

## Understanding Precautionary Behavior in the Time of COVID-19\*

SeEun Jung\*\* · Sang-Hyun Kim\*\*\*

*Compliance with the public health authority guidelines is crucial to prevent the spread of COVID-19 successfully. By analyzing individual responses to a survey, we identify the weakest links, i.e., those who do not follow the guidelines as much as others do, and why they are failing. We find that individuals older than 60 are most enthusiastic in protecting their and others' health and that those younger than 30 are least enthusiastic. We categorize the factors possibly influencing the precautionary behavior into three groups: preference, belief, and constraint. It turns out that although beliefs on the effectiveness of protective measures do predict individual differences in their endeavors, they do not vary significantly across gender and age groups. On the other hand, risk, time, and social preferences explain individual differences well and significantly differ across gender and age groups. We also derive an implication for managing long-term risks due to fatigue and depression.*

JEL Classification: D01, D91, I12, I18

Keywords: Risk Preference, Social Preference, Health Behavior, Life Satisfaction, COVID-19

### I. Introduction

In response to the COVID-19 pandemic, the public health authority provided citizens guidelines to slow down the disease's spread. Obviously, compliance with a

---

*Received: Dec. 19, 2020. Revised: Aug. 27, 2021. Accepted: March 10, 2022.*

\* We thank Yongsung Chang, two anonymous referees, and the participants of the seminar at Yonsei University for valuable comments. All remaining errors are ours. This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government(MSIT) (NRF-2020R1G1A1010968) and by the Yonsei Signature Research Cluster Program of 2021 (2021.22.0011).

\*\* First Author, Associate Professor, Department of Economics, Inha University, 100 Inharo, Michuholgu, Incheon, 22212, South Korea, Phone: +82-32-860-7781. E-mail: jse@inha.ac.kr

\*\*\* Corresponding Author, Associate Professor, School of Economics, Yonsei University, 50 Yonsei-ro, Seodaemun-gu, Seoul, 03722, South Korea, Phone: +82-2-2123-2476. E-mail: sang.kim@yonsei.ac.kr

policy is crucial for the policy to be effective. What makes everybody's compliance more important now than usual is the fact that even a small number of non-compliers without symptoms can spread the disease to many. Thus, it is of great importance to identify and secure the weakest links to successfully manage the risk.

In this paper, we identify who are not following the guidelines as much as others are and why they are failing by analyzing individual responses to an online survey of a representative sample of Koreans run in August 2020. For this purpose, we measured individual effort to protect their and others' health and life. More specifically, in the survey, we asked to report every precautionary measure that they were taking among ten items,<sup>1</sup> and for the main quantitative measure of individual effort, we employ the number of items checked. We also elicited risk, time, and social preferences by employing the method developed by Falk et al. (2018), and beliefs on the infection risk, and the effectiveness of precautionary measures. The survey design is discussed in Section 3, and the translated survey is in the appendix.

We find that individuals older than 60 are most enthusiastic in protecting their and others' health, and those younger than 30 are least enthusiastic. As statistics show,<sup>2</sup> COVID-19 is deadlier for the older than for the younger, our finding suggests that the risks of physical pain and death are rather well understood, which echoes Schmitz and Wübker (2011) who found that existing health conditions affect the health-protective behavior. This is in line with the growing body of evidence indicating that unhealthy behaviors often cluster in young individuals (Meng et al., 1999), and gender and sociocultural factors are likely to influence health-related behavior (Deeks et al., 2009).

The optimal policy to secure the weakest links would depend on the reasons why they are putting less effort than others. For example, if non-compliers have misperceptions regarding the risks of COVID-19, providing the information would correct the bias. On the other hand, if preferences are the reason, then providing correct information would not do much good. Instead, more direct and coercive measures may be called for.

Thus, we investigate individual efforts further, focusing on the factors possibly influencing the precautionary behavior: preference, belief, and constraint. By *preference*, we mean risk, time, and social preferences as well as the aversion to physical and mental pains due to COVID-19. *Beliefs* are those on risks and the effectiveness of protections such as wearing a mask and social-distancing. Some people may have to bear a greater cost to follow the health authority guidelines because of their job requirements, where they live, disabilities, etc. Such factors are what we call constraints. Our focus is guided by the literature. For instance,

---

<sup>1</sup> The list of precautionary measures includes: "keeping 2m distance from others", "taking a 3-4 day break when feeling unwell", "canceling social gatherings," and "wearing a mask when going out."

<sup>2</sup> According to Statistica 2020, fatality rates from Covid 19 in Korea by age groups are 0.05% for 30s, 0.1% for 40s, 0.42% for 50s, 1.27% for 60s, 6.68% for 70s, and 19.45% for 80s and plus, respectively.

Anderson and Mellor (2008) found that risk aversion increases the effort put in health-protective measures, and Hurley and Mentzakis (2013) reported that altruism is shown to affect similar decisions in the context of transmittable diseases.

Our results provide empirical evidence that (1) health-protective behaviors differ by age groups and gender, (2) they can be well explained by belief, preference, and cost as predicted, therefore, (3) different protective behaviors by age groups and gender can be explained by the difference in preference, and (4) those who put more effort in health protection suffer more than others in terms of life satisfaction. In other words, while beliefs on risks and the effectiveness of protective measures predict protective behaviors well, the differences in terms of belief are not significant across age groups. Why younger individuals are not putting great efforts in protective behaviors is due to the difference in risk, time, and social preferences, which differ significantly across age groups and gender.

On top of the aforementioned risk, we may also have to pay attention to fatigues and the negative effects on subjective well-being. Low life satisfaction is closely related to mental illness, depression, and high suicide rates (Bray and Gunnell, 2006; Fergusson et al., 2015). In this sense, even if individuals (like people in their 60s) put great effort to follow the guidelines, they might suffer more in terms of mental health, which could cause another type of social risk in the long term. Therefore, together with the health policy promoting protective behaviors in the pandemic period, the authority should consider the long-term mental health with constant monitoring and social support for the vulnerable groups.

Since the outbreak, thousands of papers on the psychological, social, and economic effects of and responses to COVID-19 have been written. Several studies examine the relation between health behavior and risk and time preferences, trust, and personality (Müller and Rau, 2020; Thunström et al., 2020; Briscese et al., 2020; Zettler et al., 2020). Among others, two most closely related studies are Campos-Mercade et al. (2021) and Sheth and Wright (2020). Campos-Mercade et al. (2021), studying the responses of Swedish people, find evidence that prosocial preferences are predictive of taking precautionary measures. Sheth and Wright (2020), on the other hand, study the compliance to social distancing policy in the U.S., and find that neither preferences nor health conditions are predictive of compliance. The difference may be explained by the fact that in Campos-Mercade et al. (2021) the sample includes adults of all ages and educational achievement, whereas Sheth and Wright (2020) focus on college students. Our setup and findings are closer to those of Campos-Mercade et al. (2021) than Sheth and Wright (2020).

Our contribution lies in providing a comprehensive view of health-protective behaviors. In particular, whereas existing studies focus on people's preferences such as risk, time, and social preferences, we consider all of the preferences, beliefs, and constraints to explain the behavior. This is important to avoid the *omitted variable problem* which may cause biases in the estimation.

This study contributes to the literature on the responses to health policy during a pandemic (Bish and Michie, 2010; Bults et al., 2011; Ibuka et al., 2010). In the context of COVID-19, Wise et al. (2020) find that perceived personal risk is associated with preventative behaviors, but people are incompetent at assessing the actual risk. We also contribute to the broader literature on individual health-related decisions (Anderson and Mellor, 2008; Hurley and Mentzakis, 2013; Schmitz and Wübker, 2011).

## II. Conceptual Framework

This section develops a simple model of health-protective behavior to organize ideas and present hypotheses formally. In particular, we focus on three groups of factors: *preference*, *belief*, and *constraint*. By *preference*, we mean risk, time, and social preferences as well as the aversion to physical and mental pains due to COVID-19. Of course, the *beliefs* on risks and the effectiveness of protections such as wearing a mask would affect individuals' behavior. Some people may have to bear a greater cost to follow the health authority guidelines because of their job requirements, where they live, disabilities, etc. Such factors are what we call *constraints*.

Let us consider an individual who puts effort to avoid getting infected by taking protective measures such as wearing a mask and refraining from social gatherings. The utility function of the individual is given by:

$$U_h - c(e) + \beta[U_h - p(e)\{\Delta U + q(e)G\}]$$

where  $U_h$  is the utility level when healthy,  $\Delta U (> 0)$  is the change in utility due to infection, and  $G (\geq 0)$  is the change in utility due to spreading the disease to others (namely, *guilt*).  $\beta$  is the discount factor capturing the gap between now and the time suffering.  $p(e)$  and  $q(e)$  are the probabilities (that is, subjective beliefs) of getting infected and of spreading the disease to others, respectively, and  $e$  is the effort level, which is a non-negative real number. We assume that the probabilities are decreasing, convex, and continuously differentiable, meaning that as the individual puts more effort, the probabilities of infection decline, but the marginal effects are getting smaller. Notice that the individual may experience the social *pain*  $G$  only if she gets infected first and then infects others. That is, without getting infected first, she cannot infect others.  $c(e)$  is the effort cost assumed to be increasing, strictly convex, and continuously differentiable. To ensure the existence of an interior solution, we also assume that  $c'(0) = 0$ .

Note that  $\Delta U$  is affected by a couple of factors. First, if an individual expects that suffering the disease would be physically and mentally painful,  $\Delta U$  will be

high. That is, if an individual is in a high-risk group (e.g., old and with chronic diseases), then such conditions will be captured by a high  $\Delta U$  in this model. Also,  $\Delta U$  is related to risk-aversion. A risk-averse individual would evaluate a downward utility change more greatly than an upward change. The more risk-averse an individual is, the greater the downward utility change would be. Thus, a greater risk-aversion would be captured by a greater  $\Delta U$ . On the other hand,  $G$  captures the social preferences of an individual. If she cares for others, then she would feel guilty and regretful when infecting others. Also, if the individual lives with a child and/or an old member of her family, she would be more averse to getting infected than those who live alone.

The individual maximizes her utility by choosing  $e$ . The first-order condition is:

$$\beta[-p'(e^*)\{\Delta U + q(e^*)G\} - p(e^*)q'(e^*)G] = c'(e^*).$$

where  $e^*$  is the optimal effort. A comparative static analysis is straightforward. Notice first that the marginal benefit of effort is on the left-hand side, and the marginal cost is on the right. Thus, any change that increases the left-hand-side would increase the optimal effort  $e^*$ , and any change that increases the right-hand-side would decrease it. Note also that since  $p(e)$  and  $q(e)$  are probabilities of failures, they are decreasing functions, which means that both  $p'(e)$  and  $q'(e)$  are negative.

Having these in mind, one can easily see that the optimal effort is increasing in  $\Delta U$  and  $G$ , the expected utility changes in the events of infection,  $\beta$ , how much she cares for the future utility, and  $p'(e)$  and  $q'(e)$ , the beliefs on the effectiveness of effort.<sup>3</sup> On the other hand, the optimal effort would decline as the marginal effort cost  $c'(e)$  gets larger for any given  $e$ , that is, if she has constraints such as not being able to work from home and commuting by public transportation.

Moreover, the envelope theorem implies that the utility decrease will be larger for those who have greater  $\Delta U$ ,  $G$ ,  $\beta$ ,  $p(e)$ ,  $q(e)$ , and  $c(e)$  (for any given  $e$ ). Therefore, if we interpret the utility as happiness or subjective well-being, it means that those who expect to be hit by the shock more greatly would become unhappier than others. In other words, the subjective well-being of those who have greater  $\Delta U$ ,  $G$ ,  $\beta$ ,  $p(e)$ ,  $q(e)$ , and  $c(e)$  would decline more, which roughly means that those who put greater effort in health-protective behavior would suffer more in times of pandemic.

The discussion thus far can be summarized as follows:

---

<sup>3</sup> For the probabilities which are functions of  $e$ , we must add “for any  $e$ ” when doing a comparative static analysis. For example, if  $p_1(e) > p_2(e)$  for any  $e$ , the optimal effort will be higher with  $p_1(e)$ .

- An individual would try harder to avoid getting infected if the individual
  - is more averse to physical and mental pains,
  - is more risk-averse,
  - is more altruistic,
  - lives with a child or an elderly,
  - cares more for the future utility,
  - believes that the protective measures are effective,
  - and has fewer constraints.
  
- Roughly speaking, in times of pandemic, the subjective well-being of those who put greater effort in health protection would decline more than the subjective well-being of others.

### III. Survey Design

Most people tend to be honest (or averse to lying) even when being honest is costly.<sup>4</sup> Never-theless, responses to a morally loaded survey question may be biased because they may want to keep up a good image of themselves to themselves or to others.<sup>5</sup> Thus, instead of asking directly, “how well are you following the guideline?” we asked to report every precautionary measure that they were taking among ten items, most of which are from the guideline.<sup>6</sup> We believe that people would respond more honestly in this setup because most of them were actually putting *some effort* as opposed to none, and it was challenging to do everything perfectly. So, this setup encouraged participants to be honest by allowing them to justify themselves for not being perfect easily. For the main quantitative measure of individual preventative effort, we employ the number of items checked.

As for beliefs, we directly asked the following questions: “Suppose an individual puts effort in precautionary measures exactly as you do. What do you think of the probability that the person gets infected within a week?” and “If the person got infected, what do you think of the probability that the person infects another person within a week?” Furthermore, we asked them to imagine the following hypothetical situations: they did not wear a mask at all in public places or go to social gatherings

---

<sup>4</sup> There is a growing literature documenting people’s lying aversion and preference for truth-telling. See, for example, Abeler et al. (2019), Gneezy et al. (2018), and the references therein.

<sup>5</sup> For studies on social image concern, see for instance Glazer and Konrad (1996), and Andreoni and Bernheim (2009). For those on self-image concern, see Bénabou and Tirole (2006), and Schram and Charness (2015).

<sup>6</sup> It is question #10 in Part C of the survey which can be found in the appendix. The precautionary measures include “keeping 2m distance from others”, “taking a 3-4 day break when feeling unwell”, “canceling social gatherings,” and “wearing a mask when going out.”

as before the outbreak. And then, we asked the same questions about the infection probabilities.<sup>7</sup> By subtracting the baseline probabilities from the hypothetical probabilities,<sup>8</sup> we construct the measures for the effectiveness of wearing a mask and of avoiding social gatherings.

Our preference measures can be divided into two: the standard preferences and those regarding COVID-19. We follow Falk et al. (2018) to elicit the standard preferences such as risk, time, social preferences. Falk et al. (2018) identified non-incentivized questions that generate responses highly correlated with responses to incentivized questions and ran a world-wide survey to examine how risk, time, social preferences differ across and within nations. We employed their questions with minor modifications.<sup>9</sup> We also measure the aversion to COVID-19 by asking the following questions: “What do you think of the physical pain of Covid-19 in comparison with usual influenza?” (estimated physical pain), “Let’s suppose you got infected, and infected others. What do you think of the mental pain of it in comparison with the physical pain?” (estimated mental pain), and “Let’s suppose you got infected, and infected others. What do you think of the mental pain that you may suffer due to the social blame in comparison with the physical pain?” (estimated pain of infecting others)<sup>10</sup> On top of these, we also gathered demographic information.

## IV. Results

### 4.1. Data

For this study, a private survey company<sup>11</sup> in South Korea ran an online survey in August 2020. 1,500 representative samples were collected within 3 weeks. Among this, 155 individuals who wore a mask less often or increased social activities after the COVID-19 outbreak were dropped for the analyses, which leaves us 1,345 observations in total.<sup>12</sup> Table 1 presents the summary statistics.<sup>13</sup> Precautionary

<sup>7</sup> These are questions #2.1 and #2.2 of Part A.

<sup>8</sup> These are questions #3.1 and #3.2 (for masks), and #4.1 and #1.2 (for distancing) of Part A.

<sup>9</sup> These questions are in Part B of the survey.

<sup>10</sup> These are questions #5, #6, and #7 in Part A.

<sup>11</sup> Macromill Embrain (<https://www.embrain.com>). The survey company sent out the email invitation to the registered panel between the age groups of 20s and 60s who match the Korean population by gender, age, and region (Statistics Korea), then they formed the Korean representative sample with those who clicked to participate email invitation.

<sup>12</sup> We further included these 155 participants for robustness checks, and qualitative results remain the same.

<sup>13</sup> According to the KOSIS, the average age (44.63) and the female ratio (0.5) from our sample are quite similar to the population statistics (average age between 20s and 60s: 44.67, female ratio: 0.49)

behavior is our main variable of interest, which is defined as the sum of all effort measures (e.g., wearing a mask, social distancing, etc.) each participant reported s/he followed to avoid the risk of COVID-19. There are ten effort measures they could choose in the question.<sup>14</sup> It turns out that Koreans take six health-protective measures on average. We further separate this effort measure into two categories: distancing (four effort measures) and sanitation (six effort measures).

## 4.2. Health-Protective Behavior

Table 2 shows the heterogeneity in taking precautionary measures by gender and age groups. First of all, female participants tend to make more efforts (0.823 higher) than male participants (Deeks et al., 2009). Having the participants aged in their 40s as the reference group, dummies for participants in their 20s, 30s, 50s, and 60s are considered. Younger participants make less effort, and older participants make more efforts (Deeks et al., 2009; Meng et al., 1999). Especially participants in their 20s make on average 0.796 fewer efforts than those in their 40s, and participants in their 60s reported on average 0.649 more efforts. While females put consistently more efforts in both distancing and sanitation, age groups have different figures, depending on effort types. In terms of sanitation, the age differences are not so salient, whereas efforts related to social distancing has significant differences across age groups. Compared to the individuals in their 40s, those in their 20s significantly put fewer efforts in social distancing (and so do those in their 30s). Those in their 60s try to keep social distance significantly more.

[Table 1] Summary Statistics

	(1)			
	mean	sd	min	max
Female (=1)	0.50	0.50	0.00	1.00
Age	44.63	13.09	20.00	69.00
Monthly Income	239.48	234.57	0.00	1000.00
University (=1)	0.77	0.42	0.00	1.00
Having Children (=1)	0.94	0.24	0.00	1.00
Living with Elderly	0.33	0.47	0.00	1.00
Precautionary Measure				
Total	6.03	2.43	1.00	10.00
Distancing	3.15	1.73	0.00	6.00
Sanitation	2.89	1.04	0.00	4.00
Observations	1345			

provided by Population census 2020 collected by Statistics Korea.

<sup>14</sup> There were 11 effort measures in the survey, but none checked the option “I still try to connect with people and friends even though I have to keep physical distance with them.”

This behavioral difference across age groups and gender could be explained in several possible channels. As we described in the conceptual framework, this protective behavior towards COVID-19 can be explained by factors such as preferences, beliefs, and constraints. If these factors differ by gender and age systematically, the age and gender differences of the protective behavior can be well explained by these factors.

One might conjecture that younger/female individuals have different preferences, beliefs, or constraints than older/male ones. Referring to the appendix tables, we present the empirical evidence for that. Regarding disutilities and preferences, Table A1 shows that (1) younger individuals tend to estimate pains less severe than the older, while female individuals do estimate pains more severe than males, (2) younger individuals are generally more risk-taking, less patient,<sup>15</sup> less altruistic, less reciprocal, and less trusting, while female individuals are more risk-averse, less reciprocal, and less trusting than males. Regarding the beliefs associated with the effectiveness of precautionary measures (Table A2), female individuals tend to estimate the effectiveness of wearing a mask and social distancing significantly higher than males. However, the effectiveness of these efforts does not seem to vary significantly with age. Interesting points are that younger people tend to underestimate the effectiveness of masks and social distancing than those in their 40s, and so do people in their 60s. Table A3 shows the differences in the cost of following the health guidelines (i.e., whether telecommuting is impossible),

[Table 2] Precautionary Behavior by Gender and Age Group

	(1) Total	(2) Distancing	(3) Sanitation
Female (=1)	0.823*** (0.128)	0.444*** (0.0915)	0.378*** (0.0557)
Reference Group: Age 40s			
Age 20s	-0.796*** (0.203)	-0.713*** (0.145)	-0.0829 (0.0883)
Age 30s	-0.439** (0.204)	-0.304** (0.146)	-0.135 (0.0885)
Age 50s	-0.0141 (0.188)	0.0598 (0.135)	-0.0739 (0.0818)
Age 60s	0.649*** (0.204)	0.499*** (0.146)	0.151* (0.0885)
Constant	5.726*** (0.150)	3.001*** (0.107)	2.725*** (0.0652)
Observations	1345	1345	1345
Adjusted R <sup>2</sup>	0.062	0.063	0.038

Notes: Significant level: \* 0.10 \*\* 0.05 \*\*\* 0.01.

<sup>15</sup> Individuals in their 60s also tend to be less time patient than those in their 40s.

showing there is no difference across genders and age groups, except for the individuals in their 60s whose cost is significantly lower than others. This is quite intuitive that people in their 60s are likely to have been retired. Also, Table A4 presents that the concerns due to COVID-19 might be different across the gender and age groups. For example, older people tend to worry more about health, while individuals in their 40s tend to perceive it as financial risks than other age groups. Individuals in their 20s estimate the risk associated with social activities significantly higher than other age groups. Given all this empirical evidence, the age and gender differences in the protective behavior can be well explained by introducing these factors directly into the analyses as suggested in the model. In addition, age differences in preference factors are more salient than belief factors or cost factors, resulting in that the age differences in health-protective behaviors are caused mainly by differences in preference, rather than differences in belief.

Table 3 presents the factors that can directly explain individual protective behavior. Following our conceptual framework, we analyzed the health-protective behavior by estimated pains due to the infection, risk, time, and social preferences, belief (the effectiveness of wearing masks and social distancing on infection<sup>16</sup>), and constraints, as well as various sociodemographic variables. Factors explaining disutilities such as estimated physical pain, estimated mental pain, and individual risk aversion all tend to increase the precautionary behavior: the more (especially physical) pain the participant estimates from the infection and the more risk-averse he is, the more precautionary measures he would take. Regarding social preferences, altruism, having children, and living with an elderly all are positively correlated with the protective behavior, while estimated pain of infecting others seems to be significantly and positively correlated with the protective behavior of sanitation only. Time preference is also an important factor increasing the protective behavior: the more patient the participant is, the more efforts (especially in terms of social distancing) he could exert. Estimating wearing masks and social distancing more effectively is generally increasing individual protective efforts. Note that, though, these effectiveness measures might be inter-related, causing a potential multicollinearity issue.<sup>17</sup> The cost of putting the protective behavior can be captured from the dummy variable of the impossibility of telecommuting. This constraint is strongly and negatively correlated with the distancing effort, but not with the sanitary effort. Apart from that, women tend to put more effort, those with

---

<sup>16</sup> This is measured as the difference in the estimated infection probabilities between the current situation and the hypothetical situation of acting the opposite (wearing a mask to not wearing and social distancing to not distancing). The effectiveness of wearing a mask (social distancing, respectively) on self infection =  $\beta_{3.1}(\beta_{4.1}) - \beta_{2.1}$ , The effectiveness of wearing a mask (social distancing) on infecting others =  $\beta_{3.2}(\beta_{4.2}) - \beta_{2.2}$  in Part A.

<sup>17</sup> Regarding this, we perform the same analysis using a composite measure (PCA) of all these probabilities. The results remain the same qualitatively.

more than a university degree put less effort, and the monthly income is positively correlated with the effort provision.

[Table 3] Determinants of Precautionary Behavior

	(1) Total	(2) Distancing	(3) Sanitation
<u><math>\Delta U</math></u>			
Estimated Physical Pain	0.348*** (0.0732)	0.197*** (0.0531)	0.151*** (0.0326)
Estimated Mental Pain	0.113 (0.0738)	0.0620 (0.0535)	0.0514 (0.0328)
Risk Aversion	0.446*** (0.0798)	0.335*** (0.0578)	0.111*** (0.0355)
<u><math>G</math></u>			
Estimated Pain of Infecting others	0.0872 (0.0837)	-0.00498 (0.0607)	0.0921** (0.0373)
Altruism	0.464*** (0.0759)	0.285*** (0.0550)	0.178*** (0.0338)
Having Children (=1)	0.263 (0.257)	0.190 (0.187)	0.0729 (0.115)
Living with Elderly	0.313** (0.136)	0.165* (0.0982)	0.148** (0.0603)
<u><math>\beta</math></u>			
Patience	0.142* (0.0755)	0.107** (0.0547)	0.0349 (0.0336)
<u>Belief</u>			
Effectiveness of Mask on Self Infection	-0.408* (0.220)	-0.328** (0.160)	-0.0797 (0.0981)
Effectiveness of Mask on Infecting Others	0.549** (0.262)	0.353* (0.190)	0.196* (0.117)
Effectiveness of Distancing on Self Infection	0.550* (0.296)	0.427** (0.214)	0.123 (0.132)
Effectiveness of Distancing on Infecting Others	0.641** (0.276)	0.579*** (0.200)	0.0619 (0.123)
<u>Cost</u>			
Telecommuting Impossible (=1)	-0.430*** (0.126)	-0.349*** (0.0914)	-0.0805 (0.0561)
<u>Socio-Demographic Characteristics</u>			
University (=1)	-0.425*** (0.151)	-0.366*** (0.110)	-0.0593 (0.0673)
Monthly Income	0.000890*** (0.000285)	0.000673*** (0.000206)	0.000217* (0.000127)
Female (=1)	0.618*** (0.125)	0.338*** (0.0908)	0.280*** (0.0558)
Age 20s	-0.439** (0.199)	-0.500*** (0.144)	0.0612 (0.0888)

Age 30s	-0.233 (0.193)	-0.152 (0.140)	-0.0819 (0.0860)
Age 50s	-0.0755 (0.175)	0.00971 (0.127)	-0.0852 (0.0781)
Age 60s	0.354* (0.205)	0.306** (0.149)	0.0476 (0.0913)
Constant	1.940*** (0.588)	1.228*** (0.426)	0.712*** (0.262)
Observations	1345	1345	1345
Adjusted $R^2$	0.205	0.182	0.143

Notes: Significant level: \* 0.10 \*\* 0.05 \*\*\* 0.01. Total: Level of Precautionary Behavior in total dimensions. Distancing: Level of Precautionary Behavior in terms of Social Distancing. Sanitation: Level of Precautionary Behavior in terms of Sanitation.

Table 4 shows the change in satisfaction<sup>18</sup> due to the COVID-19 pandemic across gender and age groups. The dependent variable is defined by subtracting “Life satisfaction before the pandemic” from “Life satisfaction after the pandemic.” Therefore, the lower the measure is, the unhappier s/he became by the COVID-19 situation. Basically, the satisfaction decreases due to the COVID-19 (negative constant values), showing that participants became unhappier. Female and younger (age 20s and 30s) individuals are hit harder by the COVID-19 shock than male and older participants. If we control for the protective effort measures, as expected, those who put greater effort in health-protective behavior are suffering more in times of pandemic (i.e., negative coefficients for protective behavior measures).<sup>19</sup> Also, as discussed in Section 2, the envelope theorem implies that the satisfaction decrease will be larger for those who have greater  $\Delta U$ ,  $G$ ,  $\beta$ ,  $p(e)$ ,  $q(e)$ , and  $c(e)$  would decline more. Table 5 confirms that estimated physical and mental pains,

<sup>18</sup> It would be certainly interesting and informative to look into the changes in consumption, income, and health status. However, we think that in our context, the subjective evaluation of the quality of life is relevant, maybe more so than consumption, income, and health status. First of all, the life-satisfaction measure that we employ in our paper is a standard measure of subjective well-being, which has been used in economics and happiness studies (e.g., Frey (2018)). Moreover, we think this may be a better measure than consumption, income, and health status in that this measure shows a comprehensive (albeit of low-definition) picture, while the other measures show only some parts and may be misleading. For instance, consider the case of wearing a mask. In terms of consumption/expenditure, it would be positively counted because it increases the market-transacted value. (Of course, the whole picture would be more complicated than this because consumers may have to give up some other goods to buy masks.) However, the change in the quality of life due to wearing a mask would certainly be negative.

<sup>19</sup> We cannot directly compare coefficients between precautionary behaviors: social distancing and sanitation, as not only that the two measures range differently (distancing between 0 to 6, sanitation between 0 and 4), but also we cannot guarantee that the two variables actually measure the same level of effort improvement. However, one might conjecture which effort would decrease the satisfaction during the pandemic the most. For this, we control all dummies for each 10 effort types (Table A7) It turns out that wearing masks tends to decrease the satisfaction the most, followed by not gathering socially and using less public transports, which all are mainly about social distancing.

risk aversion, estimated pain of infecting others, and altruism all are the factors making more decreases in satisfaction due to the pandemic.<sup>20</sup>

[Table 4] Change in Life Satisfaction by Gender and Age Group

	(1)	(2)	(3)	(4)
Female (=1)	-0.443*** (0.0802)	-0.385*** (0.0801)	-0.364*** (0.0808)	-0.356*** (0.0803)
Reference Group: Age 40s				
Age 20s	-0.295** (0.127)	-0.388*** (0.127)	-0.312** (0.126)	-0.379*** (0.126)
Age 30s	-0.342*** (0.128)	-0.381*** (0.126)	-0.370*** (0.126)	-0.388*** (0.126)
Age 50s	0.0633 (0.118)	0.0711 (0.117)	0.0479 (0.117)	0.0618 (0.116)
Age 60s	0.00594 (0.128)	0.0709 (0.127)	0.0374 (0.126)	0.0746 (0.126)
Precautionary Behavior: Social Distancing		-0.130*** (0.0237)		
Precautionary Behavior: Sanitation			-0.209*** (0.0390)	
Precautionary Behavior				-0.106*** (0.0169)
Constant	-0.964*** (0.0941)	-0.574*** (0.117)	-0.395*** (0.141)	-0.359*** (0.134)
Observations	1345	1345	1345	1345
Adjusted $R^2$	0.031	0.051	0.050	0.058

Notes: Significant level: \* 0.10 \*\* 0.05 \*\*\* 0.01.

## V. Conclusion

This paper investigates what makes individuals comply with public health guidelines to prevent the spread of COVID-19. Running an online survey with 1,500 Korean representative samples, we partly explain the causes of non-compliant behavior. We find that individuals older than 60 are most active in protecting their

<sup>20</sup> If we believe that satisfaction and productivity are somewhat related (Oswald et al., 2015), it is worth investigating the effect of COVID-19 on individual productivity. Tables A5 and A6 present the effect of COVID-19 on productivity change. We use question #9 in Part C (See the appendix), “How do you think the COVID-19 pandemic affects your productivity?” from very negatively to very positively. Similarly to the analyses on life satisfaction, we can conclude that the COVID-19 situation is negatively affecting individual productivity. This shock can be harsher for those who put greater effort in health-protective behavior or those who have greater  $\Delta U$ ,  $G$ ,  $\beta$ ,  $p(e)$ ,  $q(e)$ , and  $c(e)$ . From this, we could also infer that putting efforts in health-protective behavior can be considered as costs on satisfaction and productivity.

**[Table 5]** Change in Life Satisfaction: Regressions

	(1)	(2)	(3)	(4)
Estimated Physical Pain	-0.141*** (0.0481)	-0.121** (0.0483)	-0.119** (0.0484)	-0.112** (0.0484)
Estimated Mental Pain	-0.0154 (0.0491)	-0.00957 (0.0489)	-0.00853 (0.0490)	-0.00687 (0.0489)
Risk Aversion	-0.184*** (0.0528)	-0.151*** (0.0534)	-0.168*** (0.0529)	-0.148*** (0.0533)
Estimated Pain of Infecting others	-0.108* (0.0556)	-0.107* (0.0554)	-0.0948* (0.0555)	-0.0998* (0.0553)
Altruism	-0.0925* (0.0506)	-0.0670 (0.0509)	-0.0685 (0.0510)	-0.0585 (0.0511)
Having Children (=1)	0.133 (0.172)	0.149 (0.171)	0.143 (0.171)	0.151 (0.171)
Living with Elderly	0.0563 (0.0903)	0.0732 (0.0901)	0.0770 (0.0902)	0.0814 (0.0901)
Patience	-0.0814 (0.0503)	-0.0717 (0.0502)	-0.0767 (0.0502)	-0.0709 (0.0501)
Telecommuting Impossible (=1)	0.0889 (0.0839)	0.0598 (0.0839)	0.0785 (0.0836)	0.0593 (0.0837)
University (=1)	-0.0373 (0.101)	-0.0692 (0.101)	-0.0452 (0.101)	-0.0679 (0.101)
Monthly Income	-0.000133 (0.000190)	-0.0000777 (0.000190)	-0.000105 (0.000189)	-0.0000724 (0.000189)
Female (=1)	-0.351*** (0.0836)	-0.320*** (0.0837)	-0.313*** (0.0841)	-0.305*** (0.0839)
Age 20s	-0.457*** (0.133)	-0.501*** (0.133)	-0.449*** (0.132)	-0.489*** (0.132)
Age 30s	-0.368*** (0.129)	-0.383*** (0.128)	-0.379*** (0.128)	-0.387*** (0.128)
Age 50s	0.0401 (0.117)	0.0405 (0.116)	0.0280 (0.116)	0.0339 (0.116)
Age 60s	-0.0213 (0.136)	0.00153 (0.136)	-0.0171 (0.136)	-0.000220 (0.136)
Precautionary Behavior: Social Distancing		-0.0875*** (0.0249)		
Precautionary Behavior: Sanitation			-0.133*** (0.0410)	
Precautionary Behavior				-0.0721*** (0.0180)
Constant	0.623 (0.390)	0.712* (0.389)	0.709* (0.389)	0.743* (0.389)
Observations	1345	1345	1345	1345
Adjusted R <sup>2</sup>	0.066	0.074	0.072	0.076

Notes: Significant level: \* 0.10 \*\* 0.05 \*\*\* 0.01.

and others' health and that those younger than 30 are the least compliant.

We categorize the factors possibly influencing the precautionary behavior into three groups: preference, belief, and constraint. Our results provide empirical evidence that while beliefs on risks and the effectiveness of protective measures predict protective behaviors well, there are no large differences in belief across age groups. Therefore, why younger individuals do not comply with the guidelines very actively is their different preferences over risk, time, and others' well-being compared to other groups than their belief on COVID-19 infection probabilities and estimated pains. This suggests that more direct and coercive measures could be more effective in order to increase the compliance of the health guidelines.

As well as preventing the spread of the virus, the great reduction of life satisfaction should be carefully emphasized. Negative shocks in life satisfaction may lead to mental illness, depression, and even suicide, which can be a serious potential risk to society. Therefore, the public health authority should not only focus on promoting protective behaviors, but also consider the long-term mental health with constant monitoring and social support for the vulnerable groups.

Of course, these results should be interpreted with extreme caution. A few variables that we use in our analyses might be inter-related to one another, and it is yet too early to make any conclusive causal relationship. However, our results can still shed light on understanding more on individual protective behaviors, which, in turn, could be of help to set a more effective communicable disease policy.

The final caveat is that the policy implications derived here cannot be applied to other contexts immediately. For instance, Korea is one of the countries where citizens are well aware of the danger of the disease and comply relatively well with the guideline. On the other hand, many Americans have believed that the danger of COVID-19 is exaggerated and wearing a mask is not effective. Moreover, coercive measures such as shut-down seemed working in some countries (e.g., Italy and the UK) whereas they ended up resulting in backlashes in others (e.g., France and the US). So, policy makers should be take lessons from our findings with caution.

### Appendix Table

[Table A1] Disutility and Preference by Gender and Age Group

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female (=1)	-0.0177 (0.0431)	0.187*** (0.0416)	-0.0302 (0.0438)	0.0681* (0.0402)	-0.208*** (0.0497)	-0.158*** (0.0530)	0.313*** (0.0492)	0.324*** (0.0600)	0.286*** (0.0533)
Reference Group: Age 40s									
Age 20s	-0.334*** (0.0684)	-0.0777 (0.0660)	-0.208*** (0.0695)	-0.184*** (0.0638)	-0.202** (0.0788)	-0.132 (0.0841)	-0.164** (0.0780)	-0.289*** (0.0952)	-0.265*** (0.0845)
Age 30s	-0.0711 (0.0685)	-0.00368 (0.0662)	-0.266*** (0.0696)	-0.166*** (0.0640)	-0.170** (0.0790)	-0.0698 (0.0843)	0.0428 (0.0782)	-0.0264 (0.0954)	-0.0322 (0.0847)
Age 50s	-0.111* (0.0634)	-0.0316 (0.0612)	0.0929 (0.0644)	0.0868 (0.0591)	0.0517 (0.0730)	0.376*** (0.0779)	-0.00444 (0.0723)	0.0354 (0.0883)	-0.0743 (0.0784)
Age 60s	-0.193*** (0.0685)	0.0474 (0.0662)	0.323*** (0.0696)	0.227*** (0.0640)	0.00839 (0.0790)	0.451*** (0.0843)	0.0707 (0.0782)	-0.0902 (0.0954)	-0.179** (0.0847)
Constant	0.146*** (0.0505)	-0.0740 (0.0488)	0.0427 (0.0514)	-0.0149 (0.0472)	0.171*** (0.0582)	-0.0558 (0.0621)	6.301*** (0.0576)	6.148*** (0.0704)	6.381*** (0.0625)
Observations	1345	1345	1345	1345	1345	1345	1345	1345	1345
Adjusted R <sup>2</sup>	0.016	0.014	0.057	0.038	0.021	0.058	0.033	0.028	0.027

Notes: Significant level: \* 0.10 \*\* 0.05 \*\*\* 0.01. (1) Patience. (2) Risk Aversion. (3) Altruism. (4) Positive Reciprocity. (5) Negative Reciprocity. (6) Social Trust. (7) Estimated Physical Pain. (8) Estimated Mental Pain. (9) Estimated Pain of Infecting Others.

[Table A2] Belief by Gender and Age Group

	(1)	(2)	(3)	(4)
Female (=1)	4.220*** (1.446)	3.401** (1.534)	4.059*** (1.330)	5.292*** (1.518)
Reference Group: Age 40s				
Age 20s	-4.493* (2.294)	1.356 (2.434)	-3.997* (2.111)	-1.963 (2.408)
Age 30s	0.0611 (2.300)	1.359 (2.439)	-0.341 (2.116)	-2.371 (2.414)
Age 50s	-2.089 (2.127)	-4.252* (2.256)	2.207 (1.956)	-0.406 (2.232)
Age 60s	-4.773** (2.300)	-6.518*** (2.440)	0.204 (2.116)	-3.407 (2.414)
Constant	23.76*** (1.696)	25.49*** (1.799)	13.60*** (1.560)	17.31*** (1.780)
Observations	1345	1345	1345	1345
Adjusted R <sup>2</sup>	0.008	0.012	0.010	0.007

Notes: Significant level: \* 0.10 \*\* 0.05 \*\*\* 0.01. (1) Effectiveness of Mask on Self Infection. (2) Effectiveness of Mask on Infecting Others. (3) Effectiveness of Distancing on Self Infection. (4) Effectiveness of Distancing on Infecting Others.

**[Table A3]** Cost (Constraints) by Gender and Age Group

	Telecommuting Impossible (=1)
Female (=1)	0.0228 (0.0259)
Age 20s	0.00919 (0.0412)
Age 30s	-0.00883 (0.0412)
Age 50s	-0.0331 (0.0381)
Age 60s	-0.176*** (0.0412)
Constant	0.385*** (0.0304)
Observations	1345
Adjusted $R^2$	0.015

Notes: Significant level: \* 0.10 \*\* 0.05 \*\*\* 0.01.

**[Table A4]** COVID-19 Perceived Risk Type

	(1) Health	(2) Financial	(3) Social
Female (=1)	0.0427 (0.0269)	-0.0460* (0.0265)	0.00342 (0.0169)
Reference Group: Age 40s			
Age 20s	-0.0389 (0.0427)	-0.0198 (0.0420)	0.0597** (0.0268)
Age 30s	0.0674 (0.0428)	-0.0774* (0.0421)	0.00680 (0.0269)
Age 50s	0.0662* (0.0396)	-0.0601 (0.0390)	-0.00197 (0.0249)
Age 60s	0.213*** (0.0428)	-0.202*** (0.0421)	-0.00572 (0.0269)
Constant	0.398*** (0.0315)	0.493*** (0.0311)	0.0956*** (0.0198)
Observations	1345	1345	1345
Adjusted $R^2$	0.026	0.018	0.002

Notes: Significant level: \* 0.10 \*\* 0.05 \*\*\* 0.01.

**[Table A5]** COVID-19 on Productivity by Gender and Age Group

	(1)	(2)	(3)	(4)
Female (=1)	-0.238*** (0.0666)	-0.204*** (0.0669)	-0.185*** (0.0673)	-0.184*** (0.0671)
Age 20s	0.0589 (0.106)	0.00403 (0.106)	0.0472 (0.105)	0.00659 (0.106)
Age 30s	0.00845 (0.106)	-0.0149 (0.106)	-0.0106 (0.105)	-0.0204 (0.105)
Age 50s	-0.0549 (0.0980)	-0.0503 (0.0975)	-0.0653 (0.0974)	-0.0559 (0.0973)
Age 60s	0.114 (0.106)	0.152 (0.106)	0.135 (0.105)	0.156 (0.106)
Precautionary Behavior: Social Distancing		-0.0769*** (0.0198)		
Precautionary Behavior: Sanitation			-0.140*** (0.0325)	
Precautionary Behavior				-0.0657*** (0.0141)
Constant	3.293*** (0.0781)	3.524*** (0.0978)	3.676*** (0.118)	3.669*** (0.112)
Observations	1345	1345	1345	1345
Adjusted $R^2$	0.008	0.018	0.021	0.023

Notes: Significant level: \* 0.10 \*\* 0.05 \*\*\* 0.01.

**[Table A6]** COVIDI-19 on Productivity

	(1)	(2)	(3)	(4)
Estimated Physical Pain	-0.120*** (0.0397)	-0.108*** (0.0399)	-0.105*** (0.0399)	-0.102** (0.0400)
Estimated Mental Pain	-0.0637 (0.0404)	-0.0600 (0.0404)	-0.0593 (0.0404)	-0.0583 (0.0403)
Risk Aversion	-0.188*** (0.0435)	-0.168*** (0.0441)	-0.177*** (0.0436)	-0.165*** (0.0440)
Estimated Pain of Infecting others	-0.0735 (0.0459)	-0.0729 (0.0458)	-0.0643 (0.0459)	-0.0684 (0.0458)
Altruism	0.0262 (0.0417)	0.0412 (0.0421)	0.0427 (0.0421)	0.0474 (0.0422)
Having Children (=1)	-0.0589 (0.138)	-0.0522 (0.138)	-0.0505 (0.138)	-0.0489 (0.138)
Living with Elderly	0.150** (0.0728)	0.161** (0.0728)	0.164** (0.0729)	0.167** (0.0728)
Patience	0.0609 (0.0414)	0.0670 (0.0414)	0.0641 (0.0413)	0.0678 (0.0413)
Telecommuting Impossible (=1)	0.0226 (0.0691)	0.00488 (0.0693)	0.0155 (0.0689)	0.00372 (0.0691)
Female (=1)	-0.0798 (0.0690)	-0.0616 (0.0692)	-0.0540 (0.0695)	-0.0512 (0.0694)
Age	-0.0226 (0.0200)	-0.0200 (0.0200)	-0.0247 (0.0200)	-0.0214 (0.0200)
Age2	0.000245 (0.000226)	0.000226 (0.000226)	0.000268 (0.000226)	0.000240 (0.000226)
University (=1)	-0.106 (0.0833)	-0.125 (0.0835)	-0.111 (0.0831)	-0.125 (0.0833)
Monthly Income	0.000462*** (0.000157)	0.000493*** (0.000157)	0.000481*** (0.000157)	0.000499*** (0.000157)
Precautionary Behavior: Social Distancing		-0.0522** (0.0205)		
Precautionary Behavior: Sanitation			-0.0907*** (0.0338)	
Precautionary Behavior				-0.0452*** (0.0149)
Constant	5.325*** (0.488)	5.302*** (0.487)	5.423*** (0.488)	5.354*** (0.487)
Observations	1345	1345	1345	1345
Adjusted R <sup>2</sup>	0.057	0.061	0.062	0.063

Notes: Significant level: \* 0.10 \*\* 0.05 \*\*\* 0.01.

**[Table A7]** Impact of each effort on decrease in Satisfaction due to Covid 19

Effort type	
Keep 2 m distance from others.	0.127 (0.0922)
Ventilate and sanitize things twice a day.	-0.116 (0.0899)
Stay at home.	-0.0498 (0.0990)
Take a 3-4 day break when feeling unwell.	0.117 (0.0992)
Refrain from using public transportation.	-0.245*** (0.0891)
Refrain from going to public places such as bus terminals, libraries, and cafes.	-0.102 (0.0970)
Cancel social gatherings and do not go to religious gatherings.	-0.307*** (0.0926)
Cough into sleeves, not hands.	-0.0610 (0.0939)
Wash your hands when coming back home and whenever necessary.	-0.153 (0.128)
Wear a mask when going out.	-0.494** (0.193)
Observations	1345
Adjusted R-squared	0.070

Notes: Significant level: \* 0.10 \*\* 0.05 \*\*\* 0.01. Gender and age group's dummies are controlled.

## Appendix: Survey questions

### Part A

Below we ask how your everyday life has changed since the outbreak of COVID-19. Please reply as precisely as possible.

1.1. Do you wear a mask more often than before the outbreak? [ym]

1=strongly disagree	2	3	4	5	6	7=strongly agree
---------------------	---	---	---	---	---	------------------

1.2. Do you refrain from going to social gatherings than before the outbreak? [yh]

1=strongly disagree	2	3	4	5	6	7=strongly agree
---------------------	---	---	---	---	---	------------------

[The following sentences remain on the top of the screen during Part A.]

“Let us assume that all the others are behaving as they are now. On average, an adult catches a cold a couple of times a year. So during a week in the season, an individual catches a cold with about 10%.

Even if a question sounds vague, imagine as concretely as possible, and let us know what you are thinking. It will help our research a lot.”

2.1. Suppose an individual puts effort in precautionary measures exactly as you do. What do you think of the probability that the person gets infected within a week?

0%	lower than 0.1%	0.1-1%	1-5%	5-10%	10-20%	higher than 20%
----	-----------------	--------	------	-------	--------	-----------------

2.2. Suppose an individual puts effort in precautionary measures exactly as you do. If the person got infected, what do you think of the probability that the person infects another person within a week?

0%	lower than 0.1%	0.1-1%	1-5%	5-10%	10-20%	higher than 20%
----	-----------------	--------	------	-------	--------	-----------------

[If  $y_m < 5$ ]

3.1. Suppose an individual wears a mask all the time in public places. The person does everything else as you do now. What do you think of the probability that the person gets infected within a week?

0%	lower than 0.1%	0.1-1%	1-5%	5-10%	10-20%	higher than 20%
----	-----------------	--------	------	-------	--------	-----------------

3.2. Suppose an individual wears a mask all the time in public places. The person does everything else as you do now. If the person got infected, what do you think of the probability that the person infects another person within a week?

0%	lower than 0.1%	0.1-1%	1-5%	5-10%	10-20%	higher than 20%
----	-----------------	--------	------	-------	--------	-----------------

[If  $y_m > 4$ ]

3.1. Suppose an individual does not wear a mask at all in public places. The person does everything else as you do now. What do you think of the probability that the person gets infected within a week?

0%	lower than 0.1%	0.1-1%	1-5%	5-10%	10-20%	higher than 20%
----	-----------------	--------	------	-------	--------	-----------------

3.2. Suppose an individual does not wear a mask at all in public places. The person does everything else as you do now. If the person got infected, what do you think of the probability that the person infects another person within a week?

0%	lower than 0.1%	0.1-1%	1-5%	5-10%	10-20%	higher than 20%
----	-----------------	--------	------	-------	--------	-----------------

[If  $y_h < 5$ ]

4.1. Suppose an individual does not go to social gatherings at all. The person does everything else as you do now. What do you think of the probability that the person gets infected within a week?

0%	lower than 0.1%	0.1-1%	1-5%	5-10%	10-20%	higher than 20%
----	-----------------	--------	------	-------	--------	-----------------

4.2. Suppose an individual does not go to social gatherings at all. The person does everything else as you do now. If the person got infected, what do you think of the probability that the person infects another person within a week?

0%	lower than 0.1%	0.1-1%	1-5%	5-10%	10-20%	higher than 20%
----	-----------------	--------	------	-------	--------	-----------------

[ $y_h > 4$ ]

4.1. Suppose an individual goes to social gatherings as before the outbreak. The person does everything else as you do now. What do you think of the probability that the person gets infected within a week?

0%	lower than 0.1%	0.1-1%	1-5%	5-10%	10-20%	higher than 20%
----	-----------------	--------	------	-------	--------	-----------------

4.2. Suppose an individual goes to social gatherings as before the outbreak. The person does everything else as you do now. If the person got infected, what do you think of the probability that the person infects another person within a week?

0%	lower than 0.1%	0.1-1%	1-5%	5-10%	10-20%	higher than 20%
----	-----------------	--------	------	-------	--------	-----------------

5. What do you think of the physical pain of Covid-19 in comparison with usual influenza?

1 = much less painful	2	3	4	5	6	7 = much more painful
-----------------------	---	---	---	---	---	-----------------------

6. Let's suppose you got infected and infected others. What do you think of the mental pain of it in comparison with the physical pain?

1 = much less painful	2	3	4	5	6	7 = much more painful
-----------------------	---	---	---	---	---	-----------------------

7. Let's suppose you got infected and infected others. What do you think of the mental pain that you may suffer due to the social blame in comparison with the physical pain?

1 = much less painful	2	3	4	5	6	7 = much more painful
-----------------------	---	---	---	---	---	-----------------------

## Part B

1. In general, how willing or unwilling are you to take risks?

1 = completely unwilling	2	3	4	5	6	7 = completely willing
--------------------------	---	---	---	---	---	------------------------

2. You will be asked 5 questions in this section. Please imagine the following situation. You can choose between a sure payment of a particular amount of money, or a draw, where you would have an equal chance of getting amount  $x$  or getting nothing. What would you prefer: a draw with a 50 percent chance of receiving amount  $x$ , and the same 50 percent chance of receiving nothing or the amount of  $y$  as a sure payment?

[Please refer to Figure 1 for the logic]

Question Number	Choices in Previous Questions	Option A	Option B
1		100% KRW 160,000	50% KRW 300,000
2	A	100% KRW 80,000	50% KRW 300,000
2	B	100% KRW 240,000	50% KRW 300,000
3	A-A	100% KRW 40,000	50% KRW 300,000
3	A-B	100% KRW 120,000	50% KRW 300,000
3	B-A	100% KRW 200,000	50% KRW 300,000
3	B-B	100% KRW 280,000	50% KRW 300,000
4	A-A-A	100% KRW 20,000	50% KRW 300,000
4	A-A-B	100% KRW 60,000	50% KRW 300,000
4	A-B-A	100% KRW 100,000	50% KRW 300,000
4	A-B-B	100% KRW 140,000	50% KRW 300,000
4	B-A-A	100% KRW 180,000	50% KRW 300,000
4	B-A-B	100% KRW 220,000	50% KRW 300,000
4	B-B-A	100% KRW 260,000	50% KRW 300,000
4	B-B-B	100% KRW 300,000	50% KRW 300,000
5	A-A-A-A	100% KRW 10,000 (risk=1)	50% KRW 300,000 (risk=2)
5	A-A-A-B	100% KRW 30,000 (risk=3)	50% KRW 300,000 (risk=4)
5	A-A-B-A	100% KRW 50,000 (risk=5)	50% KRW 300,000 (risk=6)
5	A-A-B-B	100% KRW 70,000 (risk=7)	50% KRW 300,000 (risk=8)
5	A-B-A-A	100% KRW 90,000 (risk=9)	50% KRW 300,000 (risk=10)
5	A-B-A-B	100% KRW 110,000 (risk=11)	50% KRW 300,000 (risk=12)
5	A-B-B-A	100% KRW 130,000(risk=13)	50% KRW 300,000 (risk=14)
5	A-B-B-B	100% KRW 150,000(risk=15)	50% KRW 300,000 (risk=16)
5	B-A-A-A	100% KRW 170,000(risk=17)	50% KRW 300,000 (risk=18)
5	B-A-A-B	100% KRW 190,000(risk=19)	50% KRW 300,000 (risk=20)
5	B-A-B-A	100% KRW 210,000(risk=21)	50% KRW 300,000 (risk=22)
5	B-A-B-B	100% KRW 230,000(risk=23)	50% KRW 300,000 (risk=24)
5	B-B-A-A	100% KRW 250,000(risk=25)	50% KRW 300,000 (risk=26)
5	B-B-A-B	: 100% KRW 270,000(risk=27)	50% KRW 300,000 (risk=28)
5	B-B-B-A	100% KRW 290,000(risk=29)	50% KRW 300,000 (risk=30)
5	B-B-B-B	100% KRW 310,000(risk=31)	50% KRW 300,000 (risk=32)

3. How willing are you to give up something that is beneficial for you today in order to benefit more from that in the future?

4. You will be asked 5 questions in this section. Suppose you were given a choice between receiving a payment today or a payment in 12 months. We will now present to you five situations. The payment today is the same in each of these situations, KRW 100,000. The payment in 12 months is different in every situation. For each of these situations, we would like to know which you would choose. Please assume there is no inflation, i.e., future prices are the same as today's prices. Would you rather receive KRW 100,000 today or KRW x in 12 months?

1=completely unwilling	2	3	4	5	6	7=completely willing
------------------------	---	---	---	---	---	----------------------

[Please refer to Figure 2 for the logic]

Question Number	Choices in Previous Questions	Option A	Option B
1		a year later 154,000	today 100,000
2	A	a year later 125,000	today 100,000
2	B	a year later 185,000	today 100,000
3	A-A	a year later 112,000	today 100,000
3	A-B	a year later 139,000	today 100,000
3	B-A	a year later 169,000	today 100,000
3	B-B	a year later 202,000	today 100,000
4	A-A-A	a year later 106,000	today 100,000
4	A-A-B	a year later 119,000	today 100,000
4	A-B-A	a year later 132,000	today 100,000
4	A-B-B	a year later 146,000	today 100,000
4	B-A-A	a year later 161,000	today 100,000
4	B-A-B	a year later 177,000	today 100,000
4	B-B-A	a year later 193,000	today 100,000
4	B-B-B	a year later 210,000	today 100,000
5	A-A-A-A	a year later 103,000(time=32)	today 100,000(time=31)
5	A-A-A-B	a year later 109,000(time=30)	today 100,000(time=29)
5	A-A-B-A	a year later 116,000(time=28)	today 100,000(time=27)
5	A-A-B-B	a year later 122,000(time=26)	today 100,000(time=25)
5	A-B-A-A	a year later 129,000(time=24)	today 100,000(time=23)
5	A-B-A-B	a year later 136,000(time=22)	today 100,000(time=21)
5	A-B-B-A	a year later 143,000(time=20)	today 100,000(time=19)
5	A-B-B-B	a year later 150,000(time=18)	today 100,000(time=17)
5	B-A-A-A	a year later 158,000(time=16)	today 100,000(time=15)
5	B-A-A-B	a year later 165,000(time=14)	today 100,000(time=13)
5	B-A-B-A	a year later 173,000(time=12)	today 100,000(time=11)
5	B-A-B-B	a year later 181,000(time=10)	today 100,000(time=9)
5	B-B-A-A	a year later 189,000(time=8)	today 100,000(time=7)
5	B-B-A-B	a year later 197,000(time=6)	today 100,000(time=5)
5	B-B-B-A	a year later 206,000(time=4)	today 100,000(time=3)
5	B-B-B-B	a year later 215,000(time=2)	today 100,000(time=1)

5. When someone does me a favor, I am willing to return it.

1=strongly disagree	2	3	4	5	6	7=strongly agree
---------------------	---	---	---	---	---	------------------

6. Please think about what you would do in the following situation. You are in an area you are not familiar with, and you realize you lost your way. You ask a stranger for directions. The stranger offers to take you to your destination. Helping you costs

the stranger about KRW 20,000 in total. However, the stranger says he or she does not want any money from you. You have six presents with you. The cheapest present costs KRW 5,000, the most expensive one costs KRW 30,000. Do you give one of the presents to the stranger as a “thank-you”-gift? If so, which present do you give to the stranger?

No present	KRW 5,000	10,000	15,000	20,000	25,000	30,000
------------	-----------	--------	--------	--------	--------	--------

7. How willing are you to punish someone who treats you unfairly, even if there may be costs for you?

1=completely unwilling	2	3	4	5	6	7=completely willing
------------------------	---	---	---	---	---	----------------------

8. How willing are you to punish someone who treats others unfairly, even if there may be costs for you?

1=completely unwilling	2	3	4	5	6	7=completely willing
------------------------	---	---	---	---	---	----------------------

9. I assume that people have only the best intentions.

1=strongly disagree	2	3	4	5	6	7=strongly agree
---------------------	---	---	---	---	---	------------------

10. Imagine the following situation: Today, you unexpectedly received KRW 1,000,000. How much of this amount would you donate to a good cause? (Values between 0 and 1,000,000 are allowed.)

11. How willing are you to give to good causes without expecting anything in re-turn?

1=completely unwilling	2	3	4	5	6	7=completely willing
------------------------	---	---	---	---	---	----------------------

12. What do you think of the probability that you get infected COVID-19 in comparison to the average people in your age and gender?

1=far below	2	3	4	5	6	7=far above
-------------	---	---	---	---	---	-------------

13. How would you put yourself in terms of political orientation?

1=very progressive	2	3	4	5	6	7=very conservative
--------------------	---	---	---	---	---	---------------------

## Part C

1. Which aspect of your life concerns you the most in case you get infected?

(1) health (2) financial (3) social (4) others

2. Regarding Covid-19, what concerns you the most?

(1) getting infected (2) spreading it to others (3) your and your family members' jobs being affected (4) your children's education being affected (5) being unable to meet family and friends (6) others

3. The infection probability is

(1) controllable by efforts. (2) uncontrollable because luck matters the most.

4. Can you work from home?

(1) can always (2) can sometimes (3) cannot

5. Do you go to public restaurants to have lunch or dinner?

(1) yes (2) only when unavoidable (3) no

6. Do you use public transportation?

(1) yes (2) only when unavoidable (3) no

7. How satisfied were you with your life before the outbreak?

1=very unsatisfied	2	3	4	5	6	7=very satisfied
--------------------	---	---	---	---	---	------------------

8. How satisfied are you with your life after the outbreak?

1=very unsatisfied	2	3	4	5	6	7=very satisfied
--------------------	---	---	---	---	---	------------------

9. How do you think the Covid 19 pandemic affects your productivity?

1=very negatively	2	3	4	5	6	7=very positively
-------------------	---	---	---	---	---	-------------------

10. Check everything that you do now:

- Keep 2 m distance from others.
- I still try to connect with people and friends even though I have to keep physical distance with them.
- Ventilate and sanitize things twice a day.
- Stay at home.

- Take a 3-4 day break when feeling unwell.
- Refrain from using public transportation.
- Refrain from going to public places such as bus terminals, libraries, and cafes.
- Cancel social gatherings and do not go to religious gatherings.
- Cough into sleeves, not hands.
- Wash your hands when coming back home and whenever necessary.
- Wear a mask when going out.

11. How has your job been affected by Covid-19?

(1) getting the same wage (2) not lost a job, but the wage got cut (3) lost a job (4) not lost a job, but been unpaid

12. Check everything that is the case to you:

- My wage got cut.
- It affects my physical health negatively.
- I feel depressed because of Covid-19.
- It affects my mental health negatively.
- It affects my financial condition negatively.
- I move physically less than before.

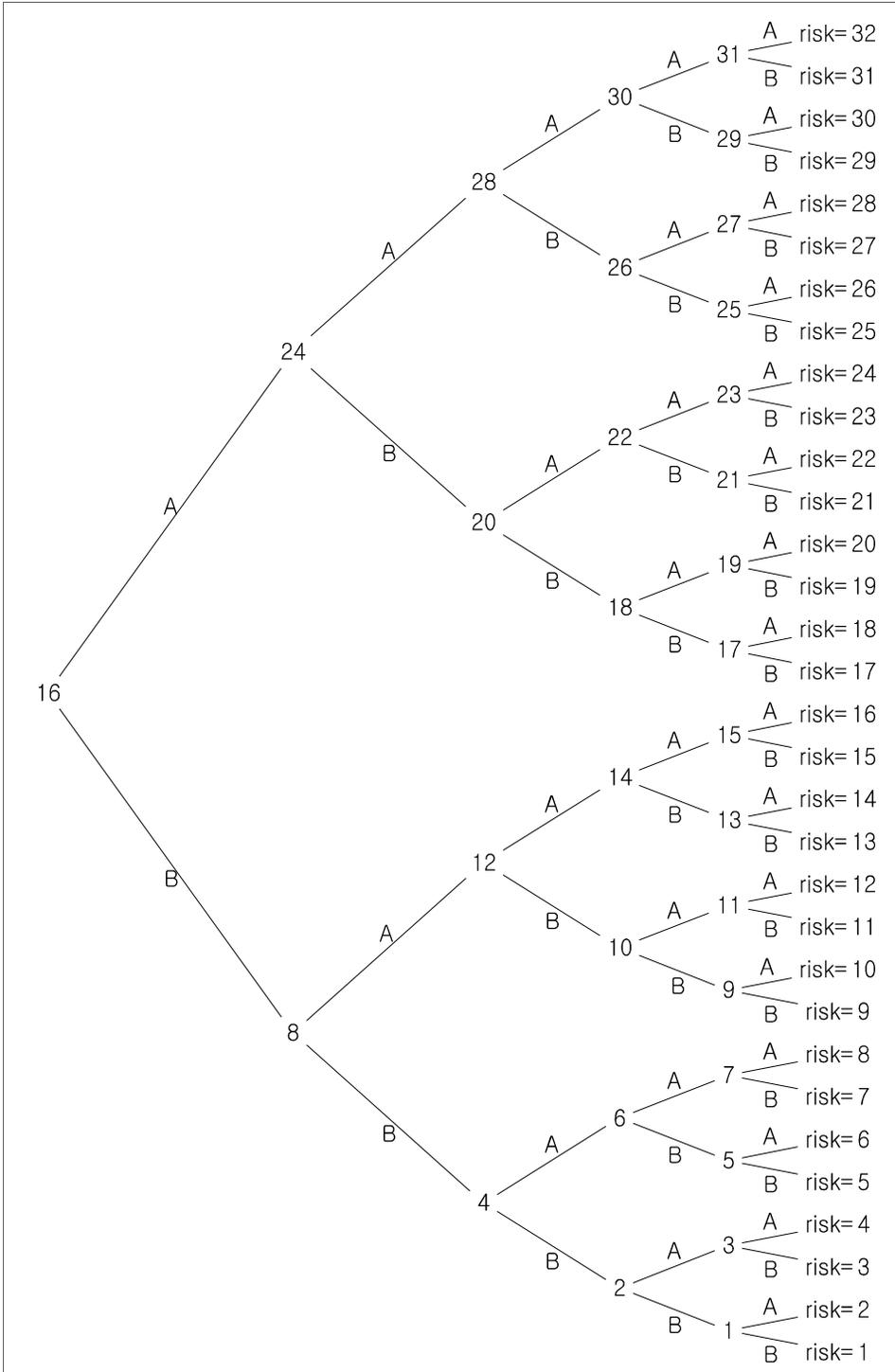
13. Do you know anyone close to you who was confirmed?

(1) yes (2) no

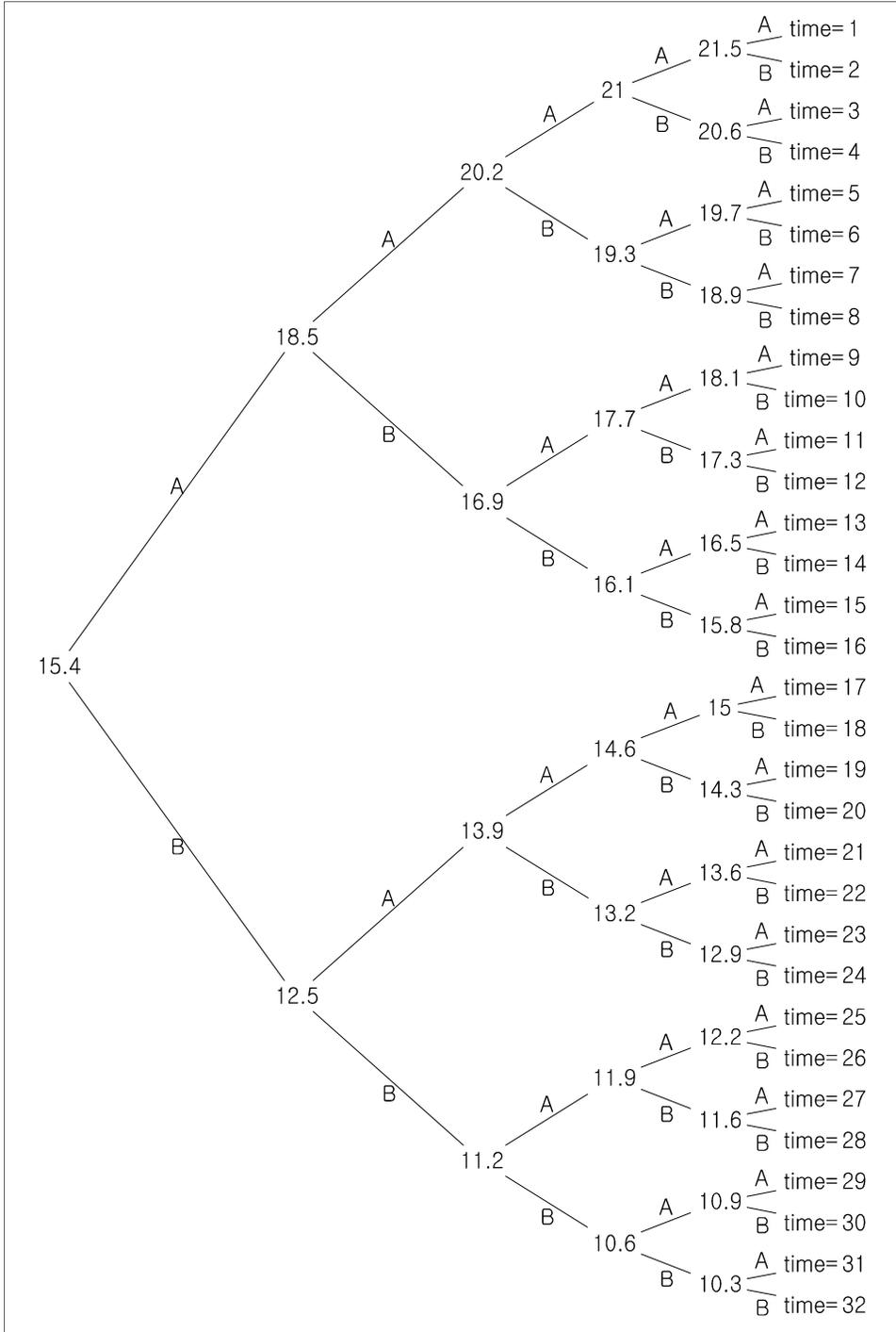
14. Do you live with anyone older than 60?

(1) yes (2) no

[Figure 1] Tree for the Staircase Risk Task (Numbers: Sure Payment in KRW 10,000, A= Choice of Lottery, B= Choice of Sure Payment in KRW 10,000)



[Figure 2] Tree for the Staircase Time Task (Numbers: Payment (in KRW 10,000) in 12 Months, A= Choice of KRW 100,000 Today, B= Choice of “X KRW 10,000 in 12 Months”)



## References

- Abeler, J., D. Nosenzo, and C. Raymond (2019), "Preferences for Truth-telling," *Econometrica*, 87(4), 1115–1153.
- Anderson, L. R. and J. M. Mellor (2008), "Predicting Health Behaviors with an Experimental Measure of Risk Preference," *Journal of Health Economics*, 27(5), 1260–1274.
- Andreoni, J. and B. D. Bernheim (2009), "Social Image and the 50-50 Norm: A Theoretical and Experimental Analysis of Audience Effects," *Econometrica*, 77(5), 1607–1636.
- Bish, A. and S. Michie (2010), "Demographic and Attitudinal Determinants of Protective Behaviours During a Pandemic: A Review," *British Journal of Health Psychology*, 15, 797–824.
- Bray, I. and D. Gunnell (2006), "Suicide Rates, Life Satisfaction and Happiness as Markers for Population Mental Health," *Soc Psychiat Epidemiol*, 41, 333–337.
- Briscese, G., N. Lacetera, M. Macis, and M. Tonin (2020), "Compliance with COVID-19 Social-distancing Measures in Italy: The Role of Expectations and Duration," *NBER WP 26916*.
- Bults, M., D. J. Beaujean, O. de Zwart, G. Kok, P. van Empelen, J. E. van Steenberg, J. H. Richardus, and H. A. Voeten (2011), "Perceived Risk, Anxiety, and Behavioural Responses of the General Public During the Early Phase of the Influenza a (h1n1) Pandemic in the Netherlands: Results of three Consecutive Online Surveys," *BMC Public Health*, 11(2).
- Bénabou, R. and J. Tirole (2006), "Incentives and Prosocial Behavior," *American Economic Review*, 96(6), 1652–1678.
- Campos-Mercade, P., A. N. Meier, F. H. Schneider, and E. Wengström (2021), "Prosociality Predicts Health Behaviors During the Covid-19 Pandemic," *Journal of Public Economics*, 195, 104367.
- Deeks, A., L. C. M. J., and T. H. (2009), "The Effects of Gender and Age on Health Related behaviors," *BMC Public Health*, 9(213).
- Falk, A., A. Becker, T. Dohmen, B. Enke, D. Huffman, and U. Sunde (2018), "Global Evidence on Economic Preferences," *Quarterly Journal of Economics*, 133(4), 1645–1692.
- Fergusson, D. M., G. F. McLeod, L. J. Horwood, N. R. Swain, S. Chapple, and R. Poulton (2015), "Life Satisfaction and Mental Health Problems (18 to 35 years)," *Psychological Medicine*, 45(11), 2427–2436.
- Frey, B. S. (2018), *Economics of Happiness*, Springer International Publishing.
- Glazer, A. and K. A. Konrad (1996), "A Signaling Explanation for Charity," *American Economic Review*, 86(4), 1019–1028.
- Gneezy, U., A. Kajackaite, and J. Sobel (2018), "Lying Aversion and the Size of the Lie," *American Economic Review*, 108(2), 419–453.
- Hurley, J. and E. Mentzakis (2013), "Health-related Externalities: Evidence from a Choice Experiment," *Journal of Health Economics*, 32(4), 671–681.
- Ibuka, Y., G. B. Chapman, L. A. Meyers, M. Li, and A. P. Galvani (2010), "The Dynamics

- of Risk Perceptions and Precautionary Behavior in Response to 2009 (h1n1) Pandemic Influenza,” *BMC Infectious Diseases*, 10(296).
- Meng, L., M. G. L. J., and K. LN (1999), “Lifestyle Factors and Chronic Diseases: Application of a Composite Risk Index,” *Prev Med*, 29(4), 296–304.
- Müller, S. and H. A. Rau (2020), “Economic Preferences and Compliance in the Social Stress Test of the Corona Crisis,” *Cege DP*, 391.
- Oswald, A. J., E. Proto, and D. Sgroi (2015), “Happiness and Productivity,” *Journal of Labor Economics*, 33(4), 789–822.
- Schmitz, H. and A. Wübker (2011), “What Determines Influenza Vaccination Take-up of Elderly Europeans?” *Health Economics*, 20(11), 1281–1297.
- Schram, A. and G. Charness (2015), “Inducing Social Norms in Laboratory Allocation Choices,” *Management Science*, 61(7), 1531–1546.
- Sheth, K. and G. C. Wright (2020), “The Usual Suspects: Does Risk Tolerance, Altruism, and Health Predict the Response to Covid-19?” *Review of Economics of the Household*, 18, 1041–1052.
- Thunström, L., M. Ashworth, J. F. Shogren, S. Newbold, and D. Finnoff (2020), “Testing for COVID-19: Willful Ignorance or Selfless Behavior?” *Behavioral Public Policy*, 1–18.
- Wise, T., T. Zbozinek, G. Michelini, C. C. Hagan, and D. Mobbs (2020), “Changes in Risk Perception and Protective Behavior During the First Week of the Covid-19 Pandemic in the United States,” *Royal Society Open Science*, 7(9).
- Zettler, I., C. Schild, L. Lilleholt, and R. Böhm (2020), “Individual Differences in Accepting Personal Restrictions to Fight the COVID-19 Pandemic: Results from a Danish Adult Sample,” *PsyArXiv Preprint*.

## COVID-19 시기의 예방행동에 관한 연구\*

정 세 은\*\* · 김 상 현\*\*\*

**초 록** COVID-19의 확산을 성공적으로 방지하기 위해서는 보건당국 지침을 준수하여 개인 스스로가 방역활동을 하는 것이 중요하다. 본 연구는 설문 조사를 통하여, 개인의 방역활동 노력에 미치는 요인들을 분석한다. 설문 에 따르면, 60세 이상의 사람들이 자신과 다른 사람들의 건강을 보호하 는 데 가장 적극적인 반면, 30세 미만의 사람들이 방역지침을 지키는 데 에 있어 가장 소극적이다. 본 연구에서는 예방 행동에 영향을 미칠 수 있 는 요인들을 개인의 선호(preference), 믿음(belief) 및 제약 (constraint)의 세 그룹으로 분류한다. 분석 결과, 예방행동의 효과에 대 한 개인의 믿음이 개인의 방역활동 노력에 유의미한 영향을 끼치나, 이는 성별과 연령 그룹에 따라 크게 다르지 않다. 반면, 위험, 시간, 사회적 선 호도는 개인의 차이를 잘 설명해 주고 성별과 연령 그룹에 따라 유의미 한 이질성을 지닌다. 나아가, 본 연구는 피로와 우울증으로 인한 장기적 인 위험 관리에 대한 고려의 필요성을 제시한다.

핵심 주제어: 위험회피성향, 사회적 선호, 건강행동, 삶의 만족도, COVID-19

경제학문헌목록 주제분류: D01, D91, I12, I18

투고 일자: 2020. 12. 19. 심사 및 수정 일자: 2021. 8. 27. 게재 확정 일자: 2022. 3. 10.

\* 본 연구는 한국연구재단의 연구지원(NRF-2020R1G1A1010968)과 2021년도 연세 시그니처 연구클러스터 사업연구비의 지원(2021.22.0011)을 받아 수행되었다. 논문에 대한 유익한 조언을 해준 장용성 교수와 익명의 두 심사자, 그리고 연세대학교 세미나 참여자들에게 깊은 감사를 표한다. 본 논문의 오류는 모두 저자들에게 있다.

\*\* 제1저자, 인하대학교 경제학과 부교수, e-mail: jse@inha.ac.kr

\*\*\* 교신저자, 연세대학교 경제학부 부교수, e-mail: sang.kim@yonsei.ac.kr