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Knowledge and awareness of leptospirosis among rural communities in northern Iran

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ABSTRACT

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Leptospirosis is a preventable zoonotic disease, and raising public awareness is essential to reduce its incidence and associated complications. This study assessed the level of knowledge about leptospirosis among villagers in Guilan Province, an area endemic for this disease. In this cross-sectional study, 322 residents of rural areas in Guilan Province were selected through multistage sampling. Data were collected using a structured questionnaire comprising demographic and clinical information, along with items evaluating participants' knowledge of leptospirosis across multiple domains. About 207 (64.3%) were male. The mean total knowledge score was 10.96 (SD = 5.11), which was significantly below the expected average level ($P < 0.001$, $t(321) = 3.64$). Participants demonstrated significantly lower knowledge in the domains of epidemiology ($P = 0.004$, $t(321) = 2.90$), routes of transmission ($P = 0.037$, $t(321) = 2.10$), and treatment and prevention ($P < 0.001$, $t(321) = 4.50$). However, their knowledge of symptoms and clinical manifestations did not differ significantly from the average ($P = 0.589$, $t(321) = 0.54$). The findings indicate insufficient knowledge about leptospirosis among villagers in Guilan Province, particularly regarding its prevention and control. Targeted educational interventions are recommended to enhance community awareness and reduce the risk of infection in this high-risk population.

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1. Introduction

Leptospirosis is a globally widespread zoonotic disease, responsible for over one million human infections and approximately 50,000 deaths each year [1]. The disease is particularly prevalent in the Asia-Pacific region, with Southeast Asia and Oceania bearing a significant burden [1,2]. The estimated annual incidence ranges from 0.1 to 1 case per 100,000 population in temperate climates, but can rise to 10–100 per 100,000 in tropical regions, and exceed 100 per 100,000 among high-risk groups [3].

In northern Iran, climatic conditions contribute to a relatively high prevalence of leptospirosis. Among occupationally exposed groups, farmers face the greatest risk of infection, whereas slaughterhouse workers show the lowest rates [4,5]. Rice cultivation is the primary agricultural activity in these rural areas, and most farming households keep livestock such as cattle, as well as guard dogs and horses. Rodents, especially rats and mice, are common in and around rural homes and rice fields. In addition, irrigation commonly relies on surface water, stagnant pools, or rivers, further facilitating the spread of leptospiral bacteria among humans [6]. Given that leptospirosis remains an underrecognized public health concern, prevention and control measures are vital to reduce risk factors and disease incidence. Increasing public awareness and knowledge is essential to define the disease burden more accurately and to implement effective control strategies [7–9]. Individual awareness and health-related behavior play a crucial role in prevention, timely diagnosis, and early treatment, which can reduce complications and mortality [8,10]. Previous studies have shown that many deaths from leptospirosis occur partly due to lack of knowledge about the disease's symptoms, leading to delayed medical care. Moreover, evidence suggests that awareness gaps, especially regarding symptoms and prevention, may significantly hinder control efforts [11,12]. Therefore, this study aimed to assess the level of knowledge about leptospirosis among villagers in northern Iran, an endemic region with high occupational exposure.

2. Materials and Methods

2.1 *Study Design and Setting*

This cross-sectional study was conducted among villagers in Guilan Province, Iran, which is the wettest region in Iran and the wettest area along the southern shores of the Caspian Sea. A complete list of city health centers in Guilan was obtained. From each city's health centers, a list of affiliated health houses was compiled. Based on the population covered by each health house, a proportionate number of villagers were randomly selected to meet the required sample size. Written informed consent was obtained from all participants prior to data collection. Data were collected including demographic items and questions assessing knowledge of leptospirosis, validated by subject-matter experts. All participants were engaged in agricultural activities, with many holding additional jobs due to the seasonal nature of rice cultivation and the proximity of villages to nearby towns. This study was approved by the Ethics Committee of Guilan University of Medical Sciences, Rasht, Iran (IR.GUMS.REC.1399.431).

2.2 *Sampling Method*

A multistage sampling method was employed. Initially, Guilan Province was stratified into four regions: north, south, east, and west. From each region, two cities were selected, resulting in eight cities in total (Fooman, Talesh, Soomehsara, Shaft, Lahijan, Anzali, Rasht, and Rudbar). Within these cities, 126 health houses were identified using cluster sampling. Finally, villagers were randomly selected from each health house in proportion to the population served by that health house, using simple random sampling. A total of 322 individuals were included in the final sample.

2.3 *Data collecting*

Data were collected using a self-administered questionnaire consisting of four sections: Section A captured socio-demographic characteristics (such as age, gender, and occupation); Section B included general questions assessing awareness of leptospirosis; and Section C contained 24 specific items evaluating knowledge across three key domains—epidemiology, routes of transmission, clinical signs and manifestations, and treatment and prevention. To ensure the questionnaire's reliability and clarity, a pilot test involving 10% of the target population was conducted, resulting in a Cronbach's alpha of 0.796, which indicates acceptable internal consistency.

2.4 *Data Analysis*

After collecting the questionnaires, all items were coded and analyzed using the Statistical Package for Social Sciences (SPSS) version 16.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics, including means and frequencies, were calculated for the knowledge scores, which were treated as continuous variables. Associations between socio-demographic characteristics and knowledge scores were examined using independent t-tests and one-way analysis of variance (ANOVA).

One-sample t-tests were used to compare the mean transformed knowledge scores (scaled to 100) with an expected mean score of 50. Pearson correlation coefficients were calculated to explore relationships between readiness domain scores, with absolute correlation values of 0.1, 0.3, and 0.5 interpreted as indicating low, moderate, and high correlations, respectively. To control for potential confounding variables, multiple linear regression analysis was performed to identify demographic factors independently associated with total knowledge scores. Statistical significance was set at P < 0.05.

3. Results

A total of 322 participants from villages in Guilan Province were enrolled in this study, with a mean age of 46 years (SD = 15.5). Of these, 207 (63.3%) were male and 115 (35.7%) were female. The majority of respondents had at least a diploma-level education, with 90 (28.0%) holding a university degree (Table 1).

The distribution of correct, incorrect, and "I do not know" responses for each knowledge item is presented in Table 2. Overall, the highest proportion of correct answers was found in the domain of *clinical signs and manifestations*. Notably, 68.6% of participants correctly identified that the main symptoms of leptospirosis include fever, headache, and muscle aches. In contrast, the lowest proportion of correct answers was seen in the *treatment and prevention* domain; for example, only 28.6% correctly disagreed with the statement that "leptospirosis can lead to death in most cases," which is incorrect. Regarding routes of transmission, 55.3% correctly identified that the pathogen can enter through skin wounds, but misconceptions were evident, as over 40% incorrectly believed in person-to-person transmission (Table 2).

The mean raw total knowledge score was 10.96 (SD = 5.11) out of a maximum possible score of 24. When converted to a scale of 0–100, the mean total knowledge score was 45.7 (SD = 21.3). Among the knowledge domains, the mean balanced score was highest for clinical signs and manifestations (mean = 49.0, SD = 33.5) and lowest for epidemiology (mean = 44.4, SD = 34.6) and treatment and prevention (mean = 44.3, SD = 22.8) (Table 3).

A one-sample t-test showed that the mean total knowledge score was significantly below the expected average of 50 ($t(321) = 3.64$, $P < 0.001$). Likewise, the mean scores for epidemiology ($t(321) = 2.90$, $P = 0.004$), routes of transmission ($t(321) = 2.10$, $P = 0.037$), and treatment and prevention ($t(321) = 4.50$, $P < 0.001$) were all significantly lower than the average score of 50. However, the mean score for clinical signs and manifestations did not differ significantly from the mean reference point ($t(321) = 0.54$, $P = 0.589$).

Significant positive correlations were observed between the scores of all knowledge domains (all $P < 0.001$). The strongest correlation was found between *treatment and prevention* and the *total knowledge score* (r = 0.828), while the weakest, though still significant, was between *epidemiology* and *clinical signs and manifestations* (r = 0.379) (Table 4).

Regression analysis identified several demographic and informational factors significantly associated with higher knowledge scores (Table 5). Compared with other occupations, being employed in a non-agricultural job was linked to a significantly higher knowledge score ($\beta = 12.16$, $P < 0.001$). Accessing information through the internet, radio, or television ($\beta = 14.99$, $P < 0.001$); receiving information from healthcare workers ($\beta = 11.76$, $P = 0.016$); consulting a family doctor or other health professionals ($\beta = 19.38$, $P < 0.001$); and learning through friends or acquaintances ($\beta = 10.17$, $P < 0.001$) were all associated with significantly greater knowledge. Participants who reported that family members or acquaintances had previously been diagnosed with leptospirosis scored, on average, 4.97 points higher than those without such history, a difference that approached statistical significance ($\beta = 4.97$, $P = 0.050$). No significant associations were observed between age, gender, or educational attainment and the total knowledge score in the adjusted model ($P > 0.05$).

Table 1. Socio-demographic characteristics associated with leptospirosis in participants.

Variables		Number (%)
Gender	Male	207 (63.3)
	Female	115 (35.7)
Education	Illiterate	70 (21.7)
	High school	79 (24.5)
	Diploma	83 (25.8)
	University degree	90 (28.0)
Occupation	Farmer	99 (30.7)
	Farmer and rancher	48 (14.9)
	Huntsman	10 (3.1)
	Employee	52 (16.1)
	Other	113 (35.1)
Leptospirosis disease information source	Course of study	24 (7.5)
	Books and magazines	16 (5.0)
	Internet, radio and television	36 (11.2)
	Health worker	23 (7.1)
	Family doctor and other health professionals	18 (5.6)
	Friends and acquaintances	120 (37.3)
	Other sources	85 (26.4)
History of leptospirosis	Yes	33 (10.2)
	No	289 (89.8)
History of leptospirosis in family members, friends and acquaintances	Yes	102 (32.0)
	No	219 (68.0)

Table 2. Frequency distribution of leptospirosis awareness questions in participants.

Knowledge Domain	Knowledge Item	I Do Not Know N (%)	Incorrect N (%)	Correct N (%)
Epidemiology (4 items)	Leptospirosis is a disease that affects both humans and animals.	99 (30.7)	64 (19.9)	159 (49.4)
	The bacteria causing this disease are present in the soil.	93 (28.9)	77 (23.9)	152 (47.2)
	Leptospirosis occurs primarily in tropical and temperate regions.	114 (35.4)	61 (18.9)	145 (45.7)
	It usually takes one to two weeks from infection until symptoms appear.	149 (46.3)	59 (18.3)	114 (35.4)
Routes of Transmission (6 items)	The causative agent enters the body through consumption of contaminated food and water.	97 (30.1)	93 (28.9)	132 (41.0)
	The pathogen can enter the body through skin wounds.	77 (23.9)	67 (20.8)	178 (55.3)
	Transmission is possible through contact with skin, mucous membranes, eyes, or nose.	85 (26.4)	65 (20.2)	172 (53.4)
	Leptospirosis can be transmitted through contact with the secretions or fetuses of infected animals.	110 (34.2)	83 (25.8)	129 (40.1)
	There is person-to-person transmission of leptospirosis. *(Incorrect)*	82 (25.5)	131 (40.7)	109 (33.9)
	Infected animals are the primary source of environmental transmission.	95 (29.5)	68 (21.1)	159 (49.4)
Clinical Signs & Manifestations (4 items)	The main symptoms include fever, headache, and muscle aches.	67 (20.8)	34 (10.6)	221 (68.6)
	Jaundice can occur in leptospirosis.	80 (24.8)	80 (24.8)	162 (50.3)
	Some cases of leptospirosis may be asymptomatic.	109 (33.9)	105 (32.6)	108 (33.5)
	Severe symptoms may include jaundice, kidney disorders, and bleeding.	133 (41.3)	49 (15.2)	140 (43.5)
Treatment & Prevention (10 items)	Leptospirosis can lead to death in most cases. *(Incorrect)*	62 (19.3)	168 (52.2)	92 (28.6)
	Leptospirosis is incurable. *(Incorrect)*	58 (18.0)	218 (67.7)	46 (14.3)
	Vaccinating animals is 100% effective in preventing leptospirosis. *(Incorrect)*	118 (36.6)	94 (29.2)	110 (34.2)
	Human vaccination plays a major role in prevention. *(Incorrect)*	96 (29.8)	119 (37.0)	107 (33.2)
	Wearing boots while working in rice fields helps prevent infection.	76 (23.6)	69 (21.4)	177 (55.0)
	Using a mask while working in fields is effective in prevention. *(Incorrect)*	79 (24.5)	99 (30.7)	144 (44.7)
	Once infected, humans cannot be re-infected. *(Incorrect)*	88 (27.3)	152 (47.2)	82 (25.5)
	Wearing gloves while working helps prevent infection.	78 (24.2)	58 (18.0)	168 (57.8)
	Taking prophylactic medication during agricultural work can prevent infection.	110 (34.2)	96 (29.8)	116 (36.0)
	If a household member is infected, protective measures such as gloves and masks should be used. *(Incorrect)*	95 (29.5)	97 (30.1)	130 (40.4)

Table 3. Descriptive values of awareness scores about it and its domains in participants

Raw score	Domain possible	Domain observed	Mean (SD)	Median (IQR)
Epidemiology	0-4	0-4	1.78 (1.39)	2 (0-3)
Ways of transmission	0-6	0-6	2.80 (1.73)	3 (1-3)
Clinical signs and manifestations	0-4	0-4	1.96 (1.34)	2 (1-3)
Treatment and prevention	0-10	0-9	4.43 (2.28)	5 (3-6)
Total knowledge Score	0-24	0-23	10.96 (5.11)	12 (8-15)
Score balanced				
Epidemiology	0-100	0-100	44.4 (34.6)	50 (0-75)
Ways of transmission	0-100	0-100	46.6 (28.8)	50 (16.7-66.7)
Clinical signs and manifestations	0-100	0-100	49 (33.5)	50 (25-75)
Treatment and prevention	0-100	0-90	44.3 (22.8)	50 (30-60)
Total knowledge Score	0-100	0-95.8	45.7 (21.3)	50 (33.3-62.5)

Table 4. Investigating the relationship between areas of knowledge about leptospirosis in villagers of Guilan province.

	Epidemiology	Ways of transmission	Clinical signs and manifestations	Treatment and prevention	Total knowledge Score
Epidemiology	1				
Ways of transmission	0.476***	1			
Clinical signs and manifestations	0.379***	0.360***	1		
Treatment and prevention	0.396***	0.490***	0.418***	1	
Total knowledge Score	0.708***	0.779***	0.673	0.828***	1

Table 5. Investigating the relationship between participants' awareness scores and demographic variables.

Variables		b	SE	β	t	P
Age	18-35			Reference		
	36-55	1.58	3.02	0.04	0.52	0.602
	>56	1.99	3.78	0.04	0.53	0.599
Gender	Male	2.47	2.43	0.06	1.02	0.310
	Female			Reference		
Education	Illiterate			Reference		
	High school	0.86	3.76	0.02	0.23	0.819
	Diploma	0.89	4.17	0.02	0.21	0.832
	University degree	-2.42	4.57	-0.05	-0.53	0.597
Occupation	Farmer	4.49	3.18	0.10	1.41	0.158
	Farmer and rancher	6.55	3.98	0.11	1.65	0.101
	Huntsman	11.01	7.02	0.09	1.57	0.118
	Employee	12.16	3.61	0.21	3.37	<0.001
	Other			Reference		
Leptospirosis disease information source	Course of study	9.16	4.96	0.11	1.85	0.065
	Books and magazines	9.29	5.71	0.09	1.63	0.105
	Internet, radio and television	14.99	4.16	0.22	3.60	<0.001
	Healthcare worker	11.76	4.85	0.14	2.42	0.016
	Family doctor and other health professionals	19.38	5.43	0.22	3.57	<0.001
	Friends and acquaintances	10.17	2.92	0.23	3.49	<0.001
	Other sources			Reference		
History of leptospirosis	Yes	-2.57	3.93	0.04	-0.65	0.514
	No			Reference		
History of leptospirosis in family members, friends and acquaintances	Yes	4.97	2.53	0.11	1.97	0.050
	No			Reference		

b: regression coefficient; SE: standard error; β: Standardized regression coefficient.

4. Discussion

Familiarity with prevalent community diseases plays an important role in shaping the attitudes and practices of both healthcare workers and the general population. Leptospirosis remains a significant global public health concern, yet levels of awareness and attitudes toward this disease vary widely across different countries [13]. In the present study, the mean total knowledge score among participants was significantly lower than the expected average, indicating limited awareness of leptospirosis in this high-risk rural population.

Similar findings have been reported in previous studies conducted in India, Thailand, Malaysia, Peru, and the United States, where insufficient knowledge has been associated with poor preventive practices and continued transmission of the disease [14–17]. Likewise, a study by Azarfar et al. in Iran also demonstrated low awareness levels regarding leptospirosis, aligning with our results [18]. By contrast, studies conducted in Sri Lanka and Thailand have reported significantly higher awareness levels, largely attributed to the high prevalence of the disease in these regions and the implementation of structured public health education programs [13,19,20]. These contrasting findings highlight the impact of sustained awareness campaigns on improving knowledge and reducing disease burden.

Insufficient awareness may expose rural residents to a greater risk of infection. Identifying specific knowledge gaps is therefore crucial for informing policymakers and public health planners to develop targeted interventions and educational programs to reduce transmission risks. As previous studies from Chile [21], Philippines [10], Trinidad [22], Malaysia [23,24] and Sri Lanka [16] emphasize, enhancing community awareness is key to effective prevention and control of leptospirosis. In general, better knowledge of zoonotic diseases is consistently associated with greater acceptance of preventive measures and protective behaviors [25,26].

In line with similar findings from studies conducted in India [27], Malaysia [3], and Thailand [28], our results indicate that although basic awareness of leptospirosis symptoms is relatively common, significant gaps persist in knowledge about transmission routes and preventive practices—areas repeatedly shown to be vital for controlling the spread of the disease. This pattern highlights a consistent need, as emphasized in these previous studies, for targeted health education programs that go beyond symptom recognition and focus on promoting practical protective measures among high-risk populations in endemic regions.

Early recognition of signs and symptoms is essential because timely treatment can prevent disease progression to more severe forms. These results are consistent with studies conducted among municipal workers and military personnel in Kelantan, Malaysia, where knowledge of clinical features was comparatively better than knowledge of transmission and prevention [24,29].

The findings of this study suggest that although participants showed relatively better knowledge regarding the clinical signs and symptoms of leptospirosis—which can help with early recognition and timely treatment—overall awareness across all domains remains limited, particularly in relation to transmission routes and preventive measures. This pattern aligns with previous studies [18,24,29], which similarly emphasize that improving knowledge about how the disease spreads and how it can be prevented plays a critical role in reducing infection risk and controlling outbreaks in endemic areas.

Similar studies have reported significant information gaps in these domains, which may hinder effective use of protective measures [14], even when individuals are aware of personal protective equipment (PPE), practical use often remains suboptimal. In this study, only about half of the respondents reported using boots, while fewer used gloves or masks—despite the known protective benefits of such equipment [24]. Many reported inadequate use of protective gear, particularly foot protection, which aligns with other studies showing that PPE use is often limited due to discomfort or lack of access [30,31]. Effective prevention of leptospirosis requires minimizing direct or indirect contact with infected animals or contaminated soil or water, practicing good personal hygiene, covering wounds, wearing appropriate protective clothing and footwear, and ensuring access to safe drinking water [1].

Most participants in this study were engaged in informal outdoor occupations such as farming, animal husbandry, fishing, hunting, and gardening. Notably, our findings revealed a significant association between occupation and knowledge scores: individuals employed in formal jobs demonstrated significantly higher awareness levels than those in informal sectors. This observation aligns with previous research showing that access to reliable information and formal health education is strongly linked to improved knowledge and safer practices among occupational groups at risk for zoonotic diseases such as leptospirosis [3]. This underscores the importance of targeted awareness and training programs for high-risk rural and agricultural workers to help reduce transmission.

Furthermore, participants cited various information sources, including the internet, radio, television, community healthcare workers (Behvarz), physicians, family members, and acquaintances. Consistent with other studies, mass media and healthcare personnel were identified as the primary sources of information [32,33]. In a study among adolescents in Sri Lanka, all respondents reported that television and healthcare workers were their main sources of information, supplemented by banners and posters [32]. Mass media remains a cost-effective and powerful tool for disseminating health information to large audiences, particularly in rural settings where direct educational outreach may be limited [33–37]. However, not all information obtained through online platforms and social media is accurate or reliable, highlighting the need for trustworthy, evidence-based public health communication.

The results also revealed a significant association between occupational group and knowledge scores: respondents employed in formal jobs had significantly higher awareness than those in other occupations. This underscores the positive impact of information access and education on disease prevention. However, this study has some limitations including the relatively small sample size that may limit the generalizability of the findings and reduce the ability to detect other influential factors. Additionally, detailed data on working hours for seasonal agricultural laborers were not collected, which could have provided further insights into occupational exposure risks.

Public health authorities, researchers, and policymakers should prioritize the development and dissemination of accessible, practical guidance on leptospirosis prevention and treatment.

This study revealed that knowledge of leptospirosis among this high-risk rural population remains relatively poor, particularly regarding the use of personal protective equipment and effective prevention measures. These findings underscore the urgent need for comprehensive, community-based educational programs targeting at-risk groups to improve awareness and promote protective behaviors.

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Authors' contributions

Study concept, design, and supervision: FJ, FMG, MA, SA. Administrative, technical, or material support: FJ, FMG, MTA. Acquisition, analysis, or interpretation of data: SM, FJ. Drafting of the manuscript: MA, FJ, SM, F M-G, SA, ST. Critical revision of the manuscript for important intellectual content: FJ, FMG, MA, ST. All authors read and approved the final version of article.

Conflict of interest

No potential conflict of interest was reported by the authors.

Ethical declarations

This study was approved by the ethics committees of the Guilan University of Medical Sciences [IR.GUMS.REC.1399.431]. Informed consent obtained from all of the participants.

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