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# UKRAINIAN POPULATION AWARENESS REGARDING LEPTOSPIROSIS

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ABSTRACT

**BACKGROUND.** Leptospirosis is one of the most common bacterial zoonoses in the world. However, there is scarce available literature on public awareness of the infection and the main clinical symptoms of leptospirosis.
**OBJECTIVE.** The aim of this study was to assess the level of leptospirosis awareness among the general population and individuals with occupational risk of the disease in Lviv Region, Ukraine.
**MATERIAL AND METHODS.** A leptospirosis questionnaire on potential risk factors, routes of transmission and ways of protection along with the demographic data was prepared, posted on Facebook and distributed as a printed version. The statistical analysis was performed using Fisher's two-sided test.
**RESULTS.** A total of 446 individuals completed the questionnaire. Of these, 364 persons had no occupational risk of acquiring leptospirosis, while 82 of them had it. The study showed the following levels of leptospirosis awareness among the participants: 193 out of 446 (43.3%) individuals knew what leptospirosis was, with 158/364 (43.4%) representing general population (Group 1) and 35/82 (42.7%) representing individuals with an occupational risk of acquiring leptospirosis (Group 2), $p>0.05$. Furthermore, a total of 55.8% of all the participants knew how they could contract leptospirosis: 194/364 (53.3%) in Group 1 and 55/82 (67.1%) in Group 2, $p<0.05$. The most common risk factors of acquiring leptospirosis observed in both groups were as follows: swimming in ponds and lakes with stagnant water (57.69% in Group 1 and 79.26% in Group 2, $p<0.01$), and the presence of rodents in houses, basements and utility rooms as well as periodic visits to these premises by respondents (45.6% of the respondents in Group 1 and 58.53% of the respondents in Group 2, $p<0.01$).
**CONCLUSIONS.** Outreach campaigns should be implemented to raise the awareness of leptospirosis, both among the general population and among the individuals at increased risk of exposure.

**Keywords:** *leptospirosis, diagnosis, risk factors, awareness, risk groups*

## INTRODUCTION

Leptospirosis is one of the most important bacterial zoonotic diseases globally (1). Leptospirosis infections in humans are acquired through direct or indirect contact with urine or tissues of leptospirosis-infected animals, most commonly rodents (2). Risk factors for leptospirosis are divided into several groups, for example, occupational risks (waste treatment facilities and water utility workers, slaughterhouse workers, farm workers, hunters, veterinarians, fish farm workers, forest rangers, laboratory workers, military personnel, farmers on rice fields) and participation in risky sports and entertainment activities (canoeing, kayaking, swimming in stagnant fresh water, fishing in stagnant water). An important role is played by the influence of casual domestic factors (livestock management, dog ownership, the presence of domestic water collection systems contaminated with rodent feces), as well as of other factors (walking barefoot on flooded surfaces, open skin wounds, contact with rodents, accidental interaction in the laboratory with specimens contaminated with *Leptospira*) (3-6).

In a study of 102 confirmed leptospirosis cases in Germany, 30% of cases were associated with occupational activities, 30% with recreational activities, and 37% with a casual domestic environment (7). Similar results were observed in a study conducted in Croatia. However, in Croatia, leptospirosis is considered an occupational disease and is associated with professions that take animal care (8). It has recently been recognised that a large percentage of patients become infected after recreational activities in regions with high humidity (4,9). High levels of leptospirosis infection have been observed in regions experiencing natural disasters, such as floods and hurricanes (10). In regions with a tropical climate, the largest number of cases is registered during the rainy

season (9). In regions with a temperate climate, the majority of leptospirosis cases are registered in the summer (2).

Annually, several hundred cases of leptospirosis are officially registered in Ukraine with a mortality rate of 10% (11). Between 2001 and 2024, a total of 10,576 human leptospirosis cases were officially registered in Ukraine. The incidence rate in Ukraine for the same period (2001 to 2024) was equal to 0.96 per 100,00 population. In Lviv Oblast, in the same period, 717 cases were registered (incidence rate = 1.17 per 100,000 population) (12). When admitted to a hospital with suspected leptospirosis, patients often hear about the disease for the first time in their lives, and these patients often belong to an occupational risk group. This prompted us to assess the degree of awareness of this disease across different segments of the population of Ukraine, as well as to conduct outreach activities among these cohorts with the aim of raising the awareness of leptospirosis among the interviewees. Such communication is instrumental in informing individuals, especially in risk groups, about the preventative actions they can take to prevent potential infection with leptospirosis.

**The aim** of the study was to assess the level of awareness of leptospirosis among the general population and among representatives of occupational risk groups in Lviv Region, Ukraine.

## MATERIALS AND METHODS

**Survey details.** A questionnaire on leptospirosis in humans was developed using Google Forms (Table 1). The questionnaire was posted on Facebook in 2019 by two individuals with an active social media presence (an average of 4,000 followers on Facebook). All adult (>18 years old) Facebook users that saw the posted questionnaire were invited to complete a survey (n=413). Additionally, a printed version of the questionnaire on leptospirosis was distributed among all interested patients admitted to Lviv Regional Infectious Disease Clinical Hospital from 2017 to 2019 (with the diagnoses other than leptospirosis). In total, 82 printed questionnaires were distributed. It is notable that we excluded answers from respondents representing professions such as medical professionals and veterinarians that would make them familiar with leptospirosis (question 9). It should also be mentioned that both surveys (on Facebook and in paper form) were anonymous for all respondents (total number of participants = 495).

In addition, a printed questionnaire was provided to two occupational risk groups. The latter included a total of 82 respondents from amongst the professional fishermen, namely the participants of a fishing tournament (n=54), and employees of Lvivvodokanal (plumbers, repair workers, engineers, etc., n=28). The participants of the survey were only allowed to select a single answer.

Table 1. Leptospirosis questionnaire

| Leptospirosis Questionnaire |
|---|
| 1. During the summer, do you swim in lakes or ponds?<br>a) Yes<br>b) No |
| 2. Do you fish in lakes or ponds?<br>a) Yes<br>b) No |
| 3. Do you have a dog?<br>a) Yes<br>b) No |
| 4. Do you have livestock (pigs, horses, large or small cattle, etc.)?<br>a) Yes<br>b) No |
| 5. Do you do seasonal haymaking?<br>a) Yes<br>b) No |
| 6. Do you sometimes consume unwashed produce (apples, oranges, cucumbers, tomatoes, etc.)?<br>a) Yes<br>b) No |
| 7. What is your gender? |
| 8. What is your age? |
| 9. What is your profession? |
| 10. Where do you live?<br>a) Town<br>b) Village |
| 11. What type of home do you have?<br>a) Flat<br>b) House |
| 12. Do you know what leptospirosis is?<br>a) Yes<br>b) No |
| 13. How can you contract leptospirosis?<br>a) From other people<br>b) From birds<br>c) From rodents<br>d) Eating canned goods<br>e) I don't know |
| 14. How can you protect yourself from leptospirosis?<br>a) Wearing medical masks<br>b) Vaccination<br>c) Ventilation<br>d) General cleaning and disinfecting<br>e) Destruction of rodents, wearing waterproof clothes while fishing<br>f) I don't know |
| 15. Do you have rodents in your apartment, house, basement, closet, cellar, yard, or barn?<br>a) Yes<br>b) No |

**Statistical analysis.** The study was conducted using the cohort method. The required sample size was

designed for the confidence level of 95% (at p=0.05 for two groups) to obtain representative data (13). Based on the calculations and the average leptospirosis incidence rate estimated from leptospirosis cases reported over the period of 5 years (2015 to 2019) in Lviv Region, the minimum sample size was 72 people. Printed questionnaires were handed over to the participants in-person. Later, all these paper data together with the data retrieved from Google Forms were aggregated in a single Excel database. All calculations were performed using Statistica software. Fisher's two-sided test was used to compare proportions between the groups. P values of less than 0.05 were considered statistically significant.

## RESULTS

**Survey response details.** In total, 577 individuals completed the survey and were divided into two groups: the general population group (Group 1) and an occupational risk group (Group 2). Group 1 included a total of 495 respondents. Of these, 131 were excluded due to their professional knowledge of leptospirosis based on answers to question number 9. Thus, 364 responses were subsequently analysed for Group 1. Group 2 involved representatives of two occupational risk groups: waterworks employees and professional fishermen. Employees of Lvivvodokanal Lviv City Communal Enterprise (plumbers, repair crews, engineers, etc.) were surveyed during an outreach event on leptospirosis (n=28). It should be noted that Lvivvodokanal is a municipal utility company and the biggest provider of water supply and drainage services in Lviv Region. In addition, the company is engaged in water purification and repair of sewage networks and water purification facilities. A survey of professional fishermen was conducted during a fishing tournament held in Lviv Region (n=54). For the occupational risk group, a total of 82 responses were subsequently analysed in Group 2.

**Age and demographics of survey responders.** The average age of all study participants was 38.7 ± 13.5 years old. Specifically, Group 1 (n=364) included 146 males (40.1%) and 218 females (59.9%). Most of the survey responders resided in urban locations at 87.6% (n=319) compared to rural locations at 12.4%

Table 2. Demographic characteristic of study participants in Group 1 and Group 2

| Demographic characteristic | | 1 Group, n=364 (%) | 2 Group, n=82 (%) | p |
|---|---|---|---|---|
| Age | | 37.8±13.4 | 42.9±13.3 | <0.01 |
| Sex | Males | 146 (40.1%) | 79 (96.3%) | <0.001 |
| | Females | 218 (59.9%) | 3 (3.7%) | |
| Residence | Urban | 319 (87.6%) | 67 (81.7%) | >0.05 |
| | Rural | 45 (12.4%) | 15 (18.3%) | |
| Accommodation | Flat | 169 (68.7%) | 44 (53.6%) | <0.05 |
| | House | 195 (31.3%) | 38 (46.4%) | |
| High education | Presence | 338 (92.9%) | 53 (64.6%) | <0.001 |
| | Absence | 26 (7.1%) | 29 (35.4%) | |

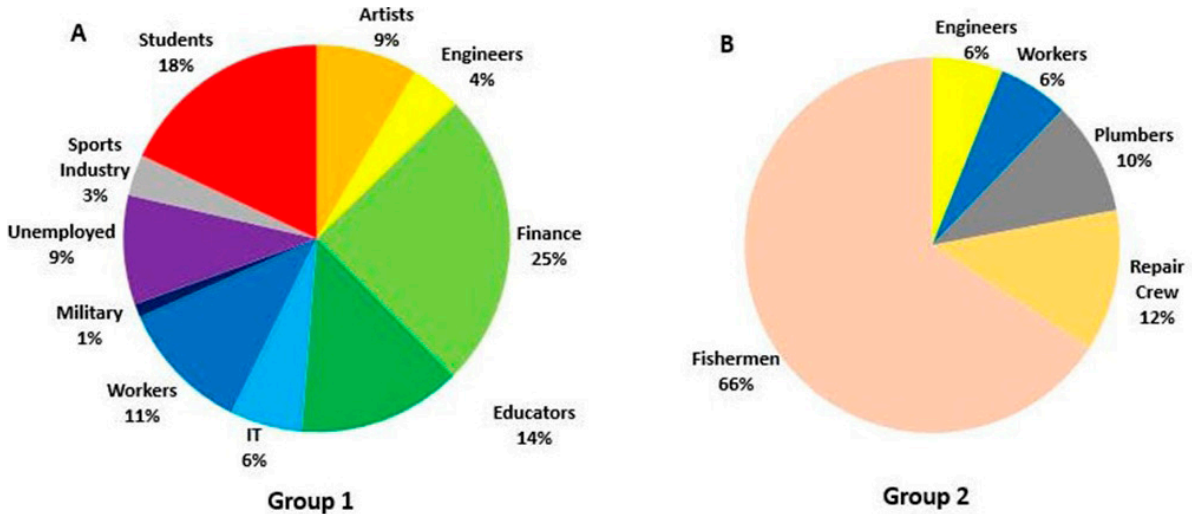


Figure 1. (A) Distribution of professions in Group 1. (B) Distribution of professions in Group 2

(n=45). Of the 364 responders, 338 had completed higher education (92.8%), with a variety of professions represented (Figure 1). Higher education was defined as having completed studies beyond high school (e.g., university studies) (Table 2). While Group 2 (n=82) included 79 males (96.3%) and 3 females (3.7%), with 67 urban residents (81.7%) and 15 rural residents (18.3%). Of the 82 responders, 53 (64.6%) had completed higher education (Table 2). Noteworthy, the profession demographics in Group 2 varied among different trades of occupational risk groups (Figure 1).

Survey responders of the two groups were comparable by age and place of residence. However, the first group included a significantly higher number of females, $p<0.001$ (Table 2). A significantly higher number of females in Group 1 could be explained by the higher percentage of females that are active on Facebook in Ukraine (14). This could also be explained by the fewer number of women employed in the occupational risk fields (15). Additionally, there were significantly more survey responders with higher education in Group 1 than in Group 2, $p<0.001$. In our opinion, respondents with higher education tend to have a broader worldview, are more actively interested in their health, and willingly participate in sociological surveys related to health. In Group 2, 82.2% of respondents worked in a water supply company, where performing job duties does not require higher education degree (plumbers, repairmen, locksmiths, and others).

In both groups, there was a significantly higher number of urban residents ($p<0.001$). This could be explained by the fact that the Facebook survey was posted by individuals that live in urban areas, thus resulting in a higher percentage of their friends (followers and respondents) also being urban residents. The survey of Group 2 was conducted in a city subdivision, which likely resulted in an overrepresentation of urban residents. Professional fishermen who were included in Group 2 travelled to the competition and came from different cities within Ukraine.

Survey participants from both groups represented a variety of professions (Figure 1). Given the diverse representation of professions, they were divided into groups based on the "similarity" of their nature. For example, bankers, financiers, accountants, and businesspeople were grouped into "Finance". In Group 1, the largest number of respondents were from the finance sector (25%) followed by students (18%) and educators (14%). In Group 2, the representation of professions was less diverse as all participants were within the occupational risk sector. In Group 2, the largest number of respondents (66%) were professional fishermen followed by repair crews (12%) and plumbers (10%).

**Characteristics and description of the survey's answers in both groups.** During the subsequent stage of the study, we attempted to assess the respondents' understanding of various aspects related to leptospirosis through a series of questions. It is notable that the leptospirosis awareness did not differ significantly between the two groups with 43.4% of respondents in Group 1 and 42.7% in Group 2 answering "yes" to the question "Do you know what leptospirosis is?" .

Next, we analysed the respondents' understanding of how leptospirosis is contracted and how to prevent infection. To address these lines of inquiry, two multiple choice questions were asked: "How can you contract leptospirosis?" and "How can you protect yourself from leptospirosis?" (Table 1, questions 13 and 14). The correct answers were "from rodents" and "destruction of rodents, wearing waterproof clothes while fishing" for questions 13 and 14, respectively. In Group 1, 38.47% of respondents did not know how leptospirosis is contracted compared to 20.73% in Group 2 (answered "I don't know" to question 13, $p<0.001$). In Group 1, significantly fewer respondents (53.29%) were aware that humans could contract leptospirosis from rodents than in Group 2 (67.07%), $p<0.05$. It was unsurprising that the occupational risk group (Group 2) was more aware of how leptospirosis is contracted given their profession. A limited number of respondents selected one of the incorrect options: from humans (4.12% in Group 1 and 6.1% in Group 2), from birds (2.47% in Group 1 and 4.87% in Group 2), or from eating canned goods (1.65% in Group 1 and 1.23% in Group 2). In response to the question "How can you protect yourself from leptospirosis", 44.23% respondents in Group 1 answered "I don't know" compared to 31.7% in Group 2 ($p<0.05$). Part of the respondents from both groups (in Group 1 – 150, or 41.21% and in Group 2 – 41, or 50%) selected one of the incorrect answers (wearing of medical masks, vaccination, ventilation, or wet cleaning). In Group 1, 14.56% selected the correct answer (destruction of rodents, wearing waterproof clothes while fishing) compared to 18.29% in Group 2, $p>0.05$ (Figure 2).

Finally, we sought to assess risk factors for leptospirosis that the respondents may be exposed to in their daily lives. The assessment was based on questions 1-6 from Table 1 which are "During the summer, do you swim in lakes or ponds?", "Do you fish in lakes or ponds?" (Figure 3A), "Do you have a dog?", "Do you have livestock (pigs, horses, large or small cattle, etc.)?", "Do you do seasonal haymaking?" (Figure 3C), and "Do you sometimes consume unwashed produce (apples, oranges, cucumbers, tomatoes, etc.)?" (Figure 3D) (questions 1-6). In regard to fishing in lakes and

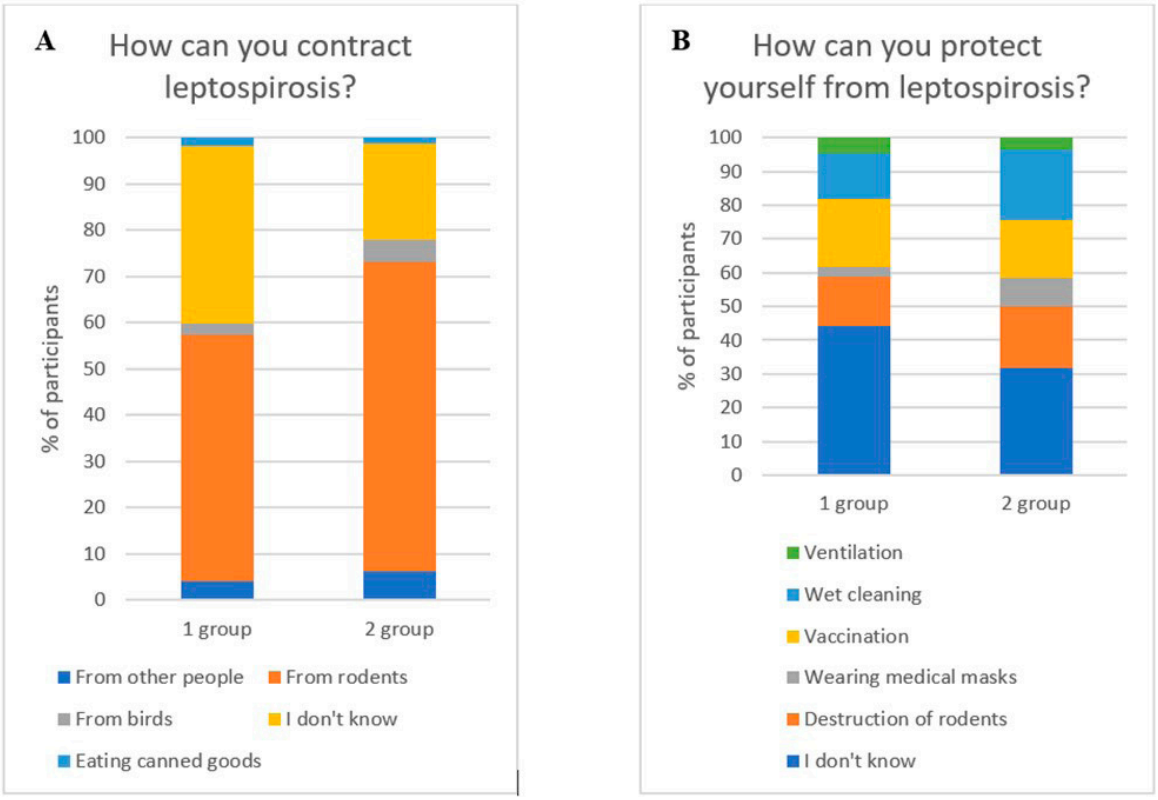


Figure 2. Knowledge regarding how leptospirosis is contracted and how to protect against leptospirosis. (A) "How can you contract leptospirosis?", (B) "How can you protect yourself from leptospirosis?"

ponds, an affirmative response was given by 28.84% of responders in Group 1 compared to 85.37 % in Group 2, p <0.001 (Figure 3A). This result is not surprising, since most of the representatives of the second group are professional fishermen. In response to the question regarding the consumption of unwashed products, 43.13% of respondents in Group 1 responded "yes," which is significantly lower than in Group 2 where the positive response rate was 56.09%, p <0.05 (Figure 3D). In response to whether or not individuals participate in seasonal haymaking, an affirmative response was given by 14.83% of responders in Group 1 compared to 26.82% in Group 2, p <0.05 (Figure 3C). In other questions concerning risk factors (presence of livestock: pigs, horses, large or small cattle, etc.; presence of dog; presence of mouse-like rodents in the places of residence or in the buildings around it, there were no significant differences between the responses in each group. Moreover, there was no difference in the response to the question "During the summer, do you swim in lakes or ponds?" which was of interest given that most individuals in Group 2 spend their time fishing (p>0.05). The answers in response to the questions about the presence of risk factors in the lives of the respondents of both groups indicate that there are more risks of leptospirosis infection in the lives of the interviewees of Group 2. In our opinion, this is primarily connected with existing professional risks.

## DISCUSSION AND CONCLUSIONS

In this study, we report the results of the survey based on the leptospirosis questionnaire that sought to assess public awareness of the routes of transmission, preventive actions, and risk factors. Subsequently, we analysed the respondents' understanding of various aspects related to leptospirosis through a series of questions. The results of the survey showed that leptospirosis awareness did not differ significantly between the groups with 43.4% of respondents in Group 1 and 42.7% in Group 2 answering "yes" to the question "Do you know what leptospirosis is?" In Group 2, a significantly higher percentage of participants knew how they could become infected with leptospirosis (67.1%) compared to Group 1 (53.3%), p<0.05. The most common risk factors for potential leptospirosis infection in both groups were: swimming in ponds and lakes with stagnant water and the presence of rodents in the premises, as well as periodic visits to these premises by respondents.

Our findings demonstrate a general low level of awareness of leptospirosis, both in the general

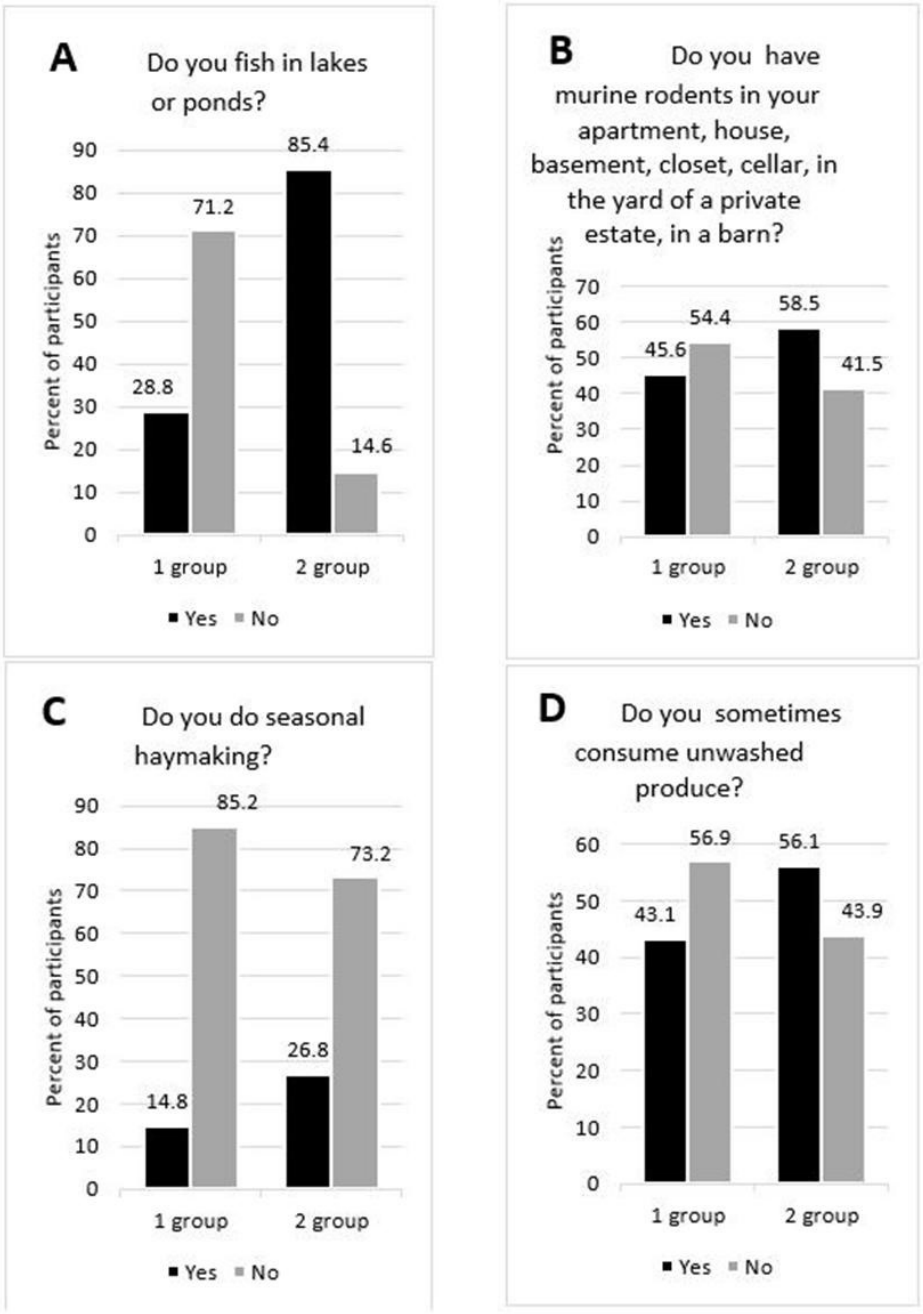


Figure 3. Assessment of daily risk factors for leptospirosis. (A) "Do you fish in lakes or ponds?", (B) "Do you have rodents in your apartment, house, basement, closet, cellar, yard, or barn?", (C) "Do you do seasonal haymaking?", (D) "Do you sometimes consume unwashed produce?"

population and among representatives of professional risk groups in Ukraine. This is largely unsurprising given that Ukraine is not considered a hyperendemic region for leptospirosis, and while leptospirosis cases are reported annually, the morbidity rates are not high (~350 cases/year) (12). Thus, the general population is predominantly unaware of leptospirosis and its associated risk factors. Taken collectively, these findings suggest that there is a gap in the awareness of the routes of transmission, risk factors, and preventive actions for leptospirosis. Future efforts to increase awareness could be focused on increased communication between the medical community and the general population as well as outreach activities to disperse information.

Several studies have been conducted to assess leptospirosis awareness through surveys in the regions that are considered endemic or hyperendemic for leptospirosis. In 2008, the largest outbreak of leptospirosis in the world occurred in Sri Lanka with a total of 7,406 cases (16). Following this outbreak, an awareness study was conducted in which a total of 601 respondents from seven provinces of Sri Lanka were interviewed (17). The participants were asked

about their awareness regarding the prevalence of leptospirosis, transmission routes, professional risks, clinical symptoms, and prophylaxis of leptospirosis. The study revealed that despite living in an endemic region, there were significant misconceptions regarding various aspects of this disease. Only 33% of responders knew that *Leptospira* can enter the body through the skin, less than 20% of responders knew about risk activities apart from farming, and only 3% of respondents were aware that cattle and buffalo are animal reservoirs for leptospirosis (17).

In another study, 257 residents from Brazil, which is also considered hyperendemic for leptospirosis, were interviewed regarding modes of disease transmission and ways to reduce exposure. Almost all participants interviewed were aware of leptospirosis with more than half of respondents having awareness that leptospirosis is most often transmitted through contact with rat excrement. However, of the individuals that participated in risky activities (e.g., fishing, swimming in lakes or ponds), only a third of them had access to protective clothing (18).

Another study was conducted from 2015 to 2017 in Malaysia, which is also considered hyperendemic for leptospirosis. Of 315 respondents, 80.3% (n = 253) had a limited overall understanding of leptospirosis (19). Another study in the north-eastern part of Malaysia was conducted among 321 town service workers, who were considered at high risk of contracting leptospirosis. While these individuals understood how to protect themselves from and how to prevent leptospirosis during work, they did not utilise personal protective equipment on a regular basis (20). Collectively, these studies demonstrate that even in hyperendemic regions, the general awareness of leptospirosis is significantly limited.

To our knowledge, there have been no similar detailed surveys conducted in Ukraine to assess the awareness of leptospirosis. To date, a single study conducted in Ukraine provided information about the general level of awareness of leptospirosis (21). In this study, oral interviews of 157 residents in rural areas within Chernivtsi Region were carried out. The results of this study suggest that that only ~10% of respondents are aware of leptospirosis and that none of the respondents demonstrated knowledge about the prevention of this disease. Collectively, these data suggest that the level of public awareness of leptospirosis in Ukraine is insufficient, which is a contributing factor in the delay in seeking medical care when leptospirosis symptoms are present (21). Furthermore, there is a need to understand the general knowledge of Ukrainians regarding the measures that reduce risks of contracting leptospirosis.

In the present study, the survey conducted to assess the awareness of leptospirosis in Ukraine was carried out utilising social media, specifically Facebook. As of June 2023, it was reported that more than half of the world population uses social media (approximately 4.8 billion people) (22). The top three geographic regions that use social media in 2023 were Europe (84%), North America (74%), and South America (72%) (23). Of all social media platforms, Facebook is the most popular, with three billion active users (24) in the second quarter of 2023. Thus, we referred to Facebook to conduct our survey, since it is the most used social media platform in Ukraine. As of July 2022, the number of Ukrainian Facebook users was 15.6 million (13). This work suggests that future survey efforts within Ukraine can capitalise on the number of users on social media platforms.

Another promising area of further research is the assessment of the territorial spread of leptospirosis, as well as determining or measuring the risks of infection in Lviv Region based on a retrospective analysis of the epidemic process employing geo cartographic technologies created using geoinformation systems. Mapping the information on leptospirosis infection of the main reservoir – mouse-like rodents – will help determine risk zones of potential leptospirosis infection for humans. This knowledge will make it possible to strengthen outreach efforts in occupational risk groups in specific areas of the region. At the same time, conducting sociological surveys such as ours will help the medical community identify new pressing issues that concern the population and improve the health of the nation as a whole. Hence, outreach activities should become standard practice for medical workers to raise leptospirosis awareness across the population.

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