reason for this difference. Another reason could probably be that, because bed bugs are more common in places such as student dormitories, prisons, and barracks with high population density compared with residential homes, so people who live or work in these places can have more exposure and knowledge. Therefore, it is necessary for health centers, educational institutions, and health authorities to educate people about the risk of bed bugs infestation in these places (23). Of course, prisons health officials, physicians, and nurses can plan and implement regular periodic training on bed bugs morphology, biology, and ecology with the help of entomologists to improve the knowledge of people in prisons.

There was a statistically significant difference in the attitude of the subjects between prisons (P< 0.05). The majority of the interviewees showed a negative attitude about the bed bugs, and most of them are afraid of the word "bed bug", and sometimes they are anxious to take the bed bugs' home. Most study subjects tended to help prisons to control bed bugs and participate in training classes. Even when the process of control is carried out in prisons, a pleasant feeling is created for the subjects. A study by Roman Ashoff et al. (27) in Germany showed that training is a key factor and affecting the belief of the students and their attitude towards bed bugs. In the pre-test, 98% of learners did not correctly identify bed bugs and had some misconceptions about the reasons for their spread. Post-test results (biology and morphology education) showed that teaching students about the bed bugs can be somewhat helpful in identifying and control-

ling bed bug outbreaks (27). In the present study, the inmates showed a higher level of attitude (44.86%) towards bed bugs, which may be due to information and training they previously received about this insect. In the studies by Kaylor et al. (25), 52% of individuals, and Alizadeh et al. (28), 92% of health care workers were concerned about bed bugs infestation and its various psychological, social, economic and health consequences. Lyons (29) reported that bed bug infestation could play a role in isolating people in the community. In the present study, individuals believed that control methods alone could not be effective in controlling bed bugs, so a combination of control measures should be used. In accordance with the present study, other researchers also believed that controlling bed bugs by combined methods such as environmental sanitation and non-chemical methods would be more effective (30, 31). Most people think that individuals with poor health and low economic status may be infected (2). But bed bugs can infest any level of society, and higher socioeconomic status does not prevent infestation of their houses. A significant number of interviewees mistakenly thought that bed bugs could cause various diseases and act as vectors of pathogens (10, 32). But so far, there is no substantial evidence on whether they can transmit pathogens to humans (10, 33). However, there are several studies that show bed bugs can cause severe skin irritation (34), severe inflammatory responses (35) and psychological stress (36).

A significant difference was recorded in the practice of individuals in most prisons. However, no significant difference was observed between the practice of individuals in prison A compared to prison I. This is because the practice of people in these two prisons were almost the same, and most of them used the vacuum cleaner and the insecticide deltamethrin as methods of controlling bed bugs. In the study of Karunamoorthi et al. (37), residents used environmental sanitation methods such as filling crevices and cracks in walls and ceilings, as well as a period of exposing the furniture to sunshine to remove bed bugs. There was a significant difference in terms of practice in most prisons in the province that may be due to several factors such as the use of various methods for controlling bed bugs according to the situation and position of those prisons. In accordance with the present study, a study in the eastern villages of Tanzania showed that the practices of individuals about bed bugs were similar. The authors reported that most of the village people were able to identify bed bugs, and at least used a control measure against them, including chemical insecticides, wash bedding and sunlight (38). They believed that the main risk associated with the chemical control of bed bugs in villages include excessive use of insecticides and use without professional guidance with irregular periods that may cause high resistance to insecticides (38). Of course, it should be mentioned that various combined methods are used in studied prisons in the province. Prisons F, B and H used fogging as they had a fog machine; prisons C and E used flame as they had proper conditions for flaming; and prisons B and E implemented vacuum cleaning method as industrial vacuum cleaner was available to them. It should be noted that the frequency of use of vacuum cleaners was different in prisons, some used daily, every three days and some weekly. Prisons of F, E and C, used sunshine method, a condition not available to all prisons. Prisons with proper sunlight conditions try to use these methods every two weeks.

In the present study, in general, participants showed lower knowledge score than attitude and practice respectively, this may root from the fact that in prisons people usually do things as dictated to them in form of imperative.

The limitations of the present study include observing maximum principles of confidentiality and gaining entrance permission only at specific times. High level of cooperation and coordination of the authorities and

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experts of prisons, designing, planning, organizing, implementing, monitoring, and training the prisons personnel the theory and practice by the executive team, holding intra-organizational sessions, availability of prisons health center with qualified and adequate personnel, were among the strengths of this study.

Conclusion

According to the results of this study, it can be expressed that bed bugs are health problems in prisons, even those who had less knowledge and negative attitude toward bed bugs, showed a positive practice in bed bug control. Therefore, reasons other than attitude and practice should be sought for low awareness to bed bugs. Since the purpose of training is ultimately behavior change, the content, and methods of health education in prisons should be thoroughly reviewed to promote the level of awareness of the inmates, staff and soldiers towards bed bugs. If the inmates, staff, and soldiers are properly trained, they can effectively remove, control, and even eradicate bed bugs by increasing knowledge and attitudes and turning it to practice. It is also suggested that the following interventions can be helpful in preventing the sustainability of bed bugs control in prison, 1) educational interventions using appropriate methods 2) implementing prevention and control strategies 3) constant surveillance and survey in each section of prisons 4) record monthly reports of infestation.

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Ethical considerations

The study was approved by the Ethical Committee of Mazandaran University of Medical Sciences (IR.MAZUMS.REC.1397.2960).

Conflict of interest statement

The authors declare there is no conflict of interests.

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