



# Factors associated with preventive behaviors for COVID-19 among adolescents in South Korea

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## ABSTRACT

**Purpose:** COVID-19's infection rate among adolescents is increasing; hence, it is important to prevent it as it can spread in the community through transmission in schools. It is crucial to determine the extent to which adolescents follow COVID-19 preventive measures and identify factors relating to such behaviors to implement more effective health education. This study aimed to understand factors related to COVID-19 preventive behaviors using the theory of planned behavior (TPB) and the health belief model (HBM) among adolescents in South Korea.

**Design and methods:** A cross-sectional face-to-face questionnaire survey was conducted among 272 adolescents in South Korea. Structural equation modeling was used to examine the relationships between perceived susceptibility, perceived severity, attitude, subjective norms, perceived behavioral control, intention, and COVID-19 preventive behaviors.

**Results:** Among adolescents' COVID-19 preventive behavior scores, wearing masks was the highest and distancing was the lowest. Adolescents' adherence to COVID-19 preventive behaviors was directly or indirectly associated with their perceived susceptibility, perceived severity, subjective norms, perceived behavioral control, and intention.

**Conclusions:** Attention to mitigate social isolation is important to improve compliance with COVID-19 preventive behaviors. Perceived susceptibility, perceived severity, subjective norms, perceived behavioral control, and intention explained 61.3% of adolescents' COVID-19 preventive behaviors, there is a need for education to promote relevant factors.

**Practice implications:** To increase adolescent awareness of COVID-19 and increase attitudes, subjective norms, and perceived behavior control, nurses need to provide education including the evidence for COVID-19 preventive behavior to increase adolescents' understanding and active implementation of those behaviors.

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## Introduction

The COVID-19 pandemic has introduced changes in adolescents' routines. Physical and social distancing from loved ones, avoiding in-person gatherings, wearing masks in public settings, and a drop in academic effort have resulted in difficulties for adolescents (Centers for Disease Control and Prevention (CDC), 2020). Unfortunately, the COVID-19 infection rate among adolescents is constantly increasing, and as this group is largely asymptomatic, they are likely to remain undiagnosed and spread it to others (Dong et al., 2020). Adolescents' COVID-19 infection has a significant impact, as it can spread to local communities through transmission within schools (Choi et al., 2015). Secondary transmission of COVID-19 infection can occur in school

settings when preventive measures are not followed (Stein-Zamir et al., 2020).

Nurses are the frontline healthcare professionals who have been working across schools and the community during the pandemic (Chen et al., 2020). Therefore, it is necessary to identify factors that are related to adolescents' COVID-19 preventive behavior and to provide effective education based on this. However, recent review showed that COVID-19-related studies in the field of nursing mainly focused on improving the health of COVID-19 patients, nursing education, and enhancing nurses' competencies in COVID-19 situations. Only one study proved the effectiveness of COVID-19 preventive behaviors and suggested strategies to improve it (Oh & Kim, 2020). In addition, previous studies have focused mostly on adult groups (Ahamad et al., 2020; Bashirian et al., 2020; Cvetković et al., 2020; Kwok et al., 2020), and thus, adolescents' behaviors for preventing infection have been largely overlooked.

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Various theories have been suggested to clarify the related factors of infection preventive behaviors among adolescents. One such framework is the theory of planned behavior (TPB). The TPB assumes that actions are determined by intention and perceived behavioral control, whereas intentions are determined by attitudes toward behavior, subjective norms, and perceived behavioral control (Ajzen, 1991). This theory has been used in various studies to identify factors that affect behavior, such as actions taken to prevent infection (Ayodele, 2017; White et al., 2015). A previous study demonstrated that teenagers believe that their preventive actions are effective, and their perception of the extent to which family and local governments urged them to adhere to said actions was significantly correlated with their compliance with respiratory hygiene guidelines (Wong & Tang, 2005).

Among the many factors that related to COVID-19 preventive behaviors, it is important to identify adolescents' perceived susceptibility and severity, two important factors that are addressed in the health belief model (HBM). Adolescents are generally ill-equipped to assess the potential dangers of a disease appropriately; consequently, this endows them with a strong belief that they cannot be infected (Millstein & Halpern-Felsher, 2001). This distorted thinking can lead to neglecting health advice and exposing oneself to destructive behaviors that increase the chance of infection (Wong & Tang, 2005). Greater levels of perceived susceptibility and severity, which reflect adolescents' perception of a disease, may serve as important factors promoting good health behaviors. A study on the factors affecting adolescents' preventive behavior for Middle East respiratory syndrome (MERS) reported that of the many individual factors influencing behavioral changes, perception of fear and severity of MERS were the most influential (Choi et al., 2015). The TPB and HBM are well-known and empirically supported theories of health behavior. An integration of the most powerful predictors of behavior may yield a more complete explanation of health behavior (Baranowski, 2005). Previous studies showed that some HBM variables influenced behavioral intention through TPB variables (Reid & Aiken, 2011; Yang, 2015). Therefore, it will be useful to integrate the HBM and TPB to explain the COVID-19 preventive behaviors of adolescents.

This study aimed to understand factors related to COVID-19 preventive behaviors using the TPB and HBM among adolescents in South Korea. The findings will provide a foundational framework for developing a more efficient and practical curriculum for COVID-19 and other respiratory infections, ultimately contributing to preventing the spread of infections in schools and large communities.

### Theoretical framework

Fig. 1 shows the theoretical framework of the current study. We integrated the TPB and HBM to determine the relationships among the latent variables. Attitudes toward behavior, subjective norms, and perceived behavioral control—the key elements of the TPB—are influenced by behavioral, normative, and control beliefs. These beliefs are associated with the HBM, in which an individual's beliefs, such as perception of the susceptibility or severity, can lead to an action. Thus,

perceived susceptibility and severity constructs of the HBM were selected in addition to the TPB.

### Methods

#### Design, sampling, and participants

Participants were recruited by convenience sampling at a middle school in Jeju, South Korea. Data were collected from August 3 to 14, 2020. We were interested in adolescents who are considered to have cognitive characteristics that accompany risk-taking behaviors (Thomson et al., 2015). In this study, we included students from only second year of middle school for the convenience of the school that cooperated with the data collection.

Due to COVID-19, the school opening period in South Korea was delayed, so in-person classes were held during the period of data collection, and a face-to-face survey could be conducted. Recruitment posters containing study details were displayed on the school's bulletin board. The parents' informed consent forms were distributed to students who saw the poster and agreed to participate. Students' informed consent forms and questionnaires were handed out to them after their parents gave written consent. Of the 330 adolescents and their parents, 50 declined to participate because of a lack of interest. In total, 280 adolescents completed the survey (participation rate = 84.8%). Eight individuals were excluded from the final analysis because of missing essential information. After deleting the eight sets of incomplete data, 272 datasets were finally used for the analysis (effective response rate = 82.4%). In a structural equation modeling (SEM) analysis, at least 150 samples are required, and 200–400 samples are preferable (Yu, 2014). Therefore, the sample size in this study was acceptable.

#### Variables and measurements

Based on our theoretical framework, a self-administered questionnaire was developed to identify the factors associated with Korean adolescents' COVID-19 preventive behaviors. First, we clarified the definition of the concept we wanted to measure by using the conceptual definition in the TPB and HBM. After that, a number of previous studies, guidelines, and news articles were reviewed according to the conceptual definition, and based on this, 34 initial questions were developed. Then, we conducted content validity testing with five experts (two nursing professors, one COVID-19 infection control nurse, one school nurse, and one respiratory physician). Definitions of the measurement concepts were presented to the group of experts. The content validity experts were asked to rate the clarity and relevance of each item on a 4-point scale (1 = not at all, 2 = largely not, 3 = mostly, 4 = very). Comments were elicited for each item. The item content validity index (I-CVI) for each item was the proportion of experts who rated it 3 or 4. The I-CVI exceeded the cutoff of 0.78 (Shi et al., 2012), except for two items. One of the two items ("I will be infected with COVID-19 more easily than others.") was not excluded because it was reported

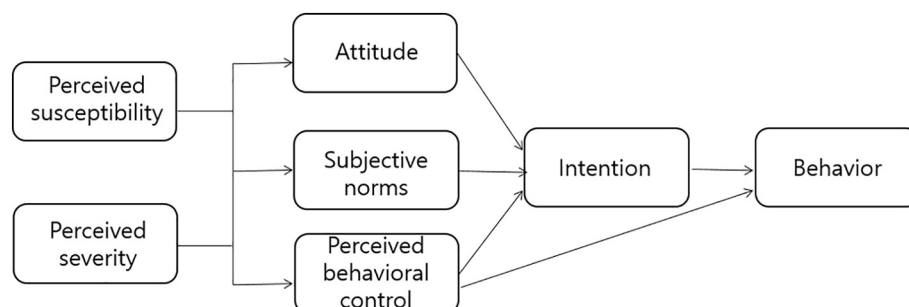


Fig. 1. The theoretical framework.

as an important item influencing adolescents' infection preventive behaviors in previous studies (Choi et al., 2015). The other item ("I tend to follow information about COVID-19 from my friends.") also had an I-CVI of 0.6, but it was not deleted because peer social norms have been found to be an important factor in adolescents' health behaviors (Wang et al., 2019). In addition, according to experts' opinions, the phrases were revised to be easy for teenagers to understand. Then, we confirmed the final 34 items on the main variables.

Finally, the questionnaire consisted of eight sections: (1) demographic characteristics (age, gender, education experience of COVID-19, experience of accessing COVID-19 promotional materials, isolation experience related to COVID-19, fever [above 37.5 °C] and/or respiratory symptoms for the past 1 week), (2) perceived susceptibility to COVID-19, (3) perceived severity, (4) attitude, (5) subjective norms, (6) perceived behavioral control, (7) intention, and (8) preventive behaviors. The items used in the study are shown in Appendix A.

#### *Perceived susceptibility to COVID-19*

Perceived susceptibility to COVID-19 refers to an individual's belief of whether they can be infected with the virus. This factor was modified based on an earlier study examining high school students' perception of MERS infection risk (Choi et al., 2015). We collected data through a two-part questionnaire on participants' fear of becoming infected with COVID-19 and belief on whether they were more susceptible to the disease compared to others. Responses were indicated on a five-point Likert scale, ranging from 1 "strongly disagree" to 5 "strongly agree." The internal consistency of the instrument as measured by Cronbach's  $\alpha$  was 0.46 in this study, indicating unacceptable internal consistency. Thus, we removed a less descriptive question ("I will be infected with COVID-19 more easily than others.") and analyzed the data using a single item on participants' fear of being infected with COVID-19.

#### *Perceived severity of COVID-19*

Perceived severity of COVID-19 refers to an individual's belief of how seriously their everyday life will be impacted after contracting the virus. The corresponding questionnaire consisted of four questions based on prior research (Jouybari et al., 2018) and the developmental stages of adolescents (Havighurst, 1972). Jouybari et al. (2018) used five items (e.g., "Influenza complication could seriously affect my life.") for assessing perceived severity. We replaced "my life" with the developmental tasks of adolescents such as studies, daily life, and maintaining relationships with family and friends. Additionally, it was modified to language that adolescents could easily understand (e.g., "If I get COVID-19, I'll have a problem with my studies."). Responses were indicated on a five-point Likert scale, ranging from 1 "strongly disagree" to 5 "strongly agree." In this study, the Cronbach's  $\alpha$  was 0.78, indicating an acceptable internal consistency.

#### *Attitudes toward COVID-19 preventive behaviors*

Attitudes toward COVID-19 preventive behaviors refers to participants' positive or negative attitude toward taking preventive measures for COVID-19. The corresponding questionnaire consisted of four questions; it was modified to fit the study and supplemented by the method used in Ajzen and Madden's (1986) study to verify the TPB. Specific questions were prepared by referring to the research by Lee et al. (2016). Attitude was measured using a semantic differential scale that asked participants which preventive behaviors for COVID-19 they performed. Adjective pairs (e.g. "beneficial-harmful") were rated on a scale from 1 to 7. A higher summative score indicated a more positive attitude toward COVID-19 preventive behaviors. The Cronbach's  $\alpha$  was 0.85, indicating good reliability.

#### *Subjective norms about COVID-19 preventive behaviors*

Subjective norms about COVID-19 preventive behaviors refer to the level of external pressure perceived by an individual to take preventive

measures. The corresponding questionnaire consisted of six questions: three on norms and three on their motivation to conform to preventive behaviors. It was modified to fit the study and supplemented by the method used by Ajzen and Madden (1986) to verify the TPB. In this study, important referents were defined as parents, teachers, and friends, by referring to previous studies (Jouybari et al., 2018; Kalolo & Kibusi, 2015). Responses were indicated on a five-point Likert scale, ranging from 1 "strongly disagree" to 5 "strongly agree." Cronbach's  $\alpha$  was 0.85 in this study.

#### *Perceived behavioral control of COVID-19 preventive behaviors*

Perceived behavioral control of COVID-19 preventive behaviors refers to an individual's perception of their ability to control factors that hinder their preventive actions. The corresponding questionnaire consisted of five questions. It was modified to fit the study and supplemented by Ajzen and Madden's (1986) method to verify the TPB. Specific questions were prepared by referring to previous studies (Lee et al., 2016; Shenal Jr et al., 2012) and qualitative data from news articles (University of Alberta, 2020; Yonhap News, 2020). Participants were asked about their confidence in their willingness to take preventive measures when they were busy, lazy, feeling uncomfortable wearing their masks, feeling lonely because they were unable to meet other people, and feeling that preventive actions had little to no effect. Responses were indicated on a five-point Likert scale, ranging from 1 "strongly disagree" to 5 "strongly agree." Cronbach's  $\alpha$  was 0.89 in this study.

#### *Intention to perform COVID-19 preventive behaviors*

To assess participants' intention to perform COVID-19 preventive behaviors, a questionnaire consisting of four items was modified to fit the study and supplemented by Ajzen and Madden's (1986) method and the guidelines for preventing COVID-19 (Central Disaster and Safety Countermeasure Headquarters, 2020; WHO, 2020). Responses were indicated on a five-point Likert scale, ranging from 1 "strongly disagree" to 5 "strongly agree." Cronbach's  $\alpha$  was 0.77 in this study.

#### *COVID-19 preventive behaviors*

To assess COVID-19 preventive behaviors, we developed a nine-item questionnaire based on the COVID-19 prevention guidelines provided by the WHO (2020) and the CDSCH (2020). Participants were asked about their practices of handwashing, hygiene habits, mask-wearing, and distancing. Responses were indicated on a five-point Likert scale, ranging from 1 "strongly disagree" to 5 "strongly agree." Cronbach's  $\alpha$  was 0.86 in this study.

#### *Data analysis*

SPSS 26.0 was used to calculate descriptive statistics, Cronbach's  $\alpha$  of the measures, and *t*-test. To observe the relationship between perceived susceptibility, perceived severity, attitude, subjective norms, perceived behavioral control, intention, and COVID-19 preventive behaviors, SEM was conducted with Mplus version 7.4. We conducted a hypothetical model test according to the two-step approach proposed by Anderson and Gerbing (1988). We first verified the fit and validity of the measurement model through confirmatory factor analysis (CFA) and correlation analysis between latent variables in step 1, and then estimated and evaluated a SEM that models the theoretical relevance between the factors in step 2. Model fit was evaluated with the following indices:  $\chi^2$ , normed fit index (NFI), comparative fit index (CFI), root mean square error approximation (RMSEA), and standardized root of the mean square residual (SRMR). Values of NFI and CFI above 0.90 (Bentler, 1990), RMSEA and SRMR below 0.08 indicate a good fitting model (Steiger, 2007). A *p*-value of <0.05 was considered statistically significant.

**Table 1**  
Descriptions of adolescents' demographic characteristics and COVID-19 preventive behaviors (n = 272).

Demographics	n(%)	Preventive behaviors	t
Gender			
Male	103(37.9)	32.17 ± 7.20	−0.501
Female	169(62.1)	32.58 ± 5.99	
Education experience on COVID-19 <sup>a</sup>			
Yes	204(75.0)	33.14 ± 6.03	3.095**
No	66(24.3)	30.35 ± 7.35	
Experience of accessing COVID-19 promotional materials provided by national agencies <sup>a</sup>			
Yes	192(70.6)	32.04 ± 6.59	−1.412
No	77(28.3)	33.27 ± 6.13	
Isolation experience related to COVID-19			
Yes	2(0.7)	34.50 ± 3.54	0.455
No	270(99.3)	32.41 ± 6.48	
Fever (above 37.5 °C) and/or respiratory symptoms for the past 1 week <sup>a</sup>			
Yes	12(4.4)	30.92 ± 5.25	−0.828
No	259(95.2)	32.50 ± 6.53	

<sup>a</sup> With missing values.

\*\*  $p < 0.01$ .

**Table 2**  
Descriptive statistics for measurement scales (n = 272).

Variables	Mean ± SD	Range	Skewness	Kurtosis
Perceived susceptibility	3.23 ± 1.13	1–5	−0.301	2.504
Perceived severity	16.35 ± 3.01	4–20	−1.272	5.481
Attitude	25.26 ± 3.33	4–28	−1.196	3.788
Subjective norms	46.10 ± 14.83	3–75	−0.449	3.543
Perceived behavioral control	19.22 ± 3.85	5–25	−0.489	3.621
Intention	15.73 ± 2.69	4–20	−0.218	2.837
Behavior	32.43 ± 6.47	9–45	−0.131	2.94

Note. SD, standard deviation.

### Ethical considerations

This cross-sectional study was approved by the institutional review board of the academic institution with which the researcher is affiliated (IRB No. JJNU-IRB-2020-025).

## Results

### Demographic characteristics and preventive behaviors for COVID-19

The demographic characteristics and preventive behaviors for COVID-19 in participants are shown in Table 1. Of the 272 respondents, 62.1% were female and 37.9% male. Students' average age was 14.94 ± 0.27 years, ranging from 13 to 15 years. The preventive behaviors

score was significantly higher in the group who received education for COVID-19 than the group who did not ( $t = 3.095$ ,  $p < 0.01$ ).

### Descriptive statistics for measurement scales

The descriptive statistics for measurement scales are shown in Table 2 and Appendix A. The average score of perceived sensitivity was 3.23 ± 1.13, and out of the total sample, 61 (22.4%) adolescents reported high levels of perceived susceptibility. Adolescents reported moderate to high perceived severity (16.35 ± 3.01), and they evaluated the most serious effects of COVID-19 on their families (4.44 ± 0.79). The people who encouraged adolescents to follow COVID-19 preventive behaviors were teachers, parents, and friends (4.19 ± 0.78, 4.04 ± 0.85 and 3.22 ± 0.96, respectively). It was difficult for adolescents to overcome and perform preventive behaviors when they felt lonely because they couldn't meet people often (3.75 ± 1.00). Among the COVID-19 preventive behaviors, the score for the item wearing a mask was the highest (4.53 ± 0.72), and the score for the distancing item was the lowest (2.97 ± 1.09).

Prior to SEM, we confirmed skewness and kurtosis to see if each measurement variable satisfied the normal distribution assumption (Table 2). As a result, the skewness and kurtosis of all measurement variables did not exceed the absolute values of 2 and 7, respectively, which do not violate the assumption of normal distribution (Curran et al., 1996). To confirm multicollinearity, the correlation between the study variables was analyzed (Table 3) and the correlation coefficients between intention and perceived behavioral control/behavior were higher than 0.80, but the values of the variance inflation factor were all less than 10 (1.16–2.22) and the problem of multicollinearity was considered acceptable.

### Model testing

First, CFA was conducted to verify the validity and relationship of the scales used to measure the study variables. Five items with a factor loading of 0.5 or less were removed (Hair Jr. et al., 2009). The overall fit information for the model was [ $\chi^2 = 438.475$  ( $p < 0.05$ ), RMSEA = 0.040, SRMR = 0.045, NFI = 0.967, CFI = 0.960], indicating that the model was acceptable. For convergent validity verification, the average variance extraction (AVE) was found to have value above 0.50 (0.52–0.84) in perceived susceptibility, perceived severity, attitude, subjective norms, and perceived behavioral control, but intention and behaviors were 0.48 and 0.47, respectively. However, the construct reliability was shown to be 0.70 or higher (0.73–89) in all variables (Table 2), providing partial convergent validity (Fornell & Larcker, 1981). Table 3 shows the discriminant validity of each latent variable. If the coefficient of determination ( $r^2$ ) is greater than the AVE, then there is a problem with the discriminant validity of each latent variable (Fornell & Larcker, 1981). The independent variables of perceived susceptibility and severity were  $r^2$  of 0.123, less than the AVE of

**Table 3**  
Correlations of latent variables and verification of construct validity (n = 272).

Variables	r ( $r^2$ )						AVE	CR
	Perceived susceptibility	Perceived severity	Attitude	Subjective norms	Perceived behavioral control	Intention		
Perceived susceptibility	1						0.843	0.843
Perceived severity	0.351 (0.123)*	1					0.551	0.784
Attitude	0.139 (0.019)**	0.288 (0.084)**	1				0.605	0.860
Subjective norms	0.307 (0.094)**	0.288 (0.085)**	0.559 (0.316)**	1			0.518	0.840
Perceived behavioral control	0.255 (0.066)**	0.122 (0.017)	0.502 (0.249)**	0.680 (0.452)**	1		0.608	0.885
Intention	0.277 (0.088)**	0.141 (0.023)	0.540 (0.292)**	0.715 (0.531)**	0.884 (0.774)**	1	0.477	0.732
Behavior	0.323 (0.101)**	0.089 (0.007)**	0.442 (0.203)**	0.614 (0.376)**	0.722 (0.507)**	0.801 (0.658)**	0.468	0.858

Note. AVE, Average Variance Extracted; CR, Construct Reliability; r, correlation estimate;  $r^2$ , coefficient of determination.

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .



**Table 4**  
Direct, indirect, and total effects.

Endogenous variables	Exogenous variables	Direct effect	Indirect effect	Total effect	SMC
		$\beta$	$\beta$	$\beta$	
Attitude	Perceived susceptibility	0.066		0.066	0.122
Subjective norms	Perceived severity	0.321***		0.321***	0.180
	Perceived susceptibility	0.260**		0.260**	
Perceived behavioral control	Perceived severity	0.260**		0.260**	0.097
	Perceived susceptibility	0.259***		0.259**	
Intention	Perceived severity	0.104		0.104	0.788
	Perceived susceptibility		0.286***	0.286***	
	Perceived severity		0.194*	0.194*	
	Attitude	0.114		0.114	
Behavior	Subjective norms	0.291***		0.291***	0.613
	Perceived behavioral control	0.780***		0.780***	
	Perceived susceptibility		0.223***	0.223***	
	Perceived severity		0.153*	0.153*	
	Attitude		0.091	0.091	
	Subjective norms		0.233**	0.233**	
	Perceived behavioral control	-0.022	0.625***	0.603**	
	Intention	0.801***		0.801***	

Note. SMC, Squared multiple correlation;  $\beta$ , Standardized regression coefficients.

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

\*\*\*  $p < 0.001$ .

0.551–0.843, and the same mediator variables, attitude, subjective norms, and behavior control, were also  $r^2$  of 0.249–0.452, less than the AVE of 0.518–0.608.

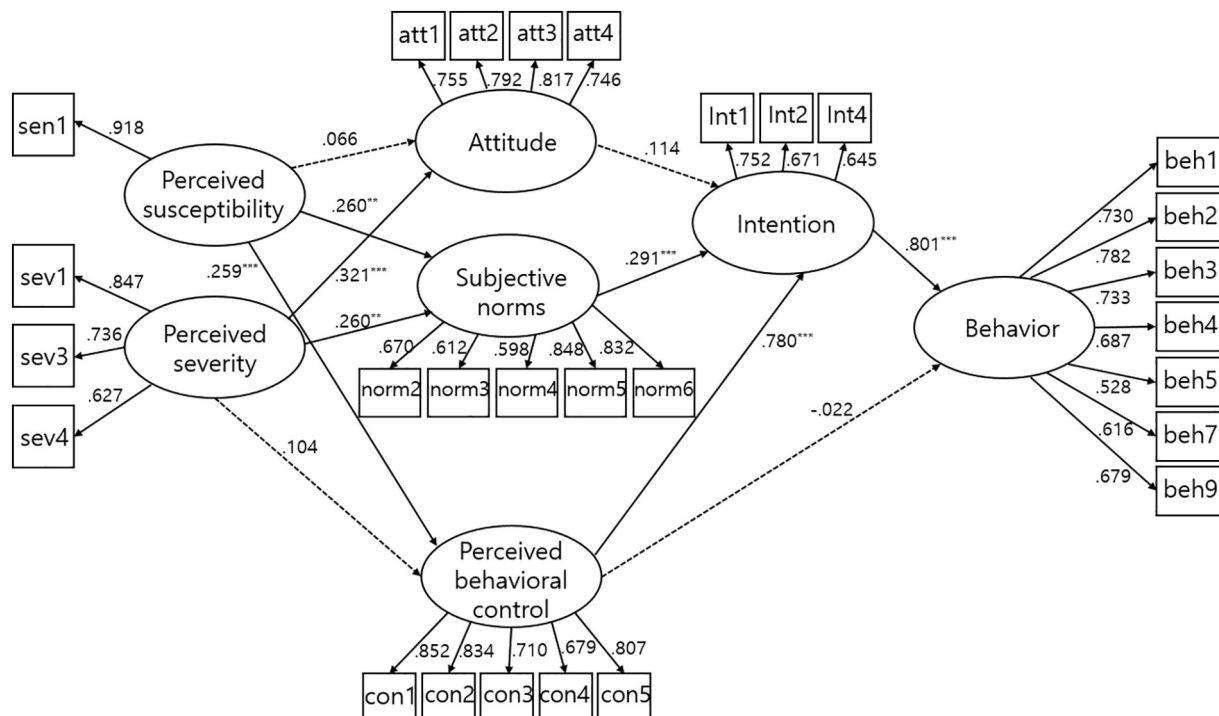
Second, we included COVID-19 preventive behaviors, perceived susceptibility, perceived severity, attitude, subjective norms, perceived behavioral control, and intention into the SEM. The overall fit information

for the model was [ $\chi^2 = 622.133$  ( $p < 0.05$ ), RMSEA = 0.060, SRMR = 0.141 NFI = 0.909, CFI = 0.925], indicating that the model was acceptable. Perceived susceptibility was positively associated with preventive behaviors by indirect effect through the mediations of subjective norms, perceived behavioral control, and intention. Perceived severity was positively associated with preventive behaviors by indirect effect through the mediation of attitude, subjective norms, and intention. Perceived susceptibility, perceived severity, subjective norms, perceived behavioral control, and intention explained 61.3% of adolescents' COVID-19 preventive behaviors. Subjective norms and perceived behavioral control had an indirect effect on preventive behaviors through the mediating role of intention. The intention also predicted COVID-19 preventive behaviors (Table 4, Fig. 2).

## Discussion

This study aimed to understand factors related to COVID-19 preventive behaviors using the TPB and HBM among adolescents in South Korea. COVID-19 preventive behaviors were measured using a questionnaire on hand hygiene, wearing a mask, and distancing. Compared to prior studies that measured similar behaviors in adults (Breakwell et al., 2021; Cvetković et al., 2020), this study showed low scores in hand hygiene and distancing, but not wearing masks, confirming the need to improve compliance with COVID-19 preventive behaviors in adolescents. Specifically, it was found that the score was exceptionally low on the item related to distancing ( $4.15 \pm 1.12/3.99 \pm 1.14$  in previous studies vs.  $2.97 \pm 1.09$  in the current study).

Among adolescents, perceived susceptibility to COVID-19 infection influenced the subjective norms about preventive behavior and perceived behavioral control. Additionally, perceived susceptibility indirectly affected adolescents' willingness to practice COVID-19 preventive behaviors; this finding is consistent with a previous study involving high school students during the MERS and influenza pandemics (Najimi & Golshiri, 2013). The average score of perceived susceptibility in this study was  $3.23 \pm 1.13$ , which is higher than that reported for adolescents' perceived susceptibility during the MERS outbreak



**Fig. 2.** The final model for evaluating the preventive behavior for COVID-19 among adolescents.

( $1.8 \pm 1.07$ ) (Choi et al., 2015). However, the current study demonstrated that 22.4% of adolescents had high levels of perceived susceptibility, which is lower than that in a recent report of adults' perceived susceptibility to COVID-19 (40.7%) (Shahnaz et al., 2020). This is similar to the results of previous studies, which showed that adolescents have lower perceptions of disease risk than adults do (Rahman et al., 2013). Adolescents may believe that they are not susceptible to COVID-19 infection, leading to non-compliance with health promotion behavior, so it is necessary to increase their perceived susceptibility to the virus to prevent infection.

In this study, parents and teachers' subjective norms influenced COVID-19 preventive behavior, indicating the importance of enhancing adolescents' subjective norms. For this, it is necessary to help parents and adults improve adolescents' ability to implement COVID-19 preventive behavior. Additionally, because adolescents tend to imitate their parents' behaviors (Tapera et al., 2020), parents should become role models to their children and promote COVID-19 preventive behaviors. However, many parents find it burdensome to educate their children about these behaviors because of the suspension of schools, having to work from home, and enduring economic difficulties, as well as managing their own fear and anxiety about the pandemic (Witt et al., 2020). Therefore, it is appropriate that education for adolescents is mainly carried out by school nurses. In this study, the COVID-19 preventive behavior score was significantly different depending on the education experience related to COVID-19. This supports previous findings that school-based education enhances the practice of adolescents' health behavior (Nurumal, Zain, & Mohamed, 2019; Swartz et al., 2010). In the infection crisis, school nurses face difficulties due to work overload and lack of rapid information sharing with health authorities (Lee et al., 2015). Therefore, it is necessary to reduce the burden on school nurses and focus on student education through support of assistant personnel and establishment of a system for infectious diseases centered on regional offices of education.

These findings can be used as a basis for planning educational and publicity measures to promote COVID-19 preventive behavior among adolescents. In a previous study of pregnancy preventive interventions for adolescents, an education program was developed to help adolescents recognize the possibility of becoming pregnant, which yielded positive results (Yakubu et al., 2019). Similarly, it is necessary to develop an intervention to raise adolescents' awareness of their susceptibility to COVID-19. However, since excessive worry about COVID-19 can lead to psychological problems, such as anxiety (Scott et al., 2020), pediatric nurses should also acknowledge adolescents' values and beliefs regarding COVID-19 and help them positively express their thoughts and feelings. In addition, fear of COVID-19 is related to media exposure (Mertens et al., 2020). Therefore, it is necessary for an authoritative institution to produce and distribute promotional materials that can increase their perceived susceptibility. However, it is appropriate to avoid sensational or provocative content, as these media should not create distress about COVID-19.

In this study, the greater the perceived severity of the impact of COVID-19 infection on one's studies, friends, daily life, and family, the greater the effect on participants' attitudes and subjective norms about COVID-19 preventive behavior. Consistent with previous findings (Puspita et al., 2017), perceived severity did have an indirect effect on the performance of COVID-19 preventive behaviors. However, in those studies, perceived severity of COVID-19 was focused on medical consequences, such as death and severe health problems (Luo et al., 2021; Zareipour et al., 2020). This study defined perceived severity as perceptions of COVID-19s impact on daily life and relationships. The mortality rate is not high when children and adolescents develop COVID-19 (Bhopal et al., 2021). However, confirmation of COVID-19 in adolescence can affect academic interruption, disruption in daily life, and spread to valuable people such as friends and family. This suggests that not only medical diagnosis but also everyday aspects should be

considered when defining the severity of COVID-19 (de Figueiredo et al., 2021).

In this study, adolescents' perceived behavioral control influenced their intention to perform COVID-19 preventive behaviors. Cutrín et al. (2020) reported similar findings that the better the adolescents' self-control, the higher the degree of health behavior performance. Therefore, continuous support and encouragement are needed to reduce difficulties in following COVID-19 preventive behaviors. Consistent with a previous study (Oosterhoff et al., 2020), this study also found that adolescents have the most difficulty overcoming loneliness when performing preventive behaviors. Humans are social beings, and from a developmental point of view, adolescents may experience great emotional distress from social distancing for COVID-19 prevention (Witt et al., 2020). Therefore, it is necessary to encourage preventive behaviors using the term "physical distancing" rather than "social distancing." Distancing does not necessarily mean a break in social relations; the use of video conferencing systems, mobile communication, and social network services should be promoted so that adolescents can cope with their socially stressful situations and feel a sense of social belonging.

Our results indicate that adolescents' attitudes toward COVID-19 preventive behaviors did not significantly affect their intention to perform COVID-19 preventive behaviors. This finding does not corroborate those of other studies (Cha & Kim, 2019), which reported that positive attitudes about the usefulness or importance of health behaviors influence health behavior performance. The recommendations for transmission-based precautions required for COVID-19 vary in terms of droplet and contact precautions. While one study revealed that the SARS-CoV-2 virus was airborne (Chia et al., 2020), another study reported that it was not airborne (Wong et al., 2020). Thus, adolescents may be unsure of the benefits of COVID-19 preventive behaviors. Prior research suggests that attitudes are linked to behavior only when shaped by appropriate information, which consequently improves people's confidence (Glasman & Albarracín, 2006). The COVID-19 prevention guidelines have been prepared based on evidence. For example, Chu et al.'s (2020) systematic review demonstrated that physical distancing of 1 m or more and using face masks reduce the infection rate. Therefore, when educating and promoting preventive behaviors to adolescents, it is necessary to convey the evidence supporting those behaviors, making it possible for adolescents to have positive attitudes toward COVID-19 preventive behaviors.

There are several limitations in this study. Using the cross-sectional design, causality relationships cannot be inferred between variables. Second, this study was based on the variables of the HBM and TPB, but it is uncertain whether COVID-19 infection can always be prevented by these individual factors, and it cannot be overlooked that the level of quarantine measures in the country and community are also influencing factors. Third, there are limitations related to the generalization of the findings, as this study targeted students in only one school. In addition, even though there are many different age groups in adolescence, only second year middle school students were selected. Therefore, future research needs to include longitudinal studies and models adding and verifying social and institutional variables that can contribute to COVID-19 preventive behavior by targeting more adolescents in the local community. Fourth, as there is currently no standardized tool to measure factors related to COVID-19 preventive behaviors, the tools were developed for use in this study. Moreover, regarding the tool for assessing perceived susceptibility, data were collected using two items; however, as the tool had a low reliability (Cronbach's  $\alpha = 0.46$ ), one item with a low explanatory power was removed. Because it is not recommended to use single item measurements in SEM (Lee, 2016), care should be taken in interpreting variables related to perceived susceptibility. Additional research is required to identify the factors associated with COVID-19 preventive behaviors among adolescents with more reliable measures.

Based on the study findings, we suggest the following. First, since this study investigated the level of adherence to COVID-19 preventive behaviors using a self-administered questionnaire, future studies should determine the exact degree of performance using an observation method. Second, in addition to the HBM and TPB variables, studies need to identify other factors associated with adolescents' COVID-19 preventive behaviors. Lastly, it is necessary to develop a systematic intervention to increase perceived susceptibility and severity to COVID-19, attitude, subjective norms, and perceived behavioral control to promote COVID-19 preventive behaviors.

## Conclusions

The COVID-19 pandemic brought about a worldwide crisis. Furthermore, COVID-19 infections among adolescents are constantly increasing. To protect society as a whole, and to decrease household transmission of COVID-19, it is important to prevent COVID-19 among adolescents. In this study, perceived susceptibility and perceived severity was positively associated with preventive behaviors through the mediation of some TPB variables. Therefore, to increase adolescent awareness of COVID-19 and increase attitudes, subjective norms, and perceived behavior control, nurses need to provide education including the evidence for COVID-19 preventive behavior to increase adolescents' understanding and active implementation of those behaviors. Additionally, taking the characteristics of adolescents, who value social relationships, into account, awareness of maintaining "physical" distance while maintaining social relationships should be increased to mitigate social isolation.

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## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pedn.2021.07.006>.

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