The Role of the Middle East in ZIKA Virus Circulation: Implications of a Cross-Sectional Study in Jordan

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Abstract. ZIKA virus (ZIKAV) outbreak in Latin America was associated with international concerns of ZIKAV circulation. The lack of vaccine and Food and Drug Administration (FDA)-approved drugs against this virus rendered prevention as the single most effective method to control its spread. Hence, this study aimed to assess Jordanian population knowledge, attitude, and practices toward ZIKAV and its prevention. An anonymous questionnaire was administered to adults in Amman, Jordan. The overall knowledge of participants was poor (mean knowledge score of 13.7/32). Between 75% and 86% of the respondents did not know the highest risk group of ZIKAV infection, its complications, and the major routes of transmission. About 40% of the population did not know that ZIKAV is sexually transmitted. Only 40% of the population believed that prevention measures are effective. Female gender, working in the medical field, having children, and the source of medical information were associated with significantly higher level of knowledge ($R^2 = 0.143$, P -value < 0.0001). Being pregnant, however, was not associated with a significantly high knowledge score. Physician recommendations and government's role were the most important predictors of practices toward ZIKAV prevention. Of the 14 returnees from outbreak areas, only six were tested for ZIKAV on coming back and only three continued the use of prevention measures for a sufficient time. Therefore, formulation of a national health policy, preparedness plans against any potential transmission, and organization of educational campaigns to meet the population's health educational needs are required. Special emphasis should be placed on pregnant women and travelers to/returnees from ZIKAV-affected areas.

INTRODUCTION

ZIKA virus (ZIKAV) is an arbovirus of the Flaviviridae family.¹ People with ZIKAV infection are often asymptomatic.² Symptoms, when present, are often characterized by self-limiting fever, rash, arthralgia, and conjunctivitis.^{1,3} Neurological complications associated with ZIKAV infection include Guillain-Barré syndrome and congenital microcephaly of the fetuses of infected mothers.^{1,3} Therefore, pregnant women are considered the highest risk group of ZIKAV infection.⁴ ZIKAV is transmitted to humans primarily through the bite of infected female *Aedes* species mosquito, particularly, *Aedes aegypti*, and *Aedes albopictus*. ZIKAV is also transmitted through sexual activity, vertically from mother to fetus, and through blood transfusion.¹ ZIKAV infection in humans was first reported in 1954 in Nigeria and later in Uganda in 1962.¹ Since then, the virus has spread into several countries in Africa and Asia, and more recently to Latin America and Brazil in 2015.^{1,5} Because of the unpredictable nature of the spread of the virus, it is a challenge to predict when and where the next arbovirus epidemic will occur.⁶ Although the Centers for Disease Control and Prevention (CDC) in America considered the Middle Eastern countries, including Jordan, as countries with no risk of ZIKAV transmission,⁷ other *Aedes*-transmitted infections such as dengue and chikungunya were reported in this region in Egypt, Saudi Arabia, Yemen, and Oman.⁸ Besides, the presence of *A. albopictus* and *A. aegypti* vectors of ZIKAV was reported in several Middle Eastern countries.⁸ In Jordan, *A. albopictus* has recently been reported in three governorates.⁹ Although, *A. aegypti* was not reported in Jordan, north Jordan region is considered to have high predicted probability of *A. aegypti* occurrence; particularly, this species was detected in nearby countries such as Syria,

Israel, and Lebanon.⁸ In addition, the fact that ZIKAV can be sexually transmitted, and the disease is asymptomatic in 80% of the cases,² has drawn attention to the possibility of its transmission to areas with no risk of ZIKAV, such as the Middle East.¹⁰

The spread of ZIKAV is usually associated with urbanization and globalization.⁶ Jordan, as a developing country, has recently witnessed a profound globalization. As of 2015, Jordan received about 3 million migrants, including foreign workers and refugees.¹¹ Jordan usually receives foreign workers from countries that are classified by the CDC to have risk of ZIKAV transmission such as the Philippines, Indonesia, India, Bangladesh, Kenya, and Uganda.^{7,12} At the same time, thousands of Jordanians travel to the United States, Europe, and Australia for educational or professional purposes, where they could similarly participate in the spread of ZIKAV to these territories. Noteworthy, because of the intra-regional conflict in the past few decades, Jordan has received refugees from Palestine, Iraq, and Syria.¹³ The most recent Syrian crises resulted in an increasing extent of infectious diseases within the refugees and the local population in Jordan.¹⁴ Although there is no evidence of ZIKAV in Syria, this alarming medical situation in Jordan could possibly contribute to the spread of infectious diseases, such as ZIKAV, not only in Jordan, but also worldwide as many refugees seek the Americas, Europe, or Australia as their final destination.¹⁵ This is particularly important as screening for ZIKAV in asymptomatic individuals is not recommended by the Pan American Health Organization and the CDC (except for asymptomatic pregnant).¹⁶

Given the aforementioned possible cycle of the spread of ZIKAV, the knowledge of the Jordanian population regarding ZIKAV and its prevention measures is critical to limit the spread of this virus in Jordan and worldwide. This is especially important as currently there is no FDA-approved drug or vaccine against ZIKAV, and prevention is the sole method to control the spread of this virus.⁴

Several surveys were conducted to evaluate public awareness regarding ZIKAV infection in several countries in the

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Americas, Europe, and Asia.^{17–20} In the Middle East region, however, there is a single report that assessed knowledge and personal perception regarding ZIKAV and its route of transmission, in a sample of educated population in the high-income country of Qatar.²¹ Yet, there are no previous reports that addressed this issue in the general population of one of the developing, limited-resources countries of the Middle East, such as Jordan. Therefore, the current comprehensive cross-sectional study aims not only to identify the major gaps in knowledge toward ZIKAV and its routes of transmission among the Jordanian population, but also to assess public awareness of its prevention measures, population attitude toward these issues, and predictors of population adherence to these measures. The data generated from this study could help in formulating strategies that have regional and global health benefits in reducing the emergence and the spread of new variants of ZIKAV.

METHODS

Study subjects. This study was conducted in Amman, the capital of Jordan. A target sample of 1,050 adults aged 18 and older was estimated based on the following equation:

$$N = \frac{PQ(Z_{\alpha} + Z_{\beta})^2}{d^2}, \text{ where } N \text{ is the sample size; } Z_{\alpha} \text{ is the type one error} = 1.96 \text{ when } \alpha = 5\%; Z_{\beta} \text{ is the type two error} = 1.28 \text{ when } \beta = 10\%; Q = 1 - P \text{ is the expected non-prevalence; } P \text{ is the proportion in the population possessing the characteristic of interest (based on the estimates that 50\% of the respondents knew general information about ZIKAV, its routes of transmission, and the main prevention measures); and } d \text{ is one-half of the desired interval of confidence, in this study } d = 5\%.$$

A similar sample size ($N = 1,068$) was previously used to address a similar topic in China.¹⁹ The participants were recruited from different sites, including outpatient clinics of the University of Jordan Hospital, health-care centers, and public places such as parks and malls in Amman. To include pregnant women in our study, data collection was also performed at the obstetrics and gynecology clinic at the University of Jordan Hospital. This approach of data collection was previously reported.¹⁷ Subjects available at the previous sites, at the time of data collection, were invited to participate in the study.

Study design and data collection. This cross-sectional study was conducted over the period from September 2016 to April 2017. A verbal consent was obtained from participants, and those consenting to participate were provided the questionnaire through a 5- to 10-minute semi-structured interview. The Institutional Review Board (IRB) at the University of Jordan Hospital approved the study protocol and the questionnaire (IRB no. 215/2016).

The questionnaire was developed based on reviewing related literature.^{3,16} The questionnaire content was critically reviewed and face-validated by several colleagues in the field, and it was then piloted to a sample of 50 adults (5% of the target sample size) and was accordingly amended. The data obtained from piloting were not included in the final results of this study.

The questionnaire consisted of four main sections with a similar structure to the questionnaire of Abu-rish et al.²² Demographics and general characteristics of the participants were covered in the first section. The second section addressed participants' knowledge about ZIKAV, its mode of transmission, and its prevention measures. The attitudes of

the participants toward ZIKAV and its prevention measures were assessed in the third section. The fourth section addressed the practices of the participants who traveled to or came back from areas with ZIKAV outbreak toward ZIKAV prevention measures. Besides, this section addressed the factors that would affect the adherence of all participants to ZIKAV prevention measures. Participants were asked to select as many factors that applied to them (refer to Supplemental File).

Statistical analysis. Statistical analysis was carried out using SPSS version 20.0 (SPSS Inc., Chicago, IL). Descriptive statistics were used to describe demographic and general characteristics of participants. Categorical variables were presented as percentages with frequencies, whereas continuous variables were presented as median with interquartile range. Participants' knowledge scores were assessed using the number of correct responses they gained of 32 knowledge items. The participants were considered adequately knowledgeable if their knowledge score, for all knowledge questions, was higher than or equal 16 (50% of the 32 knowledge questions). As the assumptions of parametric testing (normality and equal variances) were violated, nonparametric tests, including Mann–Whitney and Kruskal–Wallis tests, were used to test the differences among the variables that affect the knowledge score (bivariate analysis). Factors that were found to be significantly associated with a high knowledge score through bivariate analysis were entered into backward stepwise multivariate linear regression analysis to determine the strength of the association of each of these variables with the knowledge score. All hypothesis testing were two sided. A P -value of < 0.05 was considered significant.

RESULTS

General characteristics of participants. Participants' sociodemographic characteristics are presented in the first two columns of Table 1. The total number of participants approached was 1,530, with 1,329 participants consenting (87% response rate). The mean age of participants was 28.4 ± 7.2 years.

Knowledge about ZIKAV infection. The mean knowledge score for the study population was 13.7 ± 6.7 (of the 32 knowledge questions), with 47.7% ($n = 792$) of the participants having a score higher than or equal 16 and consequently were considered knowledgeable. However, none of the participants were able to correctly answer all of the 32 knowledge questions and only one participant was able to correctly answer 31 questions. Only 1.4% ($n = 18$) of participants knew the general information related to the definition of ZIKAV infection, its symptoms, and the highest risk group ZIKAV infection (the five questions together). In particular, less than 25% of participants knew that pregnant women represent the highest risk group for ZIKAV infection (21.3%, $n = 282$) (Table 2). A major gap of knowledge regarding ZIKAV complications was also identified, where only 0.3% ($n = 4$) of the population correctly recognized all ZIKAV complications (the five questions together). Regarding ZIKAV modes of transmission, only 13.8% ($n = 181$) of the respondents were aware of the primary route of ZIKAV transmission (the bite of infected mosquitoes). Considering ZIKAV prevention measures, more than half of the participants were able to identify the main prevention measures. However, less than 50% (45.33%, $n = 596$) of them knew that preventing mosquito bites is one of the effective ZIKAV prevention measures.

TABLE 1
Sociodemographic characteristics of all participants ($n = 1,329$) and their association with knowledge score

Variable	%* (n)	Knowledge score	P-value
		Median (interquartile range)	
Age (years)†			
< 30	68.1 (890)	15.0 (8.3)	0.215
≥ 30	31.9 (417)	15.0 (10.0)	
Gender†			
Females	71.1 (944)	16.0 (7.0)	< 0.005‡
Males	28.9 (383)	12.0 (14.0)	
Marital status§			
Married	78.2 (1033)	16.0 (7.0)	< 0.005‡
Single	20.4 (270)	10 (15.0)	
Others	1.4 (18)	12.5 (7.0)	
Education§			
< 12 years	1.1 (14)	4.0 (16.3)	< 0.005‡
High school	7.7 (102)	12.0 (13.3)	
College or technical school	11 (145)	14.0 (8.0)	
Bachelor degree	75.5 (998)	16.0 (8.0)	
Graduate degree	4.7 (62)	19.0 (12.0)	
Monthly income†			
≤ 500 JD	21.9 (279)	11.0 (14.0)	< 0.005‡
> 500 JD	78.1 (996)	16.0 (7.0)	
Employment§			
Unemployed	28.8 (380)	12.0 (12.75)	< 0.005‡
Part time	9.5 (125)	14.0 (11)	
Full time	61.7 (812)	16.0 (7.0)	
Working in medical field†			
Yes	4.2 (52)	20.0 (7.5)	< 0.005‡
No	95.8 (1186)	15.0 (9.0)	
Medical insurance†			
Yes	55.4 (718)	15.0 (10.0)	0.315
No	44.6 (579)	15.0 (8.0)	
Having children†			
Yes	55.3 (718)	16.0 (8)	< 0.005‡
No	44.7 (579)	14.0 (10.0)	
Pregnant ladies†			
Yes	47.3 (362)	16.0 (7.0)	0.471
No	52.7 (403)	16.0 (7.0)	
Man and his wife is pregnant†			
Yes	25.7 (69)¶	13.0 (12.0)	0.337
No	74.3 (201)	13.0 (13.0)	
Future plans of the partners for pregnancy†			
Yes	78.5 (806)	10.0 (14.0)	< 0.005‡
No	21.5 (221)	16.0 (7.0)	

JD = Jordanian dinar.

* Valid percent.

† Mann-Whitney *U* test.

‡ Significant at *P*-value < 0.05.

§ Kruskal-Wallis.

|| Out of 765 married females.

¶ Out of 268 married males.

As presented in the last two columns of Table 1, the gender, marital status, level of education, income, employment, working in the medical field, having children, and planning for pregnancy were associated with a significantly higher total knowledge score (of 32).

Sources of information about ZIKAV infection. The most common source of participants' information about ZIKAV was television (71.8%, $n = 808$) followed by the internet (25.0%, $n = 282$). On the other hand, much lower proportions of respondents reported brochures (2.1%, $n = 24$) or physician office (1.1%, $n = 12$) as a source of information. A significantly higher knowledge score (P -value < 0.005) was associated with using television (score = 15.8) or internet (score = 13.2) as sources of information (P -value < 0.005; Kruskal-Wallis test, test statistic = 25.900, degrees of freedom = 2).

Attitude and practice of participants toward ZIKAV and its prevention measures. Assessment of the participants'

attitude toward ZIKAV infection revealed that 59.9% ($n = 783$) of the participants believed that ZIKAV is a health threat and only 40.6% ($n = 532$) believed that ZIKAV prevention measures are effective (Table 3). Our results revealed that only 1.1% ($n = 14$) have ever traveled to an area with ZIKAV outbreak. Of these 14 participants, 10 participants have implemented ZIKAV prevention measures during their stay. On coming back home, six participants were tested for ZIKAV (test results were not reported), and only three participants continued to implement ZIKAV prevention measures to prevent infecting their partners (Table 3).

Determinants of population adherence to ZIKAV prevention measures. As presented in Table 4, physician advice was the most important determinant to encourage participant adherence to ZIKAV prevention measures, followed by almost equally important factors; the government role and television. However, the majority of participants (94.8%, $n = 1,155$)

TABLE 2
Participants' knowledge about influenza, its mode of transmission, and its prevention measures*

Question	Correctly answered % (n)
Definition, signs and symptoms, risk groups, and complications	
ZIKA is a disease caused by a virus that is primarily spread to people through the bite of an infected mosquito	14.8 (196)
Most persons infected with ZIKAV will have symptoms†	4.7 (62)
Signs and symptoms are fever, rash, joint pain, and conjunctivitis	22.8 (302)
The highest risk group is pregnant women	21.3 (282)
Complications of ZIKAV infection	
ZIKAV infection during pregnancy can cause severe birth defects, including microcephaly	15.9 (211)
Neurological disease: Guillain-Barré syndrome	5.2 (69)
Severe disease requiring hospitalization due to ZIKAV is common†	33.6 (441)
Death from ZIKAV infection is common†	21.0 (276)
ZIKAV infection in childhood has not currently been linked to developmental delays or impaired growth	13.8 (181)
Mode of transmission of ZIKAV	
The bite of infected mosquitoes	13.8 (181)
Sexual contact	42.6 (562)
Vertically from a pregnant woman to her fetus	70.1 (925)
Through blood transfusion	77.7 (1023)
Directly from one person to another through casual contact†	44.9 (592)
Through breastfeeding†	16.7 (220)
Prevention measures	
Prevention of mosquito bites	
The best way to prevent ZIKAV infection is to prevent mosquito bites	45.3 (596)
Use insect repellents	67.0 (882)
Wearing long-sleeved shirts and long pants is not necessary†	40.6 (535)
Stay in places with air conditioning or window and door screens	66.5 (870)
If your room is not well screened, use a bed net when sleeping or resting	71.2 (936)
Removing standing water and rubbish around your home	68.5 (898)
The asymptotically infected individuals returning to non-affected areas should continue the use of insect repellents for a minimum of extra 14 days	26.7 (351)
Prevention of transmission through sex	
Male partner should use condoms (or other barriers) to reduce the chance of getting ZIKAV through sex	61.7 (805)
Other prevention measures	
There is currently no vaccine to prevent ZIKAV infection	24.2 (318)
There is currently no specific drug to prevent ZIKAV infection	34.9 (460)
Isolation of persons with ZIKAV disease is recommended†	3.4 (45)
Treatment of ZIKA Infection	
There is currently no drug to treat ZIKAV infection	24.5 (320)

ZIKAV = Zika virus.

* Note: The table represents 27 of the 32 knowledge questions. Five questions (one regarding the symptoms of ZIKAV infection in children and four regarding the prevention of ZIKAV during pregnancy) were deleted to avoid a lengthy table.

† The correct answer for the questions is "NO."

declared that they have never been advised about ZIKAV by a physician.

Multivariate linear regression model for the factors associated with high knowledge score. As presented in Table 5, the results of the multivariate linear regression analysis (Adjusted $R^2 = 0.138$, P -value < 0.0001 , standard error of the estimate = 5.400, degrees of freedom of the regression = 6, $F = 27.282$, mean square = 795.649) showed that several sociodemographic characteristics, including female gender, income, employment, working in the medical field, having children, and the source of medical information were associated with significantly higher level of knowledge.

DISCUSSION

This is the first comprehensive survey conducted in one of the limited-resources, Middle Eastern country, Jordan. Although Jordan is a country with low risk for ZIKAV, transmission could occur through ZIKAV-infected passengers arriving from areas with active ZIKAV infection, as previously described in a case report of a ZIKAV-infected traveler returning to the Middle East.²³

Knowledge about ZIKAV and its prevention measures.

Our study was carried out during September 2016–April 2017, a period through which emergent ZIKAV-infected cases were

continuously reported to the WHO.²⁴ Despite the international publicity of ZIKAV during that time interval, our findings revealed critical gaps of knowledge in the sample population regarding ZIKAV. In particular, the majority of the population (75–86%) did not know the highest risk group of ZIKAV infection and the serious neurological complications of this disease, and that the major route of transmission of ZIKAV is the bite of infected mosquitos. Besides, about 40% of the population did not know that ZIKAV is sexually transmitted, less than half of the population knew that preventing mosquitos bite is the main prevention measure against ZIKAV infection. Similar inadequate level of knowledge regarding ZIKAV was reported in another Middle Eastern country, Qatar.²¹ In Europe, the result of a survey conducted in a sample of women in Greece showed some gaps of knowledge, where 63% of the surveyed women did not know that ZIKAV can be sexually transmitted and about 25% did not know the negative impact of ZIKAV infection to the fetus.¹⁸ By contrast, the sample population of surveys conducted in areas close to the outbreak regions, such as New York City, NY, was considered knowledgeable.¹⁷ In New York City, 85% of the survey respondents identified mosquitoes as a mode of transmission and 95% reported an association between ZIKAV and microcephaly.¹⁷

Migrants to Jordan from areas with risk of ZIKAV could participate in the transmission and the spread of this disease

TABLE 3

Attitude and practice toward ZIKAV and its prevention measures	
Question	%* (n)
Attitude toward ZIKAV and its prevention measures	
Think that ZIKAV is a health risk	59.9 (783)
Think that the prevention measures are effective	40.6 (532)
Practice of participants toward ZIKAV prevention	
Cancelling a trip to areas with ZIKAV outbreak	1.9 (25)
Practice of participants who have traveled to areas with ZIKAV outbreak	
Having ever traveled to areas with ZIKAV outbreak	1.1 (14)
Implementation of the prevention measures during staying there	71† (10)
Testing for ZIKAV on coming back home	43† (6)
Use of the prevention measures to prevent infecting partner on coming back	21† (3)†
Condom	21† (3)
Continuing the use of insect repellents for a minimum of extra 14 days	21† (3)
Waiting for sufficient time for future pregnancy	21† (3)

ZIKAV = Zika virus.

* Valid percent.

† Out of 14 participants who have ever traveled to areas with active ZIKAV infection.

in Jordan. This is critically important as unsafe sexual behavior was documented in domestic and foreign migrant workers in Jordan.²⁵ This creates fears for a potential of sexual ZIKAV transmission in Jordan, particularly that our results revealed that more than half of the population did not know that this virus is sexually transmitted, and that the majority of participants (95.3%) did not know that the disease is commonly asymptomatic. Similarly, passengers or migrants from Jordan to other territories could also participate in the spread of the diseases. Travel-associated ZIKAV disease has a significant impact in viral circulation as previously documented in the Americas, Europe, China, and the Middle East.^{23,26,27} Considering other routes of ZIKAV transmission, the majority of the participants correctly identified that ZIKAV is transmitted from a pregnant woman to her fetus (70.1%) or possibly via blood transfusion (77.7%). The high knowledge of the population in these aspects might be attributed to speculation based on that these routes are common routes of microbial transmission.²⁸

Multivariate linear regression analysis showed that working in the medical field was associated with significantly higher level of knowledge. In fact, higher level of knowledge regarding medical problems is a mutual characteristic of health-care personnel due to the ongoing learning demand in such fields of work and due to having easy access to specialized medical information resources. This is consistent with the results of previous reports in California and in Qatar, where those having medical background had a significantly

TABLE 4

Factors that encourage participants to adhere to ZIKAV prevention measures*	
Factor	%† (n)
Physician recommendation	93.8 (1,200)
If the government strongly encourages adherence to these measures	77.8 (969)
Advertising through television	74.7 (930)

* Participants were asked to choose as many factors that apply to them.

† Valid percent.

TABLE 5

Results of linear regression analysis for factors associated with high knowledge score

Variables	Standard error	B	T	P-value
Constant	2.170	—	6.871	< 0.000
Age	0.039	0.33	0.775	0.438
Gender	0.430	0.178	5.478	< 0.005*
Marital status	0.578	-0.042	-1.015	0.310
Educational level	0.293	0.045	1.460	0.145
Income	0.513	0.068	2.030	0.043*
Employment	0.241	0.162	4.785	< 0.005*
Working in the medical field	0.841	-0.119	-3.975	< 0.005*
Having children	0.375	-0.063	-1.978	0.048*
Sources of medical information	0.137	-0.122	-3.807	< 0.005*

B = standardized coefficient; T = T-score.

* Significant at P-value < 0.05.

higher knowledge score compared with the other groups surveyed.^{21,29}

In our study, the female gender was associated with significantly higher knowledge score than male gender (14.8 versus 11.0, respectively). This could be attributed to the fact that the high risk group of ZIKAV is pregnant women, and thus females would be more concerned regarding this disease. Of note, females accounted for 71.1% of the study population this is ascribed to approaching obstetrics and gynecology clinics during data collection to ensure having pregnant women in the study population. Similar proportions of females were previously described (75%¹⁷ and 68.2%¹⁹).

In New York City, NY, Samuel et al.¹⁷ showed that pregnancy was significantly associated with the knowledge about ZIKAV transmission but not with the knowledge of its complications or ZIKAV guidelines. Whereas, we showed that pregnant women, despite being the high-risk group of ZIKAV infection, have poor level of knowledge. The difference between our results and the results of Samuel et al. might be ascribed to regional differences, where the sample population of Samuel et al. study resides in close proximity to the areas of the latest ZIKAV outbreak in the Americas.

In contrast to previous studies,^{18,20} our results showed that participants' level of education was not associated higher knowledge score. This is due to the widespread lack of knowledge about ZIKAV within the sample population.

Television and internet were the most common sources of information regarding ZIKAV in the population of this study, while only 1.1% of them used physician office. This was consistent with Cheema et al.²¹ study in Qatar, where the primary sources of information were internet, social media, and television and only 1.9% of the participants used physician office. The sources of information regarding ZIKAV in the United States were very similar to the Middle East, the main sources were television, posters, and newspapers followed by internet. Whereas only 9% of the population heard about ZIKAV from health-care providers.¹⁷ Therefore, using television and internet could be one of the effective methods to spread the message regarding ZIKAV disease.

Attitude and practice of participants toward ZIKAV and its prevention measures. Although 60% of the participants believed that ZIKAV is a health threat, only 40% considered the prevention measures effective. This negative attitude toward prevention measures might be attributed to the poor knowledge of the sample population regarding ZIKAV and its

preventions. Our data showed that determinants of using prevention measures included physician advice followed by the government and television roles. Thus, there is a need for enforcement of physician role in this issue; particularly that physician office and clinics are the most accurate sources of information regarding medical problems.³⁰

Travelers are sentinels of ZIKAV transmission.³¹ A positive association was found between the level of knowledge and travel history in Greece,¹⁸ nevertheless, such association was not found in the sample population in United States.¹⁷ In our study associations and inferential statistics regarding travel history could not be established because of the small size of this subgroup (1.1%). Yet, most of those with travel history applied prevention measures while staying in areas with ZIKAV outbreak. Further studies are required to sufficiently address this category.

In conclusion, the results presented in this report revealed a general widespread lack of knowledge within the Jordanian population regarding ZIKAV, its complications and critically its routes of transmission and prevention measures. The primary predictors of population attitude and practice toward ZIKAV prevention were also identified. This study, therefore, introduced critical health implications for health-care policy makers. Collaboration between physicians and the government should take place to address this issue. Initial action plans should adopt the enhancement of the vital role of physicians in this regard and the organization of educational campaigns. It is also recommended to create an emerging infectious disease response team within hospitals that includes a fully prepared team that effectively address emerging infectious diseases, as previously described.³² Utilization of the audiovisual aids such as television and the internet deemed suitable to publicize the message regarding ZIKAV, and the efficacy of its prevention measures. Special attention should be given to pregnant women, those planning for future pregnancy and travelers to/returnees from areas with risk of ZIKAV. Further studies are required to address the knowledge, attitudes and practices of travelers and physicians regarding ZIKAV and its prevention.

Received August 30, 2018. Accepted for publication December 16, 2018.

Published online January 21, 2019.

Note: Supplemental file appears at www.ajtmh.org.

Financial support: The Deanship of Academic Research (DAR) at the University of Jordan.

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REFERENCES

1. Acosta-Ampudia Y, Monsalve DM, Castillo-Medina LF, Rodríguez Y, Pacheco Y, Halstead S, Willison HJ, Anaya JM, Ramírez-Santana C, 2018. Autoimmune neurological conditions associated with Zika virus infection. *Front Mol Neurosci* 11: 116.
2. Haby MM, Pinart M, Elias V, Reveiz L, 2018. Prevalence of asymptomatic Zika virus infection: a systematic review. *Bull World Health Organ* 96: 402–413.
3. Atif M, Azeem M, Sarwar MR, Bashir A, 2016. Zika virus disease: a current review of the literature. *Infection* 44: 695–705.

4. Centers for Disease Control and Prevention (CDC), 2018. *Zika Virus*. Available at: <https://www.cdc.gov/zika/healtheffects/index.html>. Accessed August 5, 2018.
5. Silva GS, Richards GA, Baker T, Hidalgo J, Jiménez JIS, Amin P; Council of the World Federation of Societies of Intensive and Critical Care Medicine, 2018. Zika virus: report from the task force on tropical diseases by the World Federation of Societies of Intensive and Critical Care Medicine. *J Crit Care* 46: 106–109.
6. Musso D, Rodriguez-Morales AJ, Levi JE, Cao-Lormeau VM, Gubler DJ, 2018. Unexpected outbreaks of arbovirus infections: lessons learned from the Pacific and tropical America. *Lancet Infect Dis* 18: e355–e361.
7. Centers for disease control and prevention (CDC), 2018. *World Map of Areas with Zika Risk*. Available at: <https://wwwnc.cdc.gov/travel/page/world-map-areas-with-zika>. Accessed June 25, 2018.
8. Ducheyne E et al., 2018. Current and future distribution of *Aedes aegypti* and *Aedes albopictus* (Diptera: Culicidae) in WHO eastern Mediterranean region. *Int J Health Geogr* 17: 4.
9. Kanani K, Amr Z, Katbeh-Bader A, Arbaji M, 2017. First record of *Aedes albopictus* in Jordan. *J Am Mosq Control Assoc* 33: 134–135.
10. Tridane A, El Khajah A, Ali BR, 2016. The possible threat of Zika virus in the Middle East. *Travel Med Infect Dis* 14: 277–278.
11. The World Bank, 2012. *International Migrant Stock, Total*. Available at: <https://data.worldbank.org/indicator/SM.POP.TOTL?locations=JO>. Accessed July 5, 2018.
12. Labour Market Profile, 2016. *Danish Trade Union Council for International Development and Cooperation Website*. Available at: http://www.ulandssekretariatet.dk/sites/default/files/uploads/public/PDF/LMP/Imp_malawi_2016_final_version1. Accessed August 5, 2018.
13. Sweileh WM, 2018. Global research output in the health of international Arab migrants (1988–2017). *BMC Public Health* 18: 755.
14. Nimer NA, 2018. Review on emerging and reemerging of infectious diseases in Jordan: the after math of the Syrian crises. *Can J Infect Dis Med Microbiol* 2018: 8679174.
15. Connor P, 2016. *Middle East's Migrant Population More than Doubles Since 2005*, Pew Research Center Website. Available at: http://assets.pewresearch.org/wp-content/uploads/sites/2/2016/10/18092506/Middle-east-migrants_FINAL_PM. Accessed August 2, 2018.
16. Pan American Health Organization (PAHO), 2016. *Guidelines for Surveillance of Zika Virus Disease and its Complications*. Available at: <http://iris.paho.org/xmliui/handle/123456789/28405>. Accessed August 2, 2018.
17. Samuel G et al., 2018. A survey of the knowledge, attitudes and practices on Zika virus in New York City. *BMC Public Health* 18: 98.
18. Mouchtouri VA, Papagiannis D, Katsioulis A, Rachiotis G, Dafopoulos K, Hadjichristodoulou C, 2017. Knowledge, attitudes, and practices about the prevention mosquito bites and Zika virus disease in pregnant women in Greece. *Int J Environ Res Public Health* 14: pii: E367.
19. Huang Y et al., 2017. Knowledge, attitudes, and practices regarding Zika: paper- and internet-based survey in Zhejiang, China. *JMIR Public Health Surveill* 3: e81.
20. Howells ME, Lynn CD, Weaver LJ, Langford-Sesepesara M, Tufa J, 2018. Zika virus in American Samoa: challenges to prevention in the context of health disparities and non-communicable disease. *Ann Hum Biol* 45: 229–238.
21. Cheema S, Maisonneuve P, Weber I, Fernandez-Luque L, Abraham A, Alrouh H, Sheikh J, Lowenfels AB, Mamtani R, 2017. Knowledge and perceptions about Zika virus in a Middle East country. *BMC Infect Dis* 17: 524.
22. Abu-Rish EY, Elayeh ER, Mousa LA, Butanji YK, Albsoul-Younes AM, 2016. Knowledge, awareness and practices towards seasonal influenza and its vaccine: implications for future vaccination campaigns in Jordan. *Fam Pract* 33: 690–697.
23. Meltzer E et al., 2016. Zika virus disease in traveler returning from Vietnam to Israel. *Emerg Infect Dis* 22: 1521–1522.
24. World Health Organization (WHO), 2017. *Zika Virus Situation Reports*. Available at: <http://www.who.int/emergencies/zika-virus/situation-report/en/>. Accessed August 3, 2018.

25. Al Rifai R, Nakamura K, Seino K, Kizuki M, Morita A, 2015. Unsafe sexual behavior in domestic and foreign migrant male workers in multinational workplaces in Jordan: occupational-based and behavioural assessment survey. *BMJ Open* 5: e007703.
26. Hamer DH et al.; GeoSentinel Surveillance Network, 2017 Travel-associated Zika virus disease acquired in the Americas through February 2016: a GeoSentinel analysis. *Ann Intern Med* 166: 99–108.
27. Jia H et al., 2018. Zika virus infection in travelers returning from countries with local transmission, Guangdong, China, 2016. *Travel Med Infect Dis* 21: 56–61.
28. World Health Organization (WHO), 2009. *Principles of Infectious Disease Transmission Short Course on Infectious Diseases in Humanitarian Emergencies*. Available at: http://www.who.int/diseasecontrol_emergencies/publications/idhe_2009_london_inf_dis_transmission.pdf. Accessed August 5, 2018.
29. Brissett DI, Tuholske C, Allen IE, Larios NS, Mendoza DJ, Murillo AG, Bloch EM, 2018. Zika virus: knowledge assessment of residents and health-care providers in Roatán, Honduras, following an outbreak. *Am J Trop Med Hyg* 99: 211–215.
30. Berenson AB, Trinh HN, Hirth JM, Guo F, Fuchs EL, Weaver SC, 2017. Knowledge and prevention practices among U.S. pregnant immigrants from Zika virus outbreak areas. *Am J Trop Med Hyg* 97: 155–162.
31. Leder K et al., 2017. Zika beyond the Americas: travelers as sentinels of Zika virus transmission. A GeoSentinel analysis, 2012 to 2016. *PLoS One* 12: e0185689.
32. McCulloch K, 2017. Creation of an emerging infectious disease response team. *Am J Infect Control* 45: S148.