Association Between Knowledge, Attitudes and Practices (KAP) Towards The COVID-19: A Cross-Sectional Study in South Korea

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Abstract

Background It is imperative for the public to routinely practice precautionary behaviors to contain transmission of COVID-19, as no vaccines and anti-viral treatments are available. This paper attempts to examine knowledge, attitudes, and practices related to COVID-19, and the relationship between them and identification of the vulnerable population.

Methods The data collection took place over three days (June 26–29) through an online survey five months after the Korea Centers for Disease Control and Prevention (KCDC) confirmed the first case in South Korea; 970 subjects were included in the analysis.

Results The level of knowledge, attitude and practice were examined. Knowledge directly affected both attitude (e.g., perceived risk and efficacy belief) and practice (e.g., preventive measures and social distancing). Among the influencing factors, efficacy belief turns out to be the most effective and significant factor on practice and also mediated the relationship between knowledge and all three preventive behaviors (wearing facial masks, practicing hand hygiene, and avoiding crowded places). Knowledge level varied by sociodemographic characteristics. Females ($\beta = 0.06, p < 0.05$) and individuals with higher level of education ($\beta = 0.06, p < 0.05$) had higher knowledge.

Conclusion To successfully increase precautionary behaviors among the public, public health officials and policy makers must promote knowledge and efficacy belief. Also, the consequent interventions and policies should be developed and implemented in a way they reduce, rather than reinforce, health disparities, by embracing vulnerable populations to COVID-19.

Introduction

Since a large number of cases of a novel coronavirus disease 2019 (COVID-19) were first reported in Wuhan, China in December 2019[1, 2], the virus has affected millions of lives worldwide. On January 30, 2020, the World Health Organization (WHO) declared that the outbreak of COVID-19 constituted a Public Health Emergency of International Concern (PHEIC) calling for countries to take urgent and aggressive action against the spread of the virus[3]. The epidemic in South Korea is also an unprecedented crisis in recent history. After the first case was announced on January 20, there have been 15,039 confirmed cases and 305 deaths as of August 15[4]. Given the epidemic’s scale, timing, and unpredictability threatening routine capabilities of the health care system, it is reasonable to state that South Korea is confronting a public health emergency[5, 6]. South Korea is still experiencing an ongoing battle with the virus.

Responding to the pandemic becomes a serious challenge, as little is known about the epidemiological evidence of the disease including transmission dynamics, epidemic doubling time, and reproductive frequency[1]. Also, there are no vaccines or treatments clinically proven to be effective yet. With the scarcity of the clinical measures raising heighten concerns, it becomes increasingly important for the general public to engage in precautionary behaviors along with the disease response and surveillance efforts at the policy level[6, 7]. Amidst pandemics, educating, engaging, and mobilizing the public to become active participants may help achieve public health emergency preparedness, thereby reducing vulnerability of the overall population[6]. When people collectively engage in behaviors including washing hands and keeping social distance, the spread of the disease is expected to be controlled. Experts have emphasized that individual behaviors may dramatically decrease morbidity and mortality rates of COVID-19[7, 8]. Therefore, a routine practice of precautionary behaviors by the public must become the new status quo.
For non-pharmaceutical public health interventions to successfully encourage and sustain preventive behaviors among the public, the evidence on social, cognitive, and psychological factors associated with the behaviors is necessary. Prior studies on infectious disease epidemics showed that knowledge and awareness[9–11], risk perception[7, 10, 12], and efficacy belief[7] help motivate people to adopt preventive behaviors. Similarly, recent studies on COVID-19 found that knowledge[13–16], perceived controllability[14, 17], optimistic beliefs[14, 16], emotion[15], and risk perception[16] may all account for precautionary actions of the public. However, the relationship between knowledge, attitudes, and practices beyond understanding the prevalence of each has not been examined. Especially, how knowledge affects practice via attitude is still less known.

When public health interventions and policies have an objective to protect all, a focus should be on vulnerable groups to the pandemic. The issue of health inequalities unfolding during disease outbreaks has been extensively investigated across pandemics[18, 19]. For example, the a novel influenza A (H1N1) burden was found substantially higher for people who were less educated[20], living in more deprived neighborhoods[20, 21], and experiencing greater financial barriers[22]. In case of 2015 Middle East Respiratory Syndrome (MERS), Lee et al. have shown social determinants were directly (gender, education) or indirectly (age, education, income) related to practicing preventive behaviors[23]. Evidence of an unequal burden of COVID-19 is also emerging fast. People living in impoverished, and racially and economically polarized areas showed considerably greater morbidity and mortality rates of COVID-19[24]. It is worth noting that the COVID-19 burden may be aggravated for some populations such as those who are in minority ethnic groups, socio-economic deprivation, and poverty, as they generally are more likely to have existing non-communicable diseases[18]. When COVID-19 interacts with and exacerbates the health conditions, the populations would further be at health risk[24, 25]. Behavioral factors toward COVID-19 are also unevenly distributed among people [26]. One study revealed that males, less educated individuals, and elders showed lower levels of COVID-19 knowledge and behaviors compared to their counterparts[27], and another study found that risk perception differed by one’s social support[6]. Another study on Chinese undergraduate students revealed that gender, major and school styles affect student’s attitude and practice[28]. Considering this, public health officials must identify vulnerable populations during the COVID-19 pandemic to ensure health education and communication interventions tailored for them.

Yet there is limited evidence with regard to behavioral factors and related vulnerability during COVID-19 in South Korea. To respond to this gap, a new approach must be taken to provide sufficient explanation as to why the public behaves in certain ways and which populations should be prioritized in health behavior change interventions. In this study, we attempted to quantify and test the link of knowledge, attitude and practices, and examine how sociodemographic characteristics interplay with the behavioral components. Specifically, we aim 1) to understand how COVID-19 knowledge impacts preventive practices and whether the relationship is mediated by attitudinal factors. and 2) to identify which populations have the least knowledge toward COVID-19, highly likely being those vulnerable to the pandemic. Implications to develop and implement evidence-based health behavior interventions and policies during the COVID-19 pandemic are discussed in this paper.

**Methods**

**Study participants and survey**

We adopted a cross-sectional survey design to evaluate the public’s knowledge, attitudes and practices during the COVID-19 epidemic using an anonymous online questionnaire. The survey was conducted via an online platform from a research company called Korea Research. Korean residents ages 18 years and older nationwide were recruited via e-mail and text message. Proportionate quota sampling to avoid the bias of subjective selection, characterized age,
population region, and gender, which included men and women equally. In all, 1,000 subjects completed the surveys for inclusion in the analyses. The data collection took place over three days (June 26–29), five months after the Korea Centers for Disease Control and Prevention (KCDC) confirmed the first case at the early stage of the epidemic and there have been 12,602 confirmed cases and 282 deaths as of June 26. The survey and consent to participate were approved by the Seoul National University Institutional Review Board (IRB No. 2006/003-023).

Measurements

The level of knowledge of COVID-19 was assessed using a six item questionnaire developed by Zhong et al[17], which includes questions about clinical characteristics, transmission, and prevention and control. The knowledge scores were scored with one point for each correct question, and an aggregate score was calculated (range 0-6), with higher scores indicating more knowledge about COVID-19.

Practice of precautionary behaviors fell into one of the two following categories: (1) preventive measures (e.g., wearing facial masks, practicing hand hygiene); or (2) social distancing (e.g., avoiding crowded places). Respondents self-reported the frequency of the practice, they have taken during the previous week using a 4-point Likert-type scale (never, sometimes, often, and always).

Attitudes related to COVID-19, we examined perceived risk of COVID-19 infection comprised both perceived susceptibility, which signifies individuals’ beliefs about their possibility to infection, and perceived severity, which signifies the seriousness of infection[29]. Respondents were asked, “What do you think is the possibility of a COVID-19 infection?” and, “What do you think is the severity if COVID-19 infects you?” Responses were rated on a 5-point Likert-type scale ranging from 1 to 5 with 1 = not at all and 5 = extremely) (Table 4). For efficacy belief, respondents answered two questions for each category of practice: “To what extent do you think precautionary behaviors such as “wearing facial masks and hand hygiene” / “social distancing such as avoiding crowded places” are an effective way to reduce the risk of COVID-19 infection?” and responses were rated on a 4-point Likert-type scale ranging from 1 to 4 with 1 = not at all and 4 = extremely) (Table 4).

Sociodemographic factors included gender (1 = male, 2 = female), age, marital status (i.e., married, single, divorced, bereaved) and the presence of children younger than elementary school at home (yes = 1, none = 0). We also assessed the education level (1 = middle school or below to 3 = college and above) and monthly household income in Korean won (KRW) (1= 200 million KRW or below to 4 = 600 million KRW or above). We collected information about the respondents’ residence (urban= 1, rural = 2) (Table 1).

Statistical analysis

We conducted statistical analyses using R version 4.0.2 (R Foundation for Statistical Computing, Vienna, Austria). All results of quantitative variables were reported either as mean (M), standard deviation (SD) or frequency (percentage%). Multivariate linear regression analysis was performed. Additionally, the indirect effects of knowledge on practices via attitudes were calculated using PROCESS model 6 macro with 5,000 bootstrap samples for IBM SPSS Statistics 25[30]. The bias-corrected 95% confidence intervals for each mediational path were obtained.

Results

Demographic Characteristics

A total of 1,000 individuals completed a survey and after excluding individuals with missing data, 970 individuals were included in the analysis (Table 1). The average age of participants was 47.44 years. Approximately half were
females (51.4%). A total of 59.2% had a high school diploma, followed by bachelor’s degree (31.9%) and graduate or professional degree (9%). 30.9% respondents’ monthly household income is within 200-400 (10,000 KRW), followed by over 600 (28.1%), 400-600 (26.8%), and under 200 (14.1%). Most were married (62.3%), have no children (76.6%), and reside in urban areas (87.3%) (Table1).

**Knowledge, attitudes and practice on COVID-19**

Among the six knowledge items, the respondents have answered about 4 items correctly (M=4.21, SD=1.16). Respondents appear to be aware of the transmission of the virus through respiratory droplets of infected people (93.2% answered correct, 2.5% incorrect and 4.3% reported don’t know), but the high prevalence of misunderstanding was revealed of infection through eating or contact with wild animals (Table 2). Only 27.9% answered it is false, 42.2% believed it was true, and 29.9% said they were not sure. About half of the respondents (48.8%) about whether wearing a general medical mask helps prevention were correct, but 39.7% answered incorrectly, and 11.5% answered that they did not know.

The knowledge score varied by gender and education level (Table 2). Females ($\beta = 0.06, p < 0.05$) and individuals with higher level of education ($\beta = 0.06, p < 0.05$) were more likely to score COVID-19 knowledge accurately (Table3). Respondent’s age, income level, marital status, residence, and presence of children were not related to the knowledge level of COVID-19.

Respondents perceived the risk of becoming infected with COVID-19 (perceived susceptibility) as being lower than ”neither high nor low” (score = 3) (M = 2.77, SD = 0.80) and the average perceived severity score was higher than perceived susceptibility, which was close to “high” (score = 4) (M = 3.77, SD = 0.85). Both efficacy belief on preventive measures (M=3.82, SD=0.44) and social distancing (M=3.66, SD=0.59) was high. The most frequently performed practice was wearing facial masks (M=3.82, SD=0.49), followed by hand hygiene (M=3.51, SD=0.66), and social distancing (M=3.11, SD=0.90) (Table 4).

**The influence of knowledge on attitude**

The role of knowledge on perceived susceptibility, severity and efficacy belief were examined (Table 5). After controlling sociodemographic factors, who have less knowledge ($\beta = -0.12, p < 0.05$) were more likely to have lower level of perceived susceptibility of COVID-19. Who had higher knowledge displayed higher efficacy belief for personal hygiene practices ($\beta = 0.19, p < 0.05$) such as wearing masks and washing hands and had higher efficacy belief for avoiding crowded places ($\beta = 0.16, p < 0.05$) (Table 5).

**The influence of knowledge and attitude on practices**

Three different preventive behaviors varied by knowledge and attitude of the respondents (Table 6). First, those with higher efficacy belief ($\beta = 0.31, p < 0.05$) were more likely to wear facial mask. Next, who had higher perceived susceptibility ($\beta = 0.08, p < 0.05$) and efficacy belief ($\beta = 0.20, p < 0.05$) were more likely to wash hands more frequently. Lastly, individuals who have higher efficacy belief ($\beta = 0.22, p < 0.05$) tended to avoid crowded places to prevent COVID-19. Efficacy belief have shown the strongest and significant effect, however, knowledge have not shown significant effect on the three practices (Table 6).

**Relationship between knowledge, attitudes, and practices**

The indirect effects of knowledge on preventive behaviors mediated by attitudes (efficacy) were significant (Table 7). Efficacy belief significantly mediated the relationship between knowledge and all three preventive behaviors – wearing
facial mask, washing hands, and avoiding crowded places. However, perceived susceptibility negatively mediated the relationship between knowledge and hand-washing behavior.

Discussion

Our findings demonstrate that knowledge significantly affects preventive behaviors through efficacy belief and has direct effects on attitudes. It is implied that changing public behaviors and attitudes for COVID-19 prevention would require the promotion of knowledge, and if needed, correction of inaccurate and misguided information. Knowledge as a fundamental predictor of health behaviors has been validated in many public health areas[27, 31, 32]. We also stress that attention must be paid to those who showed particularly low COVID-19 knowledge, as they are less likely to perform preventive behaviors. The low level of knowledge manifested in some individuals may reflect the challenge in increasing knowledge of the public during pandemics in general. During health crises, educating the public may be profoundly limited when disseminated health information conflicts with existing beliefs stemming from culture and system[33, 34], and rumors or misinformation are rampant across communication sources[35]. We thus recommend that public health researchers and policy makers put increasing effort into not only promoting knowledge but also understanding and addressing contextual factors that may hinder knowledge obtainment of the public.

Next, the results of our study showed to the fact that the level of COVID-19 knowledge differs by sociodemographic factors. Specifically, males and less educated individuals had less knowledge about COVID-19, which could make them more vulnerable to the epidemic. The phenomena of knowledge inequalities have been examined by many communication studies ever since the Knowledge Gap Hypothesis postulated that people would acquire knowledge at different paces, widening the knowledge gap over time, depending on their socioeconomic status, cognitive capabilities, and prior knowledge[36]. This study did not inquire into the temporal trend of inequalities; nevertheless, it identified the gaps in all factors within a causal link, as substantial differences among the respondents were found in knowledge and also in the subsequent factors - attitudes and behaviors. It implies that reducing gaps in health behaviors, and possibly health disparities in general, may be achieved by decreasing knowledge gaps at first focusing on those who have less knowledge. In light of this, if all behavioral aspects are disproportionately distributed across different social groups as found in this study, future policies and interventions should not be one-size-fits-all, and it must incorporate an inclusive approach to accommodate the needs of the underserved.

With respect to the relationship between knowledge and behaviors, the role of efficacy belief was found critical. It is evident that for the public to perform precautionary behaviors after acquiring information, then they need to believe that the behaviors would actually be effective. For example, people need to believe that washing hands would keep them from being infected, in addition to just being informed so, before they perform the behavior. While knowledge itself is at the root of learning, it is reasonable to expect that discrepancy between information delivered and received would occur[37, 38]. Public health experts need to acknowledge that health communication is a dynamic process, which is largely shaped by individual cognitive and psychological factors. Our findings imply that particular emphasis should be placed on bolstering efficacy as well as knowledge related to target behaviors that health interventions and policies promote. We also recommend that the efforts should prioritize populations who displayed low efficacy, particularly those who are younger and have less knowledge of COVID-19.

However, there are several limitations. First, we used the average score of knowledge in the analysis of this study, therefore, the effect of each knowledge was not examined. Second, our analyses did not extensively explore attitudinal factors such as perceived barriers to practicing preventive behaviors, or communication factors like seeking information, using the media, or processing information. Third, efficacy belief is conceptualized to include both response efficacy and self-efficacy, and the latter was not explored in this study.
During health crises and emergencies, it is essential for the public to uptake precautionary behaviors, as the novelty and unpredictability of epidemics may exceed the capability of a health system to a significant degree. This study provides evidence that knowledge is an important predictor of attitudes and behaviors contributing to advancing strategies for the sustainability of precautionary behaviors of the public. Meanwhile, some people may be disadvantaged from performing health behaviors due to an unequal distribution of knowledge, attitudes, and behaviors, in combination with a lack of access to health care and pre-existing health conditions. This study provides critical and timely insights into how the government and public health organizations establish appropriate policies and interventions that do not overlook and deprioritize those in urgent need.

**Abbreviations**

COVID-19  
coronavirus disease 2019; WHO: the World Health Organization; PHEIC: Public Health Emergency of International Concern; H1N1: novel influenza A; MERS: Middle East Respiratory Syndrome; KCDC: Korea Centers for Disease Control and Prevention; KRW: Korean won; M: Mean; SD: Standard deviation; Est.: Estimates; BC: bias-corrected confidence level

**Declarations**

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**Authors’ contributions**

MJ conceptualized the study, MS designed survey and interpreted data; BA drafted the manuscript; MJ performed literature review and data analysis; MS and MJ performed the survey; MJ critically reviewed and improved the manuscript; MS improved data interpretation and revised the manuscript. All authors substantially contributed to the study and approved its submission.

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**Availability of data and materials**

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Ethics approval and consent to participate**

The survey and consent to participate were approved by the Seoul National University Institutional Review Board (IRB No. 2006/003-023), and it conformed to the ethics guidelines of the Declaration of Helsinki. All the written consents were signed voluntarily and obtained online by all adult subjects.

**Consent for publication**

Not applicable.
Competing Interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Tables
| Characteristics            | Total (n = 970) |
|---------------------------|----------------|
|                          | n  | %   |
| **Demographics**          |    |     |
| **Gender**                |    |     |
| Male                      | 471| 48.6|
| Female                    | 499| 51.4|
| **Age (year)**            | M = 47.44 | SD = 14.78 |
| 18–29                     | 164| 16.9|
| 30–39                     | 154| 15.9|
| 40–49                     | 185| 19.1|
| 50–59                     | 195| 20.1|
| ≥ 60                      | 272| 28  |
| **Education level**       |    |     |
| High school               | 574| 59.2|
| Bachelor's degree         | 309| 31.9|
| Graduate/professional degree | 87 | 9  |
| **Monthly household income** |    |     |
| Under 200                 | 137| 14.1|
| 200–400                   | 300| 30.9|
| 400–600                   | 260| 26.8|
| ≥ 600                     | 273| 28.1|
| **Marital status**        |    |     |
| Married                   | 604| 62.3|
| Single/divorced/bereaved | 366| 37.7|
| **Presence of children**  |    |     |
| None                      | 743| 76.6|
| More than 1               | 227| 23.4|
| **Residence**             |    |     |
| Urban                     | 847| 87.3|
| Rural                     | 123| 12.7|
Table 2
Knowledge questions answered correctly, n (%)  

| #  | Knowledge items                                                                 | Correct | Incorrect | Don't Know |
|----|---------------------------------------------------------------------------------|---------|----------|-----------|
| 1  | The main clinical symptoms of COVID-19 are fever, fatigue, dry cough, and myalgia.| 85.1    | 7.8      | 7.1       |
| 2  | There currently is no effective cure for COVID-2019, but early symptomatic and supportive treatment can help most patients recover from the infection. | 76.5    | 9.7      | 13.8      |
| 3  | Not all persons with COVID-2019 will develop to severe cases. Only those who are elderly, have chronic illnesses are more likely to be severe cases. | 89.3    | 6.7      | 4         |
| 4  | Eating or contacting wild animals would result in the infection by the COVID-19 virus. | 27.9    | 42.2     | 29.9      |
| 5  | The COVID-19 virus spreads via respiratory droplets of infected individuals       | 93.2    | 2.5      | 4.3       |
| 6  | Ordinary residents can wear general medical masks to prevent the infection by the COVID-19 virus. | 48.8    | 39.7     | 11.5      |

Table 3  
Determinants of COVID-19 related knowledge score of participants

|                     | B     | Std. Error | Beta | t   | p-Value |
|---------------------|-------|------------|------|-----|---------|
| Constant            | 3.58  | 0.38       |      | 9.52| < 0.001 |
| Gender              | 0.14  | 0.07       | 0.06 | 1.93| 0.04    |
| Age                 | 0.05  | 0.03       | 0.07 | 1.61| 0.11    |
| Education level     | 0.06  | 0.03       | 0.06 | 1.9  | 0.04    |
| Income level        | 0     | 0.04       | 0    | 0.05| 0.96    |
| Marital status      | -0.02 | 0.11       | -0.01| -0.15| 0.88    |
| Residence           | 0     | 0.11       | 0    | 0.04| 0.96    |
| Presence of children | 0.09  | 0.1        | 0.03 | 0.89| 0.37    |
| Adjusted R²         | 0.013 |            |      |      |         |

a: Male:1, Female:2; b: City:1, Town:2; c: Yes:1, None:0
| Variable                              | Range | M     | SD  |
|--------------------------------------|-------|-------|-----|
| **Knowledge**                        |       |       |     |
| Knowledge score                      | 0–6   | 4.21  | 1.16|
| **Attitudes**                        |       |       |     |
| *Perceived risk*                     |       |       |     |
| Perceived susceptibility             | 1–5   | 2.77  | 0.8 |
| Perceived severity                  | 1–5   | 3.77  | 0.85|
| **Efficacy belief of precautionary behavior** |       |       |     |
| Personal hygiene practice            | 1–4   | 3.82  | 0.44|
| Keeping away from crowded places     | 1–4   | 3.66  | 0.59|
| **Practice**                         |       |       |     |
| Wearing facial masks                 | 1–4   | 3.82  | 0.49|
| Hand hygiene                         | 1–4   | 3.51  | 0.66|
| Keeping away from crowded places     | 1–4   | 3.11  | 0.9 |
Table 5
Determinants of attitudes of participants

|                        | Perceived susceptibility of COVID-19 | Perceived severity of COVID-19 | Efficacy belief on personal hygiene | Efficacy belief on social distancing |
|------------------------|-------------------------------------|--------------------------------|-----------------------------------|-------------------------------------|
|                        | B        | Beta | p-value | B        | Beta | p-value | B        | Beta | p-value | B        | Beta | p-value |
| Constant               | 2.99     | < 0.001 | 3.41   | < 0.001 | 3.27   | < 0.001 | 3       | < 0.001 |
| Gender \(^a\)          | 0.15     | 0.09 | < 0.001 | 0.15     | 0.09 | 0.01   | 0.08     | 0.09 | < 0.001 | 0.09     | 0.08 | 0.02   |
| Age                    | 0.02     | 0.04 | 0.3     | 0.09     | 0.15 | < 0.001 | 0.03     | 0.11 | 0.01   | 0.05     | 0.12 | < 0.001 |
| Education level        | -0.06    | -0.05 | 0.12    | -0.04    | -0.03 | 0.41   | -0.03    | -0.04 | 0.24   | -0.07    | -0.08 | 0.02   |
| Income level           | 0.01     | 0.02 | 0.61    | -0.05    | -0.06 | 0.1    | 0        | 0     | 0.99   | 0        | 0     | 0.97   |
| Marital status         | 0.04     | 0.02 | 0.58    | -0.04    | -0.02 | 0.63   | -0.03    | -0.03 | 0.49   | -0.04    | -0.03 | 0.49   |
| Residence \(^b\)       | -0.21    | -0.09 | 0.01    | -0.03    | -0.01 | 0.74   | 0.04     | 0.03 | 0.29   | 0.1      | 0.06 | 0.06   |
| Presence of children \(^c\) | 0.19 | 0.1 | < 0.001 | 0.12 | 0.06 | 0.1 | 0.03 | 0.03 | 0.35 | 0.09 | 0.06 | 0.07 |
| Knowledge score        | -0.08    | -0.12 | < 0.001 | 0        | 0     | 0.93   | 0.07     | 0.19 | < 0.001 | 0.08     | 0.16 | < 0.001 |
| Adjusted R-squared     | 0.01     | 0.03 | 0.06    | 0.06     | 0.06 |        |                      |       |       |            |       |        |

\(^a\): Male:1, Female:2; \(^b\): City:1, Town:2; \(^c\): Yes:1, None:0
Table 6
Determinants of practicing preventive behaviors of participants

| Variables               | Wearing facial mask | Hand hygiene | Avoid crowded places |
|-------------------------|---------------------|--------------|----------------------|
|                         | B       | Beta   | p-Value | B       | Beta   | p-Value | B       | Beta   | p-Value |
| Constant                | 2.13    | < 0.001 |         | 1.86    | < 0.001 |         | 1.66    | < 0.001 |         |
| Gender \(^a\)           | 0.1     | 0.1    | < 0.001 | 0.15    | 0.12   | < 0.001 | 0.02    | 0.01    | 0.78    |
| Age                     | 0       | 0.01   | 0.98    | 0.01    | 0.01    | 0.77    | 0.12    | 0.19    | < 0.001 |
| Education level         | 0.02    | 0.07   | 0.04    | 0.01    | 0.02    | 0.45    | -0.03   | -0.04   | 0.26    |
| Income level            | 0       | -0.01  | 0.76    | -0.01   | -0.01   | 0.81    | 0       | 0       | 0.98    |
| Marital status          | 0.04    | 0.04   | 0.76    | 0.06    | 0.04    | 0.33    | -0.03   | -0.02   | 0.69    |
| Residence \(^b\)        | -0.06   | -0.04  | 0.32    | -0.08   | -0.04   | 0.22    | 0.07    | 0.03    | 0.37    |
| Presence of children \(^c\) | -0.03 | -0.03  | 0.42    | 0.03    | 0.02    | 0.61    | 0.02    | 0.01    | 0.78    |
| Knowledge score         | 0       | 0.01   | 0.73    | 0.01    | 0.02    | 0.52    | -0.05   | -0.06   | 0.05    |
| Perceived susceptibility | 0.03    | 0.04   | 0.2     | 0.06    | 0.08    | 0.08    | 0.02    | 0.01    | 0.68    |
| Perceived severity      | 0.02    | 0.03   | 0.29    | 0       | 0       | 0.98    | -0.04   | -0.03   | 0.29    |
| Efficacy belief         | 0.35    | 0.31   | < 0.001 | 0.3     | 0.2     | < 0.001 | 0.34    | 0.22    | < 0.001 |
| Adjusted R\(^2\)        | 0.12    |        |         | 0.06    |        |         | 0.09    |        |         |

\(^a\): Male:1, Female:2; \(^b\): City:1, Town:2; \(^c\): Yes:1, None:0

Table 7
Indirect effects of knowledge on practice via attitudes

| Dependent Variable      | Mediator              | Est.     | 95% BC\(^a\)         |
|-------------------------|-----------------------|----------|-----------------------|
| Wearing facial masks   | Perceived susceptibility | -0.0021 | [0.00064, 0.0015] |
|                         | Perceived severity    | 0        | [-0.0015, 0.0014]   |
|                         | Efficacy belief       | 0.0253   | [0.0126, 0.0401]*    |
| Hand hygiene            | Perceived susceptibility | -0.0051 | [-0.0018, -0.0002]* |
|                         | Perceived severity    | 0        | [-0.0013, 0.0015]   |
|                         | Efficacy belief       | 0.0218   | [0.0101, 0.0362]*    |
| Avoiding crowded places | Perceived susceptibility | -0.0013 | [-0.0081, 0.0047] |
|                         | Perceived severity    | 0.0001   | [-0.0025, 0.0026]   |
|                         | Efficacy belief       | 0.0274   | [0.0140, 0.0429]*    |

\(^a\): Male:1, Female:2; \(^b\): City:1, Town:2; \(^c\): Yes:1, None:0