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Risk perception and preventive behaviors related to brucellosis among Iranian livestock farmers

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Abstract

Background and Aims: Brucellosis is one of the zoonotic diseases that endanger the health of the population, particularly in developing countries. This study aimed to assess risk perception and behaviors of livestock farmers on brucellosis based on PRECEDE model in a rural area in the northwest of Iran.

Methods: This was a cross-sectional study conducted with 365 livestock farmers in rural areas of Germi, Iran. Participants were selected random sampling method. Data were gathered using a PRECEDE model based questionnaire consisted of five sections including demographic characteristics, predisposing factors (knowledge and attitudes), reinforcing factors, enabling factors, and brucellosis preventive behaviors.

Results: The mean ± SD of age of participants was 47.1 ± 14.7 years. The state of knowledge about preventive behaviors and ways of disease transmission was evaluated as appropriate (with 87% and 81% of the maximum score, respectively). Three aspects of attitude in participants were desirable. Predisposing factors including knowledge of prevention ways, knowledge of transmission ways, and attitudes toward prevention, reinforcing factors, as well as education were significant predictors of brucellosis preventive behaviors. R^2 and adjusted R^2 were 0.312 and 0.310, respectively, according to which, about 31% of the changes in the brucellosis preventive behaviors explained by significant dependent variables.

Conclusions: Given that farmers are at particular high risk of exposing brucellosis, improving their knowledge and desirable attitudes of brucellosis is crucial to increasing control the disease.

KEYWORDS

brucellosis, livestock farmers, PRECEDE model, risk perception

1 | INTRODUCTION

Brucellosis is one of the zoonotic diseases endangering the health of the population, particularly in developing countries.[1,2] Brucellosis is caused by intracellular gram-negative coccobacilli which is transmitted through direct human contact with livestock, drinking or eating contaminated unpasteurized milk or cheese, and uncooked meat.[3,4]

According to World Health Organization, approximately half a million cases of brucellosis are diagnosed around the world annually.[5] A study using National data from 30 provinces of Iran has reported the mean incidence of brucellosis to be approximately 30 per 100,000 people.[6] Ardabil is one of the provinces with moderate incidence rate (11–20 per a 100,000 population).[7] At the same time, Germi County in Ardabil province has an annual incidence of 33.2 per 100,000 population, which is higher than the provincial average.[8] This rate of incidence requires that targeted studies be conducted regarding the factors affecting the behaviors related to brucellosis in this region.

The common symptoms of brucellosis include fever, night sweats, migratory arthralgia and myalgia, loss of appetite, decreased white and red blood cell counts, and increased liver enzymes.[9] The disease is characterized by spondylitis and osteomyelitis of the lumbar spine, which is caused by the concentration of brucellosis bacteria in the bones and joints.[10] In some cases, lumbar lesions due to brucellosis detected in radiological evaluation can lead to a wrong diagnosis if the examining physician is not familiar with the characteristics of Malt fever disease in endemic areas.[11]

There are several strategies to prevent the onset and control of this disease such as animals' vaccinations, disinfection of stables, extermination of infected animals, education to avoid consuming unpasteurized milk and milk derivatives.[12] Before any educational program for the prevention and control of brucellosis, an initial assessment is required, preferably based on behavioral science models and theories.[13]

The PRECEDE-PROCEED model is one of the basic models in health promotion, which has been used in the assessing a wide range of diseases and health behaviors.[14] Originally developed in the 1970s by Green et al., this model is a tool for designing, implementing, and evaluating health behavior change programs.[15] Despite the strengths of PRECEDE-PROCEED, a review of the literature shows that few studies have explored brucellosis using this model.[16,17] Until 1991, this model only included the PRECEDE section, stands for Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation. As the primary core, PRECEDE has the ability to independently assess factors related to a health behavior or outcome.[18] Predisposing factors are the basis and motivating precedent for behaviors affecting health, the most well-known of which are knowledge, attitude, and belief. Reinforcement factors are elements that support or encourage a certain behavior, the most important of which is social support from health personnel, peers, and parents. Enabling factors are factors preceding behavior that allow motivations or aspirations to be realized, such as the availability and access to community resources, individual skills, and social regulations.[15]

According to the above, this study was conducted aimed to evaluate the risk perceptions (knowledge, attitude, and beliefs) related to brucellosis affecting the preventive behaviors of livestock farmers in the rural areas of Germi, in the northwest of Iran.

2 | METHODS

2.1 | The study setting and participants

This cross-sectional study was conducted among 365 livestock farmers in rural areas of Germi, located in Ardabil province, Iran. Germi is one of the cities of Ardabil province (Figure 1), the main occupation of the people in its villages is agriculture and animal

FIGURE 1 Germi is one of the cities of Ardabil province.

husbandry, where livestock production is the main source of people's income. Based on the Cochran's formula and $d = 0.05$, the sample size for the present study was estimated to be 365. Since Germi has four districts in terms of political-geographical divisions, first, the share of each district was determined based on the population of livestock farmers. Then the questionnaire was randomly distributed among the livestock farmers in each district. The inclusion criteria were livestock farming, living in the village and completing informed consent to participate in the study. In the absence of any of these conditions, the samples were excluded from the study.

2.2 | Measurements and scoring

In this study, data was collected using a questionnaire based on the asked model. This questionnaire consisted of five parts. In the first part, demographic information was asked through 10 questions. The second part was 42 questions under the title of predisposing factors, which included several subsections; (a) knowledge: we evaluated people's knowledge with 27 questions in several sections; 10 questions about the disease transmission, seven questions about the prevention methods, six questions about the symptoms of the disease in humans (fever, weakness, excessive sweating, chills, loss of appetite, and joint, muscle and back pain), and four questions about the disease symptoms in animals (abortion, arthritis, mastitis, and lameness). Three options were provided to answer each of these 27 questions (correct answer = 3, I don't know = 2, wrong answer = 1). (b) Attitude: to measure attitude, we asked 15 questions that evaluated three attitudinal areas; 10 questions about prevention, three questions about transmission, and two questions about brucellosis patients. These questions were measured with a three-point Likert scale (3 = *agree*, 2 = *neutral*, and 1 = *disagree*). The third part was 16 questions related to enabling factors, including questions to measure the conditions and facilities related to the brucellosis prevention; for example, Brucella vaccine is available for livestock. The fourth part of the questionnaire included nine questions that measured the reinforcing factors for brucellosis prevention. These were factors that enhanced brucellosis preventive behaviors such as support from family members or colleagues and education. The questions of enabling factors and reinforcing factors were scored with a three-point Likert scale (3 = *agree*, 2 = *no opinion*, and 1 = *disagree*). We also asked 11 questions to measure brucellosis preventive behaviors, for example, I wear a mask while working in the barn, or I boil milk well before consumption. These questions were scored on a five-point Likert scale (5 = *always*, 4 = *often*, 3 = *sometimes*, 2 = *rarely*, 1 = *never*). A higher total score reflected a higher level of brucellosis-preventive behaviors. The content validity of questionnaire was measured using content validity ratio (CVR) and content validity index (CVI) through a panel of experts. This panel included experts from fields related to the study, including two epidemiologists, two infectious disease specialist, and six health education specialists. According to experts' opinions, the validity of questionnaire was confirmed with CVR of 0.90, and CVI of 0.92. Also, the internal consistency of the questions was confirmed with Cronbach's α of 0.82.

2.3 | Statistical analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS-18) and STATA-8. Descriptive statistics are presented as mean ± SD or rate (%), for the evaluation of sociodemographic data. We used multiple linear regression to determine predictors of brucellosis-preventive behaviors in which behavior was dependent variable and other constructs along with some demographic and contextual characteristics were independent variables. First, through univariate regression, the significance of the model variables in explaining preventive behaviors was examined separately, according to which the PRECEDE constructs were eligible for inclusion in the multiple regression model. Multiple linear regression was used to identify the factors related to preventive behaviors, so that the demographic variables and PRECEDE constructs entered into the stepwise model. In this study, a 95% ($p < 0.05$) significance level was adopted.

3 | RESULTS

This study was conducted with the participation of 365 people, 307 of whom were men (84.1%) and 58 were women. The mean and standard deviation of the age of the participants was 47.1 ± 14.7 years. The majority of farmers were literate (65.8%) and 34.2% were illiterate. More details on demographic and contextual variables are provided in Table 1.

The descriptive statistics of PRECEDE constructs are shown in Table 2. The results showed that the participants had a minimum level of knowledge of symptoms in humans and animals (55% and 58% of the maximum score were obtained, respectively). The state of knowledge about preventive behaviors and ways of disease transmission was evaluated as appropriate (with 87% and 81% of the maximum score, respectively). In general, the attitude related to brucellosis including transmission, prevention, and patients was favorable (with 92%, 84%, and 82% with 92%, 84%, and 82% of the maximum score, respectively). The mean score of the enabling

TABLE 1 Demographic characteristics of livestock farmers in the rural area of Germi, Iran ($n = 365$).

Variables	Subcategories	Number	Percent
Gender	Male	307	84.1
	Female	58	15.9
Education level	Illiterate	125	34.2
	1–6 grades	147	40.3
	≥7 grades	93	25.5
History of brucellosis	Yes	126	34.5
	No	239	65.5
Type of livestock	Cow	88	24.1
	Sheep and goats	277	75.9

TABLE 2 Risk perception analysis of PRECEDE model constructs and the preventive behaviors related to the brucellosis.

Variables	Range scores	Obtained scores	Percent
Predisposing factors			
Knowledge about symptoms in human	6–18	9.90 ± 2.8	55
Knowledge about symptoms in animals	4–12	7.03 ± 2.3	58
Knowledge about transmission ways	10–30	24.25 ± 3.1	81
Knowledge about prevention	7–21	18.61 ± 2.6	87
Attitudes toward transmission	2–6	5.53 ± 0.8	92
Attitudes toward patients	10–30	24.90 ± 2.4	83
Attitudes toward prevention	3–9	7.52 ± 1.3	84
Enabling factors	16–48	35.11 ± 8.2	73
Reinforcing factors	9–27	17.53 ± 5.3	65
Preventive behaviors	11–55	29.82 ± 10.22	54

TABLE 3 Multiple linear regression demonstrating predictors of brucellosis preventive behaviors.

Independent variable		Coefficient (β)	Standard error	p Value
Age		−0.072	0.025	0.322
Sex	Female	Ref		
	Male	0.045	0.112	0.625
Education	Illiterate	Ref		
	≤1–6 grades	**0.121**	**0.098**	**0.038**
	≥7 grades	**0.139**	**0.105**	**0.023**
History of brucellosis	No	Ref		
.	Yes	0.087	0.129	0.096
Type of livestock	Cow	Ref		
	Sheep and goats	0.055	0.086	0.522
Predisposing factors				
Knowledge about symptoms in human		0.036	0.062	0.830
Knowledge about symptoms in animals		0.016	0.052	0.862
Knowledge about transmission ways		**0.129**	**0.180**	**0.031**
Knowledge about prevention ways		**0.166**	**0.281**	**0.006**
Attitudes toward transmission		0.078	0.120	0.612
Attitudes toward patients		−0.065	0.089	0.722
Attitudes toward prevention		**0.103**	**0.190**	**0.048**
Enabling factors		0.092	0.141	0.065
Reinforcing factors		**0.128**	**0.112**	**0.032**
Prob >F		**0.001**		
R^2		**0.312**		
Adjusted R^2		**0.310**		

factors was 35.11 ± 8.2, which showed that the participants obtained 73% of the maximum score. Also, the mean score of reinforcing factors was 17.53 ± 5.3, which was 65% of the maximum score. The mean score of preventive behaviors was 29.82 ± 10.22, which represented 54% of the maximum score. This indicated that the participants did not have a positive performance regarding the prevention of brucellosis, despite the favorable mean scores in predisposing, enabling, and reinforcing factors.

In the regression model, R^2 and adjusted R^2 were 0.312 and 0.310, respectively, according to which, about 31% of the changes in the brucellosis preventive behaviors explained by significant dependent variables (Table 3). As shown in Table 3, amongst constructs of PRECEDE, predisposing factors including knowledge of prevention ways (coefficient = 0.166, $p = 0.006$), knowledge of transmission ways (coefficient = 0.129, $p = 0.031$), and attitudes toward prevention (coefficient = 0.103, $p = 0.048$), as well as reinforcing factors (coefficient = 0.128, $p = 0.032$), were significant predictors of brucellosis preventive behaviors. Also, education of one to seven grades (coefficient = 0.121, $p = 0.038$), and seven or more grades (coefficient = 0.139, $p = 0.023$), were significant demographic predictors of brucellosis preventive behaviors.

4 | DISCUSSION

Brucellosis is one of the most common infectious diseases transmitted from livestock which has negative socioeconomic effects on the life of the rural population. The results of the regression model in this study showed that education level, reinforcing factors, and predisposing factors including knowledge about transmission ways, knowledge about prevention ways, and attitudes toward prevention were significant predictors of brucellosis prevention behaviors.

The present study indicated that education was a significant predictor for the high score of preventive behaviors. Being literate can improve preventive behaviors through studying educational materials, and consequently increasing knowledge and changing attitudes. For example, Jahangiry et al. have reported that the knowledge and attitude toward brucellosis were significantly lower in illiterate people than in literate people.[19] Babazadeh et al. also reported that education was a significant predictor of brucellosis preventive behaviors along with knowledge, self-efficacy.[20] This issue can be a challenge from one point of view because it causes discrimination against and ignoring illiterate people in educational interventions. Therefore, it is necessary to target illiterate people in educational interventions.

The results on assessing predisposing factors revealed that farmers had a moderate level of knowledge about the symptoms of brucellosis in humans and livestock. At the same time, the state of knowledge about preventive behaviors and ways of disease transmission were appropriate, and among the subcategories of knowledge, only these two were significant in the regression model. Babazadeh et al. found that patients' knowledge about brucellosis was the strongest predictor for performing preventive behaviors.[20] Barati et al., also reported that knowledge was a significant predictor of brucellosis preventive behaviors, where a one-unit increase in knowledge score increased the mean preventive behavior score by 0.189.[21] Another predisposing factor is attitude, in this study, three attitudinal aspects were examined, and among them Attitudes toward prevention was significant in the regression model. In some studies positive and significant relationship between the attitude and behaviors of brucellosis prevention were reported.[19,20] Another study also showed that a positive attitude toward non-pasteurized foods is one of the significant determinants of brucellosis-related behaviors.[2] One benefit of the significant association between knowledge and attitudes with preventive behaviors is that they are strongly influenced by education. Many studies indicate the positive effect of education on increasing knowledge and changing attitudes about brucellosis-related behaviors.[12,22,23]

In the present study, reinforcing factors were significant predictors of brucellosis prevention behaviors. This result indicates that increasing social support from family members, providing education through the department of agriculture, as well as support and consensus of colleagues, can promote preventive behavior. Alizadeh-Siuki et al., in a study based on PRECEDE model reported a direct and significant relationship between the preventive behaviors and reinforcing factors.[16]

The results of the present study revealed that the participants did not perform well in the field of brucellosis prevention behaviors and only 54% of the maximum performance score was obtained. Risky behaviors associated with brucellosis are almost worldwide, especially in developing countries. For example, Tschopp et al., in a study reported that that all respondents from Afar and Somali regions of Ethiopia drank raw milk and discarded animal afterbirths in the direct surroundings with minimal protection.[24] A study in Tajikistan reported that a majority of the respondents did not use any protection when handling livestock having an abortion or when dealing with aborted materials.[25] The results of a study in the west of Iran also show that the majority of participants used non-pasteurized dairy products.[21] One of the effective ways to reduce risk behaviors and increase preventive behaviors is to train people especially livestock farmers. These trainings can be effective in reducing brucellosis cases through increasing knowledge, changing attitudes and beliefs, and learning skills. There are many successful examples of these trainings in Iran and the world. An educational study conducted in India reported that after education, reduction in the risk behaviors practices like raw milk consumption, assisted animal delivery without gown, and throwing animal birth products in the dustbin were statistically significant.[26] An educational intervention based on the health belief model in Iran showed that after the educational program, the scores of awareness, perceived susceptibility and severity, self-efficacy, and performance in the intervention group increased significantly.[13] This study was conducted only in livestock farmers, so it was not possible to compare with other demographic groups. The study was also based on the PRECEDE model and the possibility of examining variables outside the model was limited.

5 | CONCLUSION

Given that farmers are at particular high risk of exposing brucellosis, improving their knowledge and desirable attitudes of brucellosis is crucial to increasing control the disease. Therefore knowledge and attitude play a decisive role in reducing high-risk behaviors and increasing protective behaviors against brucellosis, but it alone does

not cause protective behavior, but strengthening the enabling factors in these people can lead to make protective behavior.

AUTHOR CONTRIBUTIONS

Shandiz Moslehi: Conceptualization; supervision. **Leila Jahangiry**: Formal analysis; validation. **Sajjad Narimani**: Conceptualization; investigation; methodology; supervision; validation; writing—original draft; writing—review and editing. **Ali Maleki**: Investigation; resources. **Elham Zarehoseinzade**: Formal analysis; resources. **HamidReza Shaker**: Formal analysis; resources.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data collection tools and data sets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

Informed consent was obtained from all participants. Ethical approval was obtained from Ethic Committee of Ardabil University of medical sciences (IR.ARUMS.REC.1399.202). we understand that the article will be freely available on the internet and may be seen by the general public.

TRANSPARENCY STATEMENT

The lead author Sajjad Narimani affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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