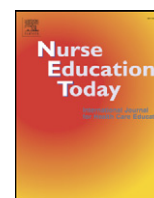Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Factors influencing preventive behavior against Middle East Respiratory Syndrome-Coronavirus among nursing students in South Korea☆

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A B S T R A C T

Background: Middle East Respiratory Syndrome Coronavirus (MERS-CoV), an emerging infectious disease introduced in South Korea in 2015, spreads quickly through hospitals, and Korea became one of the major areas affected by the disease after the Middle East region. To stop the spread of an emerging disease, it is important to practice prevention guidelines correctly.
Objectives: The purpose of this study was to investigate factors influencing preventive behavior against MERS-CoV among Korean nursing students.
Methods: This is a cross-sectional study using a questionnaire survey. Data were collected from 429 nursing students from three colleges of nursing in Korea from June 25 to July 3 in 2015.
Results: Preventive behavior against MERS-CoV was affected mostly by attitude ($\beta = .243$, $p < .001$). Such behavior was also high in relation to the variables of perceived risk ($\beta = .232$, $p < .001$), older students ($\beta = .202$, $p < .001$), knowledge level ($\beta = .153$, $p < .01$), and female respondents ($\beta = .115$, $p < .05$).
Conclusion: Preventive behavior against emerging infectious diseases such as MERS-CoV was found to be affected most significantly by attitude and risk perception. It is crucial to provide nursing students with information or knowledge, but it is also important to help those in nursing education recognize that active preventive behavior can prevent this infectious disease and stop its spread.

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1. Introduction

In Korea, the first Middle East Respiratory Syndrome Coronavirus (MERS-CoV) patient was identified on May 20, 2015; from that time on, the disease spreads rapidly throughout the Korean society. By July 5, the number of patients definitely diagnosed with the disease had reached 186, and 33 (17.8%) of them had died (Korea Centers for Disease Control and Prevention, 2015). MERS-CoV was first detected in Saudi Arabia in 2012, and approximately 95% of cases have been detected in the Middle East region. The infection route has not been explained clearly, although its transmission through Arabian camels was reported in Saudi Arabia (Centers for Disease Control and Prevention, 2015). Most patients originally present with a severe acute lower respiratory infection, but some are asymptomatic or show a mild acute upper respiratory infection (Centers for Disease Control and Prevention, 2015).

Until the incidence of its first case, MERS-CoV was an unfamiliar disease in Korea. Accordingly, the spread of this infectious disease caused anxiety among the Korean people, an anxiety aggravated further by the news that infected patients had died. It has now become common

for people to wear masks on the street to prevent infection. Schools were gradually closed, various cultural events were canceled, and the number of tourists decreased. The spread of MERS-CoV had extensively impacted the Korean society, not only in the socio-economic aspect but also in individuals' daily lives (Jun, 2015; Lee and Yeo, 2015).

To stop the spread of an infectious disease, it is most important to observe the established prevention guidelines correctly. Nursing students in Korea theoretically learn the concept of universal precaution as their infection prevention curriculum in the Fundamental Nursing undergraduate course, where they also practice hand washing and the use of personal protective equipment. In addition, when nursing graduates become clinical nurses, they are educated on standard isolation precautions for each transmission route through facility programs for new nurses and continuing education programs on infection control. However, it is difficult for hospitals to maintain the resources needed to carry out, since the high cost of protective equipment for each transmission route is not covered by Korea's national health insurance (Jeong et al., 2008; Kim et al., 2001).

Currently, healthcare-associated transmission plays a pivotal role in the evolution of the MERS-CoV epidemic. Above all, nurses are mostly affected, a situation attributed to their prolonged, repeated, and close physical contact with patients (Maltezou and Tsiodras, 2014). Because nursing students complete their clinical practice coursework in hospital settings, they may also be exposed to patients and health care workers

who are suspected of or diagnosed with MERS-CoV infection. Therefore, preventive behavior against MERS-CoV needs to be promoted among nursing students to limit the reach of the novel infectious disease in hospital environments. In this sense, it is necessary first to identify factors influencing nursing students' MERS-CoV preventive behavior.

Previous studies on MERS-CoV have mostly been medical research investigating infection cases, infection routes, or infection risk (Choi et al., 2015; Cowling et al., 2015; Hall et al., 2014; Hui et al., 2015; Maltezou and Tsiodras, 2014; Park et al., 2015). In Saudi Arabia, where the disease originated, research was conducted on health care workers' and ordinary people's knowledge and attitudes regarding MERS-CoV (Gautret et al., 2013; Khan et al., 2014). However, no study has analyzed factors influencing MERS-CoV preventive behavior among nursing students who are future health care workers.

In addition, according to previous studies, university students' preventive behavior against respiratory infectious disease such as SARS and H1N1 is affected by knowledge level (Brug et al., 2004; Choi and Yang, 2010; Hussain et al., 2012), attitude toward the disease (Choi and Yang, 2010), and risk perception (Brug et al., 2004; Hussain et al., 2012). However, previous studies did not identify if the three variables of knowledge, attitude, and risk perception are correlated with preventive behavior against respiratory infectious disease.

This study's researchers therefore composed a conceptual framework of knowledge, attitude, and MERS-CoV preventive behavior based on the KAP (Knowledge, Attitude, and Practice) model (Coreil, 1997), adding a concept of risk perception. The study is expected to identify whether knowledge, attitude, and perceived risk are correlated with MERS-CoV preventive behavior and to explain the integrated effect of these variables on MERS-CoV preventive behavior.

2. Methods

2.1. Design

This study used a cross-sectional descriptive research design. The study was conducted in two phases. First, a pilot study was conducted to test the feasibility and reliability of the measuring tools. After the pilot study's completion, the main survey was conducted to investigate factors influencing preventive behavior against MERS-CoV among Korean nursing students. The survey questionnaire consisted of 6, 15, 9, 1, and 10 questions concerning general characteristics, knowledge, attitude, perceived risk and preventive behavior against MERS-CoV, respectively.

2.2. Participants

Study participants were sampled through convenient sampling from nursing students attending 4-year nursing schools in Incheon, Iksan, and Busan in Korea. Data were collected from June 25 to July 3 in 2015.

The sample size was estimated using G-Power 3.1 (Faul et al., 2007). With $\alpha = 0.05$, effect size f = 0.06, power = 0.95, and number of predictors = 8 for linear multiple regression, the smallest required sample size was 387. However, to insure against elimination and the even distribution of participants among the conveniently selected three universities, 150 questionnaires were delivered to each school. In total, 432 questionnaires were recovered (response rate, 95.3%), and three incomplete questionnaires were excluded. Therefore, 429 questionnaires were used in analysis as valid data.

2.3. Measures

2.3.1. Knowledge about MERS-CoV

The researcher developed the MERS-related knowledge scale based on the MERS response guidelines provided by the Centers for Disease Control and Prevention (2015) and Korea Centers for Disease Control and Prevention (2015) and the questions used to survey health care

workers' knowledge in Saudi Arabia (Khan et al., 2014). This scale consisted of 16 items, and its content validity (CVI) was rated by two infection control nurse practitioners, one infectious disease specialist, and one nursing professor using a scale of 1 = not relevant to 4 = very relevant. One item that received 1 or 2 points was removed, and 12 nursing students who were not participants in the main survey were given the restructured 15-item scale as a pilot study to correct ambiguous phrases and words.

The 15 items included questions about the cause of MERS (3 items); symptoms and latent period (2 items); test, treatment, and prevention methods (7 items); and patient nursing guidelines (1 item); a high score indicated a high level of knowledge. A correct answer was given 1 point, an incorrect answer or "don't know" response was given 0 points, and the total score was converted into a percentile. The final CVI of the scale was 0.95, and its reliability (Kuder–Richardson 20) was 0.65 in the pilot study and 0.79 in the main survey.

2.3.2. Attitude toward MERS-CoV

The researcher developed the scale on attitude toward MERS-CoV by extracting 9 items from a review of previous studies (Brug et al., 2004; Choi and Yang, 2010; Hussain et al., 2012; Khan et al., 2014). Each item was answered on a 5-point Likert scale from "Not at all" (1) to "Absolutely yes" (5), and a high score meant that the respondent felt MERS-CoV was a serious issue and believed that preventive behavior would protect him or her against MERS-CoV infection.

When the validity of the scale was tested through factor analysis, two factors were extracted and labeled as belief in prevention and perceived severity. Ambiguous phrases and words were revised through a pilot study; the reliability (Cronbach α) of the tool was 0.79 in the pilot study and 0.86 in the main survey. On the other hand, the factors explained 66.481% of variance, and the reliability coefficient of each factor was 0.741–0.898, an acceptable level (Table 1).

2.3.3. Perceived risk of acquiring MERS-CoV

To rate the perceived risk of MERS-CoV, the researchers developed a descriptive 5-point scale (1 = "Not at all" to 5 = "Absolutely yes") to answer the statement, "I am worrying about being infected with MERS.", The content validity of this scale was tested by two infection control nurse practitioners, one infectious disease specialist, and one nursing professor. A high score meant a high perceived risk of acquiring MERS-CoV.

2.3.4. Preventive behavior against MERS-CoV

Preventive behavior against MERS-CoV refers to the degree the respondent practices behavior to avoid becoming infected with the disease. The researcher developed the scale for this factor based on questions that Gautret et al. (2013) used to survey the performance of MERS prevention and the MERS response guidelines provided by the Korea Centers for Disease Control and Prevention (2015) for Korean people. The scale was tested by two infection control professors, two infection control nurse practitioners, and one infectious disease specialist, and its CVI was 0.90. This scale consisted of 10 items, including items focused on the reduced use of public places in daily living (6 items), the avoidance of people who are coughing (1 item), intensified cleaning and disinfection (1 item), hand washing (1 item), and discussion with people in one's environment about coping with the disease (1 item). Each item could be answered as "Performed" (1) or "Not performed"/ "Not applicable" (0), and the total score ranged from 0 to 10. A high score meant a high performance of preventive behavior. The reliability (Cronbach α) of the scale was 0.76 in the pilot study and 0.85 in the main survey.

2.4. Procedure

Before data collection, this research was approved by the Institutional Review Board of G University in Korea (No. 1044396-201504-HR-029-

Table 1
Factor analysis of attitudes toward MERS-CoV.

Factors	Eigen values	Relative explanatory power (%)	Cumulative explanatory power (%)	Factor reliability
Belief in prevention (7 items)	4.440	49.336	49.336	.898
Perceived severity (2 items)	1.543	17.145	66.481	.741

MERS-CoV = Middle Eastern respiratory syndrome-coronavirus.

01). The study was explained to professors at the three conveniently sampled nursing schools. Once their consent was obtained, the questionnaires were sent by mail to each professor. The professor explained the purpose of this research to their students during class time, obtained the students' written consent, distributed the questionnaires, and recovered answered questionnaires. A gift (ballpoint pen and notepad) was delivered to those students who answered the questionnaire. The finished questionnaires were mailed back to the researcher.

2.5. Data analysis

Collected data were analyzed using SPSS/WIN 21.0, and the normal distribution of the major variables was confirmed before analysis. The participants' general characteristics, MERS-CoV-related knowledge, attitude, perceived risk, and preventive behavior were analyzed using frequencies, percentages, means, and standard deviations. The reliability of related variables was assessed using Cronbach α. Differences in preventive behavior according to general characteristics were analyzed through the independent t-test, ANOVA, and post-hoc Scheffe test. Correlations were computed using the independent Pearson correlations test. To identify factors influencing MERS-CoV preventive behavior, multiple linear regression analysis was performed using variables found significant on difference testing and correlation analysis. The Durbin-Watson statistic was used to test for the presence of serial correlation among the residuals, and multicollinearity was detected by examining the tolerance for each independent variable.

3. Results

3.1. General characteristics and differences in preventive behavior

The participants' average age was 20.98, and 89.5% of them were women. In addition, 32.6% were seniors and 27.0% were juniors. Only 36.8% replied that they had been provided with information about MERS-CoV, and 76.5% mentioned "Remedies for MERS-CoV" as

information that they wanted to have about the virus (Table 2). There was a significant difference in preventive behavior according to gender and grade among general characteristics ($p < .01$; Table 2).

3.2. Characteristics of MERS-Cov-related knowledge, attitude, preventive behavior, and perceived risk

The participants' mean scores were 81.89 out of 100 on knowledge about MERS-CoV, 3.75 out of 5 on attitude, 2.55 out of 5 on perceived risk of MERS, and 4.51 out of 10 on preventive behavior (Table 3).

3.3. Correlation between MERS-CoV preventive behavior and the main study variables

The participants' MERS-CoV preventive behavior was statistically significantly correlated with their knowledge (r = 0.247, $p < .01$), attitude (r = 0.340, $p < .01$), perceived risk (r = 0.383, $p < .01$), and age (r = 0.207, $p < .01$) (Table 4).

3.4. Factors influencing preventive behavior against MERS-CoV

According to the results of linear multiple regression analysis using variables found to have a significant effect on preventive behavior against MERS-CoV (as in Tables 1 and 3), MERS-CoV preventive behavior was most affected by attitude, defined as recognizing the seriousness of MERS and believing that one's own preventive behavior could prevent MERS infection ($\beta = .242$, $p < .001$). Preventive behavior against MERS-CoV was also related to high-perceived MERS-CoV risk ($\beta = .232$, $p < .001$), older students ($\beta = .202$, $p < .001$), knowledge level ($\beta = .153$, $p < .05$), and female respondents ($\beta = .115$, $p < .05$). In addition, these variables explained 24.9% of variance in preventive behavior against MERS-CoV (Table 5).

On the other hand, the Durbin–Watson statistic was 1.822 in the error auto-correlation test for regression analysis, demonstrating no auto-correlation. Tolerance for testing multicollinearity was .719–.947,

Table 2
Preventive behavior against MERS-CoV according to participant characteristics ($N = 429$).

Variables		n (%)		Mean ± SD	t or F
Age (years)				20.98 ± 2.12 (range 18–36)	
Gender	Female	384	(89.5)	3.60 ± 2.84	−2.670[**]
	Male	45	(10.5)	4.61 ± 2.36	
Grade	Freshman[a]	64	(14.9)	3.56 ± 2.20	6.245[**]
	Sophomore	109	(25.4)	4.44 ± 2.13	(b > a[*])
	Junior	116	(27.0)	4.37 ± 2.28	
	Senior[b]	140	(32.6)	5.11 ± 2.73	
Religion	Have	181	(42.2)	4.48 ± 2.44	−0.182 (.856)
	Do not have	248	(57.8)	4.53 ± 2.43	
Informed about	Yes	158	(36.8)	4.70 ± 2.42	1.216 (.225)
MERS-CoV	No	271	(63.2)	4.40 ± 2.44	
Information required about MERS-CoV[***]	Prevention	31	(73.0)		
	Causative organism	162	(37.8)		
	Remedy	328	(76.5)		
	Symptom	302	(70.4)		
	Prognosis	302	(70.4)		
	Transmission	326	(76.0)		

MERS-CoV = Middle Eastern respiratory syndrome-coronavirus.
[*] Scheffe post hoc test ($p < .05$).
[**] $p < .01$.
[***] Multiple response.

Table 3
Main variables participant characteristics ($N = 429$).

Variables	Mean ± SD	Observed range
Knowledge about MERS-CoV	81.89 ± 15.53	0–100
Attitude toward MERS-CoV	3.76 ± 0.67	1–5
Perceived risk of acquiring MERS-CoV	2.55 ± 1.15	1–5
Preventive behavior against MERS-CoV	4.51 ± 2.43	0–10

MERS-CoV = Middle Eastern respiratory syndrome-coronavirus.

Table 5
Linear regression analysis predicting preventive behavior against MERS-CoV ($N = 429$).

Variables	B	SE	β	t
Constant	−7.443	1.523		−4.887***
Age	0.226	0.059	.202	3.812***
Gender (female)	0.891	0.376	.115	2.370*
Grade (senior)	−0.131	0.265	−.025	−0.494
Knowledge	0.024	0.007	.153	3.325**
Attitude	0.869	0.171	.243	5.085***
Perceived risk	0.243	0.051	.232	4.785***
	$F = 21.659$*** Adj. $R^2 = .249$			

MERS-CoV = Middle Eastern respiratory syndrome-coronavirus.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

higher than 0.1, and the variance inflation factor was 1.056–1.390, lower than the reference level 10. Thus, there was no multicollinearity problem.

4. Discussion

Contrary to expectation, MERS-CoV, an emerging infectious disease first detected in Korea in 2015, spread quickly through hospitals, hospital visitors, and health care workers, and Korea became one of the major areas affected by the disease after the Middle East region. To stop the transmission of the disease, the KCDC suggested a MERS-CoV prevention guideline that would include personal hygiene rules such as hand washing and cough etiquette as well as tips such as avoiding crowded places (Korea Centers for Disease Control and Prevention, 2015). Despite these efforts, people's anxiety about infection was unchecked, and Korean society was in great confusion, as demonstrated by the closure of kindergartens and elementary schools.

As the MERS-CoV epidemic continues to evolve, effective infection control measures are urgently needed in health care facilities (Maltezou and Tsiodras, 2014). In particular, nursing students who complete their clinical practice courses in hospital and have direct and indirect contact with hospital patients are now required to observe infection prevention behavior more effectively than the general population to prevent various types of infection (Chalmers and Straub, 2006). In this study, however, nursing students' mean MERS-CoV preventive behavior score was less than half at 4.51 out of 10. Considering that patients continued to be diagnosed with MERS even during the period of data collection, this score is not satisfactory. This result suggests that nursing students need special education on emerging infectious diseases and have preventive behaviors actively reinforced during a disease outbreak. The authors' university stopped nursing students' hospital practice, provided hand sanitizer in each lecture room, and required that students' temperatures be checked regularly as part of its preventive measures against infection during the outbreak. However, there was no education specifically on MERS-CoV and preventive behaviors against this contagious disease. Although nursing students learn and practice the universal precaution in regular curriculum, nursing educators need to provide additional education on novel infectious disease for undergraduate nursing students during an outbreak.

By analyzing the factors influencing nursing students' MERS-CoV-related preventive behavior, this study confirmed that attitude was the most important variable and perceived risk was the second most important in strengthening preventive behaviors among a population.

This is similar to the report of Brug et al. (2004) that risk perception was correlated with precautionary actions to avoid SARS. However, it is somewhat different from a previous report that knowledge was the most significant factor influencing university students' preventive behavior against novel influenza A (H1A1) (Choi and Yang, 2010). Although not exactly comparable because of differences in disease and measuring tools, it is believed that this study's participants perceived MERS-CoV to be very serious due to the severity of MERS-CoV and the occurrence of mortal cases, and this perception induced them to practice preventive behavior more actively.

Other factors found in this study to intensify preventive behavior were age, knowledge level, and gender. Nursing students' age has been shown to be correlated with the application of infection control or preventive behavior against H1A1 (Choi and Yang, 2010), a result supported by this study. Moreover, this study found age to be a factor influencing preventive behavior. Knowledge has been continuously reported as a factor correlated with infection prevention behavior and influencing preventive behavior (Brug et al., 2004; Choi and Yang, 2010; Wu et al., 2009). Therefore, continuing education is required to reinforce preventive behavior against emerging infectious diseases such as MERS-CoV. Furthermore, for nursing students who are future health care workers, a separate course on infection prevention may be an efficient measure for preventing the spread of infectious diseases like MERS-CoV.

Participant gender was found to be another factor influencing MERS-CoV prevention behavior, with women being more active in taking preventive measures against the disease. Previous studies on MERS and SARS found women to be more likely to perceive risk (Brug et al., 2004; Khan et al., 2014). In addition, a previous report that perceived SARS risk was correlated with preventive behavior (Brug et al., 2004) explained that gender is a factor influencing preventive behavior. However, because approximately 90% of the participants of this study were women, it is hard to generalize this result. Expanding the sample to include both men and women evenly and analyzing the correlations and mediating effects of the three variables of gender, risk perception, and preventive behavior would address this limitation.

The conceptual framework of this study hypothesis, that knowledge level, attitude toward MERS-CoV, and risk perception could influence

Table 4
Pearson's correlation coefficient between study variables ($N = 429$).

Variables	Preventive behavior against MERS-CoV	Knowledge about MERS-CoV	Attitude toward MERS-CoV	Perceived risk of acquiring MERS-CoV	Age
Preventive behavior against MERS-CoV	1				
Knowledge about MERS-CoV	.247**	1			
Attitude toward MERS-CoV	.340**	.165**	1		
Perceived risk of acquiring MERS-CoV	.383**	.155**	.300**	1	
Age	.207**	.109*	.072	.093	1

MERS-CoV = Middle Eastern respiratory syndrome-coronavirus.
* $p < .05$.
** $p < .01$.

preventive behavior against MERS-CoV, was accepted. Although correlation was weak among main variables in univariate analysis, these variables significantly influenced the preventive behavior against MERS-CoV in the linear multiple regression.

This study found age and gender to also be factors to consider for reinforcing MERS-CoV preventive behavior. Differing from a previous report on H1N1 (Choi and Yang, 2010), this study reported attitude as a more significant variable than knowledge for MERS-CoV preventive behavior.

At present, Korean nursing education for infection prevention is focused on the delivery of knowledge. This study's confirmation of the importance of attitude and risk perception suggests the need for future nursing education and infection prevention education to publicize the risk of the spread of novel infectious diseases and to enhance the performance of infection prevention behavior. MERS is a new infectious disease but already well-known and has inflicted severe socio-economic damages upon Korea. Because of the disease outbreak, schools were closed, various cultural events were canceled, and the annual gross domestic product decreased by at least 0.1% (Jun, 2015). This study's findings provide new insights for infection prevention education in the wake of this new infectious disease.

5. Limitations

This study has a limitation in generalizing its results because the participants were limited to nursing school students sampled from certain areas in Korea. Moreover, because of these schools' demographics, most of the study participants were women. Furthermore, this study was conducted as a cross-sectional survey, making it hard to explain causal relationships. Lastly, because there was not a standardized scale designed to measure attitude toward infection control, the authors developed and used a new tool to evaluate this factor in relation to MERS-CoV, and psychometric properties were not extracted separately for the scale in factor analysis. Thus, attitude toward MERS-CoV measured in this study might not reflect psychometric properties adequately.

6. Conclusions

As future health care workers, nursing students must observe infection control rules more closely than the general population. In this study, preventive behavior against emerging infectious diseases such as MERS-CoV was found to be affected most significantly by attitude and risk perception. Accordingly, nursing education needs to focus on enhancing students' confidence in their ability to prevent infection through perceiving risk accurately and practicing preventive behavior.

Although this study was conducted with nursing students, its findings may be used as basic information for infection prevention and education programs for new nurses in hospitals as well. At the outbreak of an emerging infectious disease, it is important for nurses to be provided with information or knowledge, but it is also crucial to help them recognize that active preventive behavior can help them avoid the disease as well as stop its spread in clinical settings.

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