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Infection-control knowledge, attitude, practice, and risk perception of occupational exposure to Zika virus among nursing students in Korea: A cross-sectional survey^{☆,☆☆}

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ABSTRACT

Background: As the number of patients with Zika virus infection increases worldwide, nursing students who conduct clinical practice in hospitals tend to at risk of Zika virus infection. Therefore, this study was conducted to identify nursing students' knowledge, attitudes, practices, and risk perceptions of infection prevention related to occupational exposure to Zika virus infection, and to identify correlations among the related variables.

Methods: This cross-sectional study included 249 nursing students from 3 nursing colleges located in 3 Korean cities, with experience in hospital clinical practice. A questionnaire to assess the knowledge, attitudes, practices, and risk perceptions of Zika virus infection was developed through a literature review and was subjected to pilot testing and validation.

Results: The level of infection-control knowledge for Zika virus was 54.5 of 100 points, and that of practice was 4.5 of 5 points. The infection-prevention attitude score was 4.4 of 5 points, and the risk-perception score was 2.3 of 5 points. Significant differences emerged in infection-prevention attitude toward Zika virus based on Zika virus vaccination intention. Additionally, practice and risk-perception scores differed significantly based on gender and Zika virus vaccination intention. Knowledge significantly correlated with attitude and attitude toward preventive behavior.

Conclusion: Improvement in infection-control knowledge for Zika virus can help improve nurses' related attitudes, which in turn could promote effective practice. Considering the characteristics of nursing students, it is necessary to develop and apply an effective and viable education program related to the prevention of Zika virus infection.

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Introduction

Zika virus was first discovered in 1947 in Zika Forest, Uganda [1]. A human case was reported in 1952 and about 28,000 people were infected in Polynesia in 2013 [2]. The association of Zika virus with Guillain-Barre syndrome was first proposed by Duong et al. [2]. Zika virus infection in pregnant women is also a known cause of serious birth defects in children. In February 2016, the World Health Organization declared Zika virus infection a public health

emergency and an international issue [3,4]. In Korea, 3347 Zika virus diagnostic tests were conducted in 2016, and 16 of them were diagnosed as Zika virus infections. Zika virus is designated and managed as a legal infectious disease since 2016 in Korea [5,6]. Between 2016 and 2017, 28 patients with Zika virus infection were reported from a national surveillance system. An analysis on demographic, epidemiological, and clinical characteristics of those infected with Zika virus indicated that they had traveled overseas, for mostly short-term visits, to Southeast Asian countries [5].

Zika virus is transmitted by the infected *Aedes aegypti* mosquito and is not transmitted by routine contact, but it is known to spread through the placenta, breast milk, saliva, blood transfusion, and sexual intercourse [7]. Moreover, the estimated rate of asymptomatic Zika infection, as described in other arboviruses such as West Nile virus and dengue, is reportedly high [4]. Recently, a case was reported in which an experimenter was infected with Zika virus due to a needle stick injury in the laboratory setting

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[6,8]. Therefore, there is a renewed need for attention to blood-borne diseases for health care workers (HCWs), who are at high risk for exposure to infections through blood or body fluids such as Zika virus, HIV, and Ebola virus [9,10]. Nursing students experience nursing care at the clinical site during their clinical practice [11]. Consequently, they are also involved in clinical practice related to blood-borne infections during the practice period. However, nurses lack expertise regarding this situation and lack interest in self-protection against the associated risk of infection, leading to a greater risk of exposure to blood-borne infections [12]. Nursing students' recapping habits could last even after they become nurse. Indeed, it is difficult to change inappropriate nursing habits once they have developed, which may lead to an increase in the incidence of blood-borne infections after students start working as nurses [11].

Research on HCWs and Zika virus has thus far focused on investigating general knowledge of Zika virus [3,13], or the knowledge that nurse practitioners or health care providers should possess, along with their misconceptions regarding Zika virus [14,15]. To prevent the spread of infections such as that caused by Zika virus, compliance with standard precautions, being equipped with appropriate expanded personal protective equipment (PPE), and the prevention of needle-stick injuries are important [9,10]. However, a lack of research describes the prevention of infectious diseases, and Zika virus infection in particular, among medical staff in hospitals, presenting a new problem.

Therefore, it is necessary to investigate nursing students' level of knowledge, attitudes, risk perceptions, and infection-prevention practices related to Zika virus infection to prepare them for the risk of blood-borne infection, as the number of patients with Zika virus infection increases. Nursing students are future professionals who can address new emerging infectious diseases [16]. Therefore, the present study focused on nursing students who could be exposed to Zika virus infection, and investigated their knowledge on infection prevention, attitudes, practice, and risk perceptions of Zika virus. The study aimed to provide basic information to undergird the development of a health-education program for the effective and feasible prevention of Zika virus infection and to contribute to nursing students' compliance with infection-prevention guidelines and health promotion.

Methods

Design and sampling

This descriptive study attempted to investigate knowledge, attitudes, practices, and risk perceptions regarding Zika virus among nursing students who had experienced hospital clinical practice, and to identify the correlation among study variables.

Participants were recruited through convenience sampling from three 4-year nursing universities located in three cities (Seoul, Gyeonggi-do, and Incheon) in Korea. Junior or senior nursing students who had engaged in clinical practice for 8 h a day at university hospitals in the last 6 months were selected.

The data-collection period was June 2017. The sample size was calculated using the G-Power 3.1 program [17], 16 with a significance level of .05 for the correlation analysis, an average effect size of 0.15, and power of 0.95. The minimum number of participants required for this study was 134, but a sample of 260 was targeted, in consideration of dropouts. Finally, 255 students (response rate 98.1%) responded to the survey, and 249 of them were used in the final analysis, after excluding questionnaires with incomplete responses. The study was approved by the institutional review board of the author's university of affiliation before its commencement (No. 2017-082).

Study tools

The study questionnaires assessed general characteristics, infection-control knowledge on Zika virus, practice, attitudes, and risk perceptions, developed based on prior research [6,9,10,16,18]. The appropriateness of the questionnaires was verified based on the Content Validity Index (CVI) for the evaluations of 2 infection-control nurses, 1 infection medical doctor, and 2 nursing professors. Additionally, the validity of the preliminary questionnaires was evaluated through pilot testing, conducted with 14 nursing students.

Infection-control knowledge on Zika virus

The questionnaire was developed by referencing interim guidelines for protecting workers from occupational exposure to Zika virus presented by OSHA [10], the questionnaire for Zika response guideline provided by the CDC and the KCDC [6], and a survey that investigated the knowledge of U.S. college students on Zika virus [18].

The questionnaire comprises 19 items on the following topics: Zika virus epidemiology (2 items), transmission mechanism (3 items), symptoms (4 items), complications (5 items), treatment (2 items), and clinical infection-prevention practice (3 items). Higher scores indicated a higher level of knowledge. Each correct answer was scored 1, whereas a wrong answer was scored 0. The total score was then converted to a 100-point scale. The reliability score of the questionnaire in the pilot study was Kuder-Richardson 20 = .66, and that in the main study was Kuder-Richardson 20 = .72.

Infection-Control Attitude Toward Zika Virus

This questionnaire included the following two questions: "prevention of needle stick injuries is important when caring patients with Zika virus infection" and "it is important to wear protective equipment if blood or body fluids are likely to splash during a nursing care in patients with Zika virus infection." Participants responded on a 5-point Likert-type scale ranging from 1 point for "Do not practice at all" to 5 points for "Always practice." Higher scores indicated a higher level of preventive behavior. The reliability of the questionnaire in the pilot study was Cronbach's α = .88, and that in the main study was Cronbach's α = .90.

Infection-control practice against Zika virus

The questionnaire assessed the following 3 items: "I do not recap the syringe needle to prevent needle stick injuries when caring for patients with Zika virus infection," "To prevent a needle stick injuries when caring for patients with Zika virus infection, I use a special container to dispose of the needle," and "I wear protective equipment when exposed to blood or body fluids when nursing patients with Zika virus infection." Responses were made on a 5-point Likert scale ranging from 1 point for "Do not practice at all" to 5 points for "Practice always." Higher scores indicate a higher degree of prevention. The reliability of the questionnaire in the pilot study was Cronbach's α = .80, and that in the main study was Cronbach's α = .88.

Risk perceptions of Zika virus

Risk perception is the possibility and fear of infection, and items related to it originally assessed nursing students' risk perception toward Middle East Respiratory Syndrome [16] used after modifying the source of infection to Zika virus. The following 2 questions were asked: "I am more susceptible to being infected with Zika virus as compared to others" and "I am afraid of being infected with Zika virus." Responses were made on a 5-point Likert-type scale ranging from 1 point for "Strongly disagree" to 5 points for "Strongly agree." Higher scores indicated a higher perceived risk of Zika virus infection. The reliability of the questionnaire in the

Table 1
Differences in the level of infection control knowledge, attitude, practice, and risk perception of Zika virus according to sample characteristics (N=249).

Variables	Characteristics	N	%	Knowledge (range 0–100%)		Attitude (range 1–5)		Practice (range 1–5)		Risk perception (range 1–5)	
				M ± SD	t	M ± SD	t	M ± SD	t	M ± SD	t
Gender	Male	29	11.6								
	Female	220	88.4								
Age in years (M ± SD, range)		21.9 ± 1.4	20–27								
Hospital clinical practice experience		249	100.0								
Zika virus vaccination intention	Yes	188	75.5	54.5 ± 19.8	0.002	4.5 ± 0.6	4.804*	4.6 ± 0.8	8.506*	2.3 ± 0.9	6.515*
Experience with education related to Zika virus	No	61	24.5	54.4 ± 19.9		4.2 ± 0.8		4.2 ± 1.0		2.0 ± 0.7	
	Yes	45	18.2	53.7 ± 17.7	0.098	4.4 ± 0.8	2.562	4.5 ± 0.8	2.777	2.3 ± 0.8	0.131
	No	204	81.9	54.7 ± 20.3		4.3 ± 0.8		4.3 ± 1.0		2.3 ± 0.8	

Computed using the independent samples *t*-test.

* $p < .05$.

Table 2
Scores for the main variables (N=249).

Items	%
Infection control knowledge related to Zika virus (possible range: 0–100%)	54.5
Epidemiology	71.3
Zika virus is spread throughout South America. (True)	70.3
There is an infected person in Korea who returned after travelling to Zika-infected countries. (True)	72.3
Transmission	57.1
Zika virus spreads via contaminated food. (False)	47.8
Zika virus spreads via infected mosquitoes. (True)	90.8
A man infected with Zika virus infects a woman during sexual intercourse. (True)	32.7
Symptoms	42.4
The common symptom of Zika virus is fever. (True)	84.3
The common symptom of Zika virus is skin rash. (True)	44.2
The common symptom of Zika virus is bloody diarrhea. (False)	14.9
Zika virus symptoms in adults are generally not severe. (True)	25.9
Complications	50.4
Zika virus causes problems to the fetus of a pregnant woman. (True)	79.1
Zika virus is considered to be the cause of artificial abortion. (True)	45.2
Zika virus is considered to be the cause of Guillain-Barre syndrome, an inflammation of peripheral nerves. (True)	21.5
Zika virus is associated with fetal microcephaly. (True)	71.1
Zika virus is considered to be the cause of diabetes. (False)	34.9
Treatment	36.3
Until recently, Zika virus could not be treated. (True)	35.5
Until recently, there was no vaccine against Zika virus. (True)	36.9
Clinical infection prevention practice	75.9
Blood donation from patients with Zika virus infection is not a problem. (False)	81.9
One could be infected with Zika virus with a needle stick injury from a syringe needle used with patients with Zika virus infection. (True)	72.1
Nurses should be aware of blood-borne infectious diseases while caring for patients with Zika virus infection. (True)	73.7
Infection control practice against Zika virus (M ± SD, possible range: 1–5)	4.5 ± 0.8
I do not recap the syringe needle to prevent needle stick injuries when caring for patients with Zika virus infection.	4.5 ± 0.9
To prevent a needle stick injuries when caring for patients with Zika virus infection, I use a special container to dispose of the needle.	4.5 ± 1.0
I wear protective equipment when exposed to blood or body fluids when nursing patients with Zika virus infection.	4.5 ± 0.9
Infection control attitude toward Zika virus (M ± SD, possible range: 1–5)	4.4 ± 0.7
Prevention of needle stick injuries is important when nursing patients with Zika virus infection.	4.4 ± 0.7
It is important to wear protective equipment if blood or body fluids are likely to splash during nursing patients with Zika virus infection.	4.4 ± 0.7
Risk perception of Zika virus (M ± SD, possible range: 1–5)	2.3 ± 0.8
I am more susceptible to being infected with Zika virus as compared to others.	2.2 ± 0.9
I am afraid of being infected with Zika virus.	2.3 ± 1.0

pilot study was Cronbach's $\alpha = .75$, and that in the main study was Cronbach's $\alpha = .78$.

Data analysis

The collected data were analyzed using the SPSS/WIN 21.0 program (IBM, Armonk, NY, USA), and the main variables were normally distributed, according to the Kolmogorov–Smirnov test. Participants' general characteristics, knowledge, attitudes, practices, and risk perceptions were analyzed using frequency, percentage, and mean and standard deviation. The reliability of the questionnaires was calculated using Cronbach's α . The differences

in the main variables by participants' general characteristics were analyzed using an independent samples *t*-test, and the correlations among variables were computed using the dependent Pearson's correlation test.

Results

General characteristics and differences in the level of main variables

A total of 249 participants had experienced clinical practice, of whom, 88.4% were women. The average age of participants was

Table 3
Pearson's correlation coefficients for the main study variables (N=249).

Variables	1	2	3	4	5
1. Infection control knowledge	1.00	–	–	–	–
2. Infection control attitude	0.24*	1.00	–	–	–
3. Infection control practice	0.08	0.38*	1.00	–	–
4. Risk perception	0.08	0.00	0.02	1.00	–
5. Age in years	–0.09	–0.07	–0.09	–0.03	1.00

Computed using in the dependent Pearson's correlation test.

* $p < .01$.

21.9 years. Of the participants, 75.5% expressed Zika virus vaccination intention, and 81.9% had no experience with Zika-related education.

A significant difference emerged in participants' infection-prevention attitude toward Zika virus based on their Zika virus vaccination intention ($p < .05$). Similarly, a significant difference arose in practice and risk perception based on gender and Zika virus vaccination intention ($p < .05$; Table 1).

Characteristics of the level of infection-control knowledge, attitude, practice, and risk perceptions of Zika virus

Infection-control knowledge related to Zika virus was 54.5 of 100 points. The rate of correct answers was the highest for the category "clinical infection prevention practice" (75.9 points) and lowest for the category "treatment" (35.5 points). Further, the rate of correct answers was highest for the item "Zika virus spreads via infected mosquitoes. (T)" (90.8 points) and lowest for the item "The common symptom of Zika virus infection is bloody diarrhea. (F)" (14.9 points).

Of a possible 5 points, the score on infection-control practice against Zika virus was 4.5 points, that on infection-prevention attitude was 4.4 points, and that on risk perception was 2.3 points, which was the lowest (Table 2).

Correlations among the main study variables

Infection control knowledge on Zika virus significantly correlated with attitude ($r = 0.24$, $p < .01$), which in turn significantly correlated with practice ($r = 0.38$, $p < .01$; Table 3).

Discussion

Between 2016 and 2017, a total 28 patients with Zika virus infections were reported in South Korea. All of them were infected due to short-term overseas trips [5]. Furthermore, since the *Aedes aegypti* mosquitoes are not found in South Korea, the public tends to be aware of the seriousness of Zika virus infection [5,6]. Because Zika virus can spread through blood and body fluids, nurses and other HCWs are at risk of exposure to Zika virus during their work. As the number of Zika virus-infected patients is increasing worldwide, nursing students engaging in clinical practice could also be exposed to the risk of Zika virus infection [9,10]. Therefore, Zika virus infection-prevention measures in hospitals must include not only HCWs but also nursing students. The present study is meaningful in that it examined the actual condition of Zika virus-related knowledge, attitudes, practices, and risk perceptions in nursing students, who are the future experts who will cope with new blood-borne infections.

To prevent the spread of Zika virus, patients should be informed by nurses and other HCWs using charts or other means [8]. Additionally, OSHA and CDC advise HCWs to follow the standard precaution to prevent the blood-borne spread of Zika [9,10], including hand hygiene, use of PPE, and prevention of needle-stick injuries [8]. However, as reported by Kim et al. [19], nursing stu-

dents are at higher risk of exposure to needle-stick injuries than other HCWs because they lack expertise and proficiency. Therefore, nursing students should acquire proper knowledge on blood-borne diseases and should pay more attention on their exposure. In the present study, the average nursing students' level of knowledge on infection control related to Zika virus was relatively low. Studies on general knowledge of Zika virus in nursing students have been limited. As the rate of correct understanding of Zika virus was 58% among nurse practitioners in the United States [14] and only 35% (against the 80% cut-off level) among doctors [13], it is evident that knowledge about Zika virus is generally low not only among nursing students but also among other HCWs. However, by subcategory, nursing students' knowledge level regarding clinical infection prevention practice was relatively high. Nursing students were well informed that the Zika virus could be transmitted through the blood. Nursing students had learned the standard precaution in their fundamentals of nursing [20]. Therefore, scores regarding the prevention of infection and attitude toward preventive measures such as the use of PPEs, not recapping syringe needles, and the use of the needle waste container were relatively fair. The lowest scores were obtained on the subcategories of treatment and symptoms. Nursing students did not have adequate knowledge about the symptoms of Zika virus, except for fever, and were not well aware of the possibility of Guillain-Barré syndrome (the rate of correct answers was 25.9%). Further, 81.9% of the nursing students responded that they did not have educational experience related to Zika virus. These results suggest the need for education to promote knowledge about Zika virus among nursing students, which includes women of childbearing age. Further, such education should be provided systematically as a part of the curriculum to protect nursing students, who are future nurses, from Zika virus infection. In particular, education in areas of little knowledge, such as treatment and symptoms, should be considered. According to the previous study [13], female gender was a significant predictor of knowledge in Indonesian physicians. However, in the present study, data analysis on the differences based on gender was not performed. Approximately 90% of nursing students are women in South Korea [21]. In the present study, 11% of the participants were men.

The present study revealed a significant difference in attitudes, practices, and risk perceptions of Zika virus based on degree of intention to be vaccinated against Zika virus. These results are similar to those obtained from a study on undergraduate students in the United States [18]. Additionally, despite the development of a vaccine against Zika virus [22], most nursing students in the present study did not know about this vaccine (the rate of correct answer was 36.9%). Therefore, Zika virus vaccination intention needs to be considered when developing strategies for the provision of accurate information about the vaccine and to improve attitudes toward infection prevention.

In the present study, nursing students' risk perception regarding Zika virus was relatively low. This may be because Zika virus infections have occurred in South Korea mainly due to foreign influx, with no reports of domestic infection. However, countries to which Korean women in their 20s and 30s mainly travel include Thailand, Singapore, Vietnam, and the Philippines, which have reported cases of Zika virus infection [23,24]. Therefore, when planning a trip abroad, it is necessary for women of childbearing age to check whether the destination country has reported cases of Zika virus. Additionally, they need to be aware of the precautions for preventing mosquito bites and sexual behavior when traveling to countries that have reported Zika virus infections.

Harapan et al. [13] reported that the factor most robustly associated with positive attitude was experience in considering Zika virus infection. Furthermore, positive attitude is associated with knowledge on Zika virus infection. The present study revealed

that Zika virus infection-control knowledge significantly correlated with attitude, and that attitude significantly correlated with practice. This finding indicates that the improvement of nursing students' knowledge on Zika virus infection prevention could change their attitude, which in turn could effectively promote infection-control practices. Nursing students' continue to practice their skills related to the prevention of blood-borne infectious diseases even after they become nurses [11]. Therefore, it is essential to improve infection-control practices, attitudes, and knowledge regarding the blood-borne transmission of newly emerging infections such as Zika virus infection, owing to globalization. The results of the present study can thus be used as basic data for the development and implementation of effective and viable educational programs for nursing students.

The limitations of this study are that subjects were selected from urban areas (Seoul, Gyeonggi-do, and Incheon provinces) in South Korea. All cases of Zika virus infections in South Korea were influx from abroad. Therefore, considering these national characteristics, we propose a comparative study in other countries where Zika virus infection is prevalent or newly emerging.

Conclusion

The present study showed that nursing students' level of knowledge regarding Zika virus infection control and their risk perception were low. However, they had a relatively good knowledge that Zika virus infection are blood-borne transmitted.

A significant difference was observed on infection-prevention attitudes, infection-prevention practices, and emerging risk perception based on Zika virus vaccination intention. Finally, infection-control knowledge is significantly correlated with infection-control attitude, which is also significantly correlated with infection-control practices.

These findings suggest the need to develop effective and systematic promotional and educational programs in nursing colleges and hospitals, considering the low scores on knowledge items. Education to improve knowledge of prevention of Zika virus infection may contribute to the improvement of attitudes toward the prevention of Zika virus infection and the promotion of infection-control practice for disease prevention.

Competing interests

None declared.

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