Original Article

Awareness of West Nile Virus and Zoonotic Disease Transmission among Residents of Northern Cyprus: A Cross-Sectional Study

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Abstract

Background: West Nile Virus (WNV) can cause severe neurological disease in humans, making public awareness crucial for prevention. The study aims to investigate the knowledge and attitudes of individuals living in Northern Cyprus regarding sources and transmission routes of this disease.

Methods: In this cross-sectional study, 389 people participated. Data were collected using a questionnaire designed by researchers. The survey included questions about participants' awareness, sources of information, knowledge of WNV transmission routes, and preventive measures. It was conducted face-to-face. Descriptive statistics were used to analyze data, and results were expressed as frequencies and percentages. Chi-square tests assessed p-values and significance.

Results: 80.1% of participants had never heard of zoonotic diseases. When asked about the transmission route of WNV, 59.7% correctly identified animal or insect bites as the mode of transmission. In terms of precautions, 60.7% reported taking measures such as window screens and bed nets to protect from mosquito bites, while 39.3% did not. As hypothesized, a significant association was shown between nationality and knowledge of zoonotic disease (p=0.026). In addition, gender was significantly associated with preventive measures (p=0.008), with females more likely to show protective behaviors compared to males.

Conclusion: Results indicate a general lack of awareness about zoonotic diseases among the population of Northern Cyprus; however, a larger proportion reported taking personal precautions against mosquito bites. The Ministry of Health can organize training sessions and seminars to increase public awareness about WNV. Additionally, municipalities should take mosquito and larval control measures, particularly in summer.

Keywords: Public health; Vector-borne diseases; Health knowledge; Attitudes; Preventive behaviors

Introduction

Animals and insects constitute the source, host and/or intermediate host of at least half of the 1700 known disease agents today (1). Zoonotic diseases account for 60% of infectious illnesses affecting humans. Again, 75% of diseases that are a significant public health problem are caused by zoonoses (2). The number of zoonoses is increasing every day, both with newly discovered zoonotic diseases and with the understanding that diseases thought to be specific to humans are actually zoonotic diseases (1, 2). Increased trade and travel, along with the globalization process, cause diseases seen in one region of the world to cease to be endemic and reach a level that affects other countries. The “SARS Epidemic” seen in Toronto in 2003 was a result of tourist activities (3, 4).

Zoonotic diseases, particularly West Nile Virus (WNV), were first reported in the United States in 1999 (5). The disease caused by WNV has led to significant morbidity and mor-

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tality worldwide. WNV is a single-stranded RNA virus whose primary route of transmission is the bite of infected *Culex* mosquitoes. Birds serve as the main reservoir hosts. Various precautionary measures can help reduce the spread of WNV, such as early diagnosis of infected individuals and mosquito control programs to minimize mosquito bites. Increasing public awareness about these zoonotic diseases is crucial for personal protection and community health.

The issue of zoonotic diseases is a worldwide concern for public and veterinary health. After the transport system improved, travel became easier and more attractive over the last century. Parallel to this improvement, according to the WHO, the number of zoonotic diseases also increased.

Cyprus, an island located in the Mediterranean Sea, is divided into two regions for political reasons: the north and the south. Turkish Cypriots live in the northern part of Cyprus, while Greek Cypriots reside in the southern part. There is a border between the two regions, and after showing their passports at security checkpoints, people from both sides are allowed to travel across the divide. This arrangement supports global connectivity with a wide range of countries. The division of the island could lead to differences between the two regions and may influence the results of our study. However, the findings presented in this research reflect only the northern part of Cyprus.

The northern part of the island has an economy that mostly depends on agriculture, tourism, university students and small-scale farming, which increases the risk of human infections, particularly zoonotic ones (6).

WNV cases have recently started to be documented in our country. The island hosts a large number of students and tourists, which may play a role in the introduction of new cases. A lack of knowledge significantly hinders the ability to empower local communities to effectively combat mosquito-borne diseases through individual interventions. Recent studies and local newspapers have reported that WNV infection has become particularly common on our island (6).

Taken together, the present study was conducted with the following objectives: (i) to assess the level of knowledge among individuals living in Northern Cyprus regarding zoonotic diseases focused on WNV; (ii) to evaluate awareness of WNV, including its transmission routes and sources of infection; and (iii) to examine knowledge of preventive measures and protective behaviors against zoonotic diseases, with particular emphasis on WNV. We hypothesized that knowledge and awareness levels would significantly vary according to sociodemographic characteristics such as nationality, age, education level and occupation.

Materials and Methods

This study was planned as a cross-sectional descriptive study. The survey forms were developed for this research and were applied to people who were living in the Turkish Republic of Northern Cyprus between February and May 2024. The required sample size was calculated using OpenEpi software, assuming an expected frequency of 5%, with a 95% confidence level and a 5% margin of error. Eventually, 389 was found. Participants were recruited using a convenience sampling method. Individuals who met the inclusion criteria and agreed to participate in the study were invited to complete the questionnaire. The exclusion criteria include being under 18 years of age, as individuals under 18 are not legally authorized to provide informed consent, and individuals with cognitive impairment were excluded from the current study. The questionnaire was designed by researchers based on a review of existing literature and distributed randomly. Before distribution of the survey, the questions were reviewed by experts in the field to assess content validity and clarity of the questionnaire.

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It was administered using the Google Forms online platform (https://docs.google.com/forms/u/0/d/1d7Nj4xRygVK_lmLNKXd-LjCMIHuaYLet-PlofVTay90M/viewform?edit_requested=true&pli=1&authuser=0).

The questionnaire consists of 24 questions, and it was written in Turkish, with 5 being demographic and the rest being about the attitude and knowledge level of the individuals living in Northern Cyprus. The first part of the survey included questions regarding the demographic characteristics of the participants (age, level of education, institution they work in), the second part included questions regarding their knowledge of zoonotic diseases (agents, sources, transmission routes) and the third part included questions regarding the sources of information about zoonoses and their knowledge levels regarding protection methods. The information was collected anonymously.

Data analysis of the survey was conducted by using Excel and SPSS IBM SPSS Statistics 26.0 for Macintosh. A chi-square test was done. A $p< 0.05$ was considered statistically significant. Unadjusted p-values were used. Participants were given verbal information about the purpose of the study and the evaluation of the results.

Results

Demographic characteristics of the participants

Respondents were divided into three age groups as follows: 18–35, 35–60 and above 60 years. Most respondents were from the 18–35 age group, 79.1% of the total respondents. This was followed by the 35–60 age group, representing 17.0% of participants. Those aged above 60 represented the smallest group, at only 3.9%. As the data points out, most of the respondents were younger adults, and this limits the generalizability of the study. The results may primarily reflect the knowledge and behaviors of the younger generation.

Among the 389 participants, 42.5% were male and 55.8% were female. Additionally, 1.7% chose not to specify their sex. 44.7% of respondents identified as Turkish, making up the largest nationality group. Cypriot participants represented 34.4% of the sample, while 20.9% were from other nationalities, including Iran, Sudan and Russia. Most of the participants reported having a high level of education (above high school) (78.3%), while 21.7 % of participants indicated having a lower education level. In terms of occupation, the majority were students, corresponding to 66.8% of the sample, while the remaining 33.2% stated that they had other types of occupations. Regarding blood types, the most common type was A^+, as 34.2% of the sample, followed by O^+ at 23.3%. Others included B^+ (16.5%), AB^+ (9.1%), O^- (5.7%), A^- (4.9%), AB^- (3.9%) and B^- (2.5%) (Table 1). Some subgroups of blood type have been related to susceptibility to certain zoonotic diseases in past studies. In the current research, the blood type distribution is presented descriptively as frequencies and percentages to characterize the Northern Cyprus population. This information may be informative for possible future research, which would address exploring potential links between blood type and disease risk.

Knowledge related to zoonotic disease

The question "Have you heard of zoonotic diseases before?" was answered as follows: 19.9% of participants responded "Yes," while 80.1% had not heard of zoonotic diseases. Regarding WNV, 36.9% of participants reported having heard of the virus, while 63.1% had not. The sources from which participants had heard the information varied, including from a person and, more commonly, from a healthcare provider. The frequencies of these sources are shown in Fig. 1. On the other hand, the majority of participants (89.4%) reported having heard of malaria before, while 10.6% had not. The question about WNV transmission was answered as follows: 59.7% of respondents correctly stated that animal or insect bites are the

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mode of transmission. 14.7% responded that the virus was airborne, while 25.6% chose other modes of transmission. Understanding that mosquitoes can transmit West Nile Virus (WNV) is crucial, as this awareness empowers people to take preventive action.

Regarding preventive measures and precautions against mosquito bites, only 21.6% of respondents reported being aware of preventive measures for WNV, while 78.4% were unaware of any preventive strategies. When it came to personal precautions, 60.7% of respondents said they protected themselves from mosquito bites, whereas 39.3% did not. Only 17.0% of respondents stated as being aware of specific treatments or vaccines available for WNV, while 83.0% were unaware. 28.5% of respondents reported having constant water around their house, while 71.5% did not. Among those who reported having constant water sources, 7.1% stated that they changed the water daily, 4.7% every other day, 9.6% weekly, and 13.8% never changed the water. Only 14.3% of respondents reported hearing information about WNV from the Ministry of Health in their government, while 85.7% had not. A significant majority (76.9%) stated that they are interested in receiving more information about WNV, while 23.1% did not. Lastly, 4.7% of respondents reported having been diagnosed with WNV, while 95.3% reported no such experience (Table 2).

Although a very small proportion of respondents were aware of preventive measures for WNV, a larger proportion (60.7%) reported actually taking precautions against mosquito bites. This indicates that, regardless of their knowledge about WNV, respondents are taking steps to protect themselves from mosquito bites.

Associations between demographic characteristics and knowledge-related questions

Chi-square tests were conducted to examine the relationships between demographic variables and knowledge-related questions regarding WNV. Only significant associations are presented in Table 3. However, all variables were statistically analyzed, and no significant associations were found between other demographic variables and knowledge-related levels (Table 3). A significant association was shown between nationality and whether respondents had heard of WNV (p=0.04). A second significant association between nationality and knowledge of zoonotic disease was calculated (p=0.026).

The chi-square test also showed a significant relationship between age and whether respondents had constant water around their house (p=0.034). A significant association was found between gender and whether respondents had taken precautions to protect themselves from mosquito bites (p=0.008). This indicates that gender may influence the likelihood of taking preventive measures against mosquito bites. The female participants in this study stated that they protect themselves from mosquito bites.

A significant relationship was found between education level and awareness of specific treatments or vaccines for West Nile Virus (p=0.010). This suggests that individuals with higher education levels are more likely to be aware of WNV treatments or vaccines.

Table 1. Demographic characteristics of the participants in Cyprus, 2024

Variable	No. of Respondents (n)	Percent (%)
Age Group		
18-35	322	79.10
35-60	69	17.00
Above 60	16	3.90
Sex		
Male	173	42.50
Female	227	55.80
Don't want to specify	7	1.70

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Table 1. Continued ...

Nationality		
Cypriot	140	34.40
Turkey	182	44.70
Others	85	20.90
Educational level		
Low education level*	88	21.70
High education level**	319	78.30
Occupations		
Students	272	66.80
Others	135	33.20
Blood type		
A^-	20	4.90
A^+	139	34.20
AB^-	16	3.90
AB^+	37	9.10
B^-	10	2.50
B^+	67	16.50
O^-	23	5.70
O^+	95	23.30

*Low education level was defined as primary and secondary education.
**A high education level was defined as high school education and above

Table 2. Knowledge related to zoonotic disease, preventative measures, and treatment among the participants, Cyprus, 2024

	No. of Respondents (n)	Percent (%)
Have you ever heard about Zoonotic disease?		
Yes	81	19.90
No	326	80.10
Have you ever heard about Malaria?		
Yes	364	89.40
No	43	10.60
Have you ever heard about WNV?		
Yes	150	36.90
No	257	63.10
How do you think West Nile Virus is transmitted?		
Airborne	60	14.70
Animal or insect bite	243	59.70
Others	104	25.60
Are you aware of any preventive measures for West Nile Virus?		
Yes	88	21.60
No	319	78.40
Have you taken any precautions to protect yourself from mosquito bites?		
Yes	247	60.70
No	160	39.30
Have you or anyone you know ever been diagnosed with West Nile Virus?		
Yes	19	4.70
No	388	95.30
Did you hear any information from the Ministry of Health in your government?		
Yes	58	14.30
No	349	85.70
Do you have constant water around your house?		

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Table 2. Continued ...

Yes	116	28.50
No	291	71.50
If you answered 'Yes', how often do you change the water?		
Daily	29	7.10
Every other day	19	4.70
Never	56	13.80
Weekly	39	9.60
Are you aware of any specific treatments or vaccines available for West Nile Virus?		
Yes	69	17.00
No	338	83.00
Would you like to be informed more about the West Nile Virus?		
Yes	313	76.90
No	94	23.10

Table 3. Chi-square analyses the associations of knowledge questions and practice scores of the study participants with sociodemographic status, Cyprus, 2024

Variables	Knowledge-related question	P value
Nationality	Have you ever heard about WNV?	0.040
Nationality	Have you ever heard about zoonotic disease?	0.026
Age	Do you have constant water around your house?	0.034
Gender	Have you taken any precautions to protect yourself from mosquito bites?	0.008
Education Level	Are you aware of any specific treatments or vaccines available for West Nile Virus?	0.010

Note: Only significant associations were presented

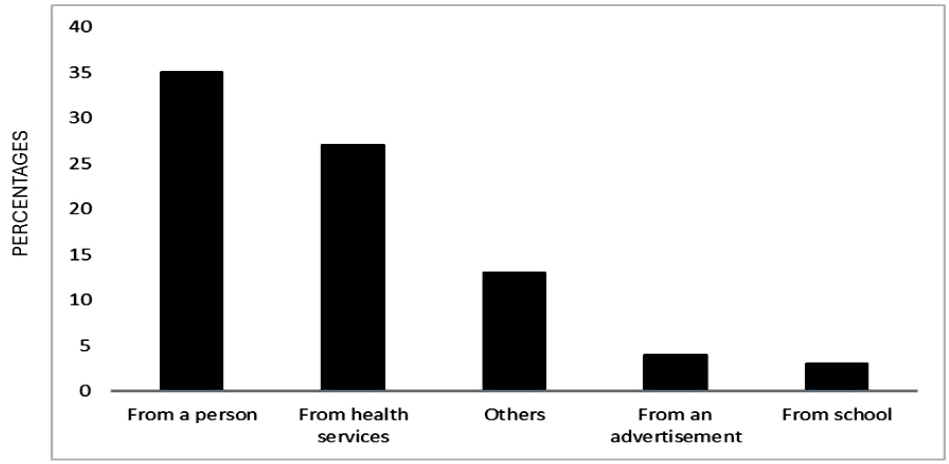

Fig. 1. Frequencies of sources of information about West Nile virus in Cyprus, 2024

Discussion

Having a high-level knowledge about zoonotic diseases is extremely important both for protecting ourselves against these diseases and for preventing them from spreading and becoming life-threatening.

In our study, 59.7% of respondents identified

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insect bites as the primary method of transmission, while 25.6% mentioned other routes, such as airborne transmission. A study conducted by Riccò et al. (7) documented that healthcare workers in Italy had a moderate (60%) understanding of WNV transmission. Similarly, in Northern Cyprus, the knowledge level about WNV transmission was also found to be low to moderate. These results highlight the urgent need for educational training on WNV.

One of the results of our study highlighted that nationality has a significant effect on knowledge of WNV. Turkish respondents had higher awareness of zoonotic diseases (p= 0.026) as well as WNV (p=0.040) compared to other nationalities. This result may be caused by the cultural and educational differences in the educational systems. Parallel to this, the occurrence of zoonotic diseases differs geographically, which may affect the awareness and knowledge level of these diseases.

The results of the study indicate that individuals who had higher educational levels were more likely to have knowledge about WNV (78.3%). Higher educated people may have lectures about WNV through their higher education, and this has led to an increase in the knowledge level of WNV and zoonotic diseases. A similar outcome was observed in previous research by Natalia et al. (8).

The results demonstrated that 60.7% of participants reported taking precautions against mosquito bites. Even though their knowledge level is low, respondents take precautions against mosquito bites without knowing about the zoonotic diseases.

Gender was significantly associated with preventive measures (p=0.008), with females being more likely to show protective behaviors compared to males. These findings are also similar to previous studies, particularly research conducted by Chang et al. (9).

Another important finding of our study is that 28.5% of participants reported having constant water around their homes, which serves as a breeding ground for mosquitoes. It is known that to prevent WNV transmission, the water should be changed frequently. The frequency of water change was significantly influenced by the age of participants (p=0.034), suggesting that older individuals may be more aware of WNV and other mosquito-borne disease risks.

Kaidarova et al. (10) have suggested a potential association between certain blood groups and susceptibility to symptomatic West Nile virus infection and higher viral loads; however, this association remains limited and not consistently demonstrated across studies. In our study, no association was observed between blood type and knowledge level regarding WNV.

When we compare the current study with previous studies conducted in a similar geographical area, the Mediterranean, particularly in Turkey, similar results are observed. Low to moderate knowledge levels were found, despite the ongoing endemic presence of the virus in this region (11, 12). A recent community-based study conducted in Germany also reported low knowledge levels, similar to our study, and public awareness should be improved (13).

Finally, it is important to note that WNV antibodies in blood donors from Northern Cyprus were reported by Balaman et al. (14). Our data showed that 80.1% of respondents had never heard of WNV, indicating a significant lack of knowledge about WNV. Considering the reported cases related to WNV infection, there is an urgent need for further seroprevalence studies, as well as increased public awareness through educational initiatives supported by the Ministry of Health.

Lastly, a very small proportion of respondents were aware of preventive measures for WNV; a larger proportion reported actually taking precautions against mosquito bites. This indicates that, regardless of their knowledge about WNV, respondents are taking steps to protect themselves from mosquito bites.

The present study has a cross-sectional design, which carries certain limitations, includ-

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ing the overrepresentation of younger participants. In particular, the study sample was predominantly composed of young adults and university students (66.8% students and 79.1% aged 18–35 years), which may introduce sampling bias and limit the generalizability of the findings. Consequently, the observed knowledge and awareness levels may not fully represent the broader and more heterogeneous population of Northern Cyprus. Future studies employing longitudinal designs with larger and more diverse samples, as well as more comprehensive questionnaires, are recommended to further assess knowledge levels in Northern Cyprus.

Conclusion

In this study, awareness of zoonotic diseases was very low among participants in Northern Cyprus, with 80.1% having never heard the term. Knowledge of West Nile Virus (WNV) was also limited: only 36.9% had heard of the virus, and 59.7% correctly identified insect or animal bites as the transmission route. Despite this low awareness, 60.7% of participants reported taking personal precautions against mosquito bites (for example, using window screens or bed nets). However, a substantial proportion (39.3%) did not take any such measures. A significant gender difference was observed: females were more likely than males to adopt protective behaviors ($p= 0.008$). Additionally, nationality and education level were associated with knowledge of zoonotic diseases and WNV, while age influenced water-changing practices around homes ($p= 0.034$), with older individuals showing more responsible behavior.

Public health campaigns in Northern Cyprus should prioritize increasing awareness of zoonotic diseases and WNV transmission, particularly targeting young adults and males, who exhibit lower protective behaviors. The Ministry of Health and universities should develop structured educational programs, and municipalities should implement mosquito and larval control measures, especially during summer. Given that 76.9% of respondents expressed interest in receiving more information about WNV, there is clear public receptiveness to such initiatives.

Ethical considerations

In order to conduct the study, written consent was obtained from the Ethics Committee of Cyprus Health and Social Sciences University (KSTU//2024/144) and from the participants during the data collection process.

Conflict of interest statement

The authors have declared that no competing interests exist.

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