



Socio-demographic, psychological, and experiential predictors of COVID-19 vaccine hesitancy in South Korea, October-December 2020

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ABSTRACT

Vaccine hesitancy is the primary barrier to controlling the COVID-19 pandemic in South Korea. We used logistic multivariate regression modeling to investigate (1) the prevalence and reasons for COVID-19 vaccine hesitancy, (2) sub-groups that had higher rates of vaccine hesitancy, and (3) vaccine hesitancy predictors. We used a national survey of representatively sampled households ($n = 13,021$ adults) from October to December 2020. A self-report questionnaire asked about vaccination intention and reasons for hesitancy and gathered data on socio-demographic, demographic, psychological, and experiential factors. Our study indicated that 39.8% of the participants answered that they hesitated or refused to be vaccinated. The most common reason for vaccine hesitancy was a lack of confidence in the COVID-19 vaccine (77.9%). Less or no fear of COVID-19 (OR = 2.08, 95% CI = 1.92–2.26; OR = 1.79, 95% CI = 1.54–2.08), unstable job status (OR = 1.42, 95% CI = 1.18–1.70), decreased family income (OR = 1.40, 95% CI = 1.21–1.61), and worsening health status (OR = 1.38, 95% CI = 1.13–1.68) were predictors of vaccine hesitancy. Younger age, no religious affiliation, political conservatism, and lower family income were also significantly associated with vaccine hesitancy. Effective health communication and policies need to consider the target subgroup population and predictors of vaccine hesitancy to attain herd immunity at an early stage.

ARTICLE HISTORY

Received 15 June 2021
Revised 1 September 2021
Accepted 15 September 2021

KEYWORDS

Vaccine; hesitancy; attitude; belief; change of life; COVID-19

Introduction

Vaccination is the safest and most cost-effective strategy to curb the pandemic and promote herd immunity.¹ Accessibility of vaccination services and the availability of vaccines are critical; meanwhile, individuals' vaccination intentions involving individual needs, attitudes, and contexts of vaccination are also considerable determinants to end the pandemic.¹

Vaccine hesitancy has been a global challenge that has caused a significant threat to the acceptance of vaccines and vaccination programs.² Vaccine hesitancy is defined as “delay in acceptance or refusal of vaccination despite the availability of vaccination services” or “the reluctance or refusal to vaccinate despite the availability of vaccines.”³ Indeed, vaccine hesitancy has hampered efforts to control infectious diseases in several countries, such as polio in parts of Nigeria and Pakistan, influenza A (H1N1) among pregnant women in the Americas, and the human papillomavirus (HPV) in Japan and India.^{1,4–6}

In order to control the current COVID-19 pandemic, identifying the predictors of vaccine hesitancy in subgroups is essential to address low vaccine uptake.³ Previous studies suggested several models for understanding vaccination behavior. World Health Organization advisory body explained that vaccine hesitancy using the 3 C model defining that the behavior is influenced by complacency (not perceiving diseases as high risk and vaccination as necessary), convenience (practical bar-

riers), and confidence (lack of trust in safety and effectiveness of vaccines).⁷ The model was extended to the 4 C model by integrating calculation (engagement in extensive information searching) as an additional psychological antecedent.⁸ The 5 C model additionally considered collective responsibility (the willingness to protect others by vaccination through herd immunity) to the 4 C model.⁹ Recent studies also have indicated that COVID-19 vaccine hesitancy is a complex behavior associated with socio-demographic, psychological, and experiential factors. People of younger age, African American race, lower income, lower education, and conservative political ideology were less likely to have a vaccination intention.^{10–12} Psychological factors, including lower levels of anxiety^{13,14} and lower perceived risk of infection^{15,16} were associated with decreased intentions to get vaccinated. Those who had positive experiences or minor impacts on daily life during the COVID-19 pandemic were less likely to get vaccinated.¹⁰

Korea commenced its vaccination drive against COVID-19 in February 2021. Given that vaccines are free of charge and under universal healthcare coverage, the population's vaccination intention would be critical to promote herd immunity in the Korean context. Studies to control COVID-19 have estimated that more than 70% of the population needs to have immunity to achieve herd immunity.^{17,18} Since more variants related to a higher risk of transmission and lower efficacy of vaccination were reported recently, the coverage needed

should be even higher. As pregnant women and children under 16 are currently excluded from vaccination in Korea, achieving this goal would require approximately 90% of the adults to be vaccinated, though the target coverage rate could be lower if the future recommended schedule includes children.¹⁹ Thus, understanding who will take the vaccine, who will refuse, who are uncertain, and the associated reasons are crucial to facilitate the control of the COVID-19 pandemic. Based on these findings, the government needs to develop health communication strategies to achieve herd immunity and minimize the consequences of the pandemic.

Thus, this study aimed to (1) describe how willing Koreans are to be vaccinated against COVID-19 and the main reasons for vaccine hesitancy, (2) identify which sub-groups are more likely to have vaccine hesitancy, and (3) identify demographic, psychological, and experiential predictors of vaccine hesitancy on COVID-19 vaccination in Korean adults.

Materials and methods

Study population

A cross-sectional and nationwide population-based survey, entitled “Koreans’ Happiness Survey,” was conducted from October to December 2020 for the population aged over 15 years. Based on the entire population over 15 aged (more than 45 million people from 20 million households) in 2019,²⁰ a total of 13,824 participants from 6,857 households were selected, based on a stratified multi-stage cluster sampling method and probability proportional to size sampling. A total of 650 strata at the second stage were selected from 34 strata at the first stage, identified using administrative districts (seven metropolitan cities and ten provinces) and strata characteristics. Ten households were randomly selected from each stratum. Professional surveyors visited the selected households, and family members over 15 were required to complete the structured questionnaire using tablets. Given the COVID-19 pandemic, a self-report survey was also administered to participants concerned about possible infections during the survey. After excluding participants under 20 ($N = 471$), 13,353 samples were included in the final analysis. This study was approved by the Institutional Review Board of the Seoul Metropolitan Government-Seoul National University Boramae Medical Center (No. 07–2021-12). All respondents provided written informed consent before completing the survey.

COVID-19 situation in Korea during the survey

Before this survey, from October 24th to December 18th, 2020, Korea experienced two waves of COVID-19. Confirmed cases peaked at 909 in February and 441 in August 2020. During the survey period, confirmed cases were gradually increased from 50 to 600. Meanwhile, the results of clinical trials of COVID-19 vaccines had been reported. Phase III’s vaccine results from Moderna, AstraZeneca, and the Pfizer/Biotech vaccine were preliminarily announced in November 2020. As the number of confirmed cases was increased in Korea, the announcements were reported through media. However, influences on the vaccination intention were limited as vaccines were still not approved by

official health authorities, including U.S. Food and Drug Administration (FDA), CDC, or WHO during the survey. The U.S. FDA granted Pfizer/Biotech and Moderna vaccines emergency use authorization in December 2020. At the end of August 2021, barely 28.4% of Korean have completed vaccination.

Outcome variables

To measure vaccination intentions, the question, “If a vaccine against COVID-19 becomes available, would you get vaccinated?” was asked, and participants selected their responses among the options “Yes,” “No,” or “Uncertain.” We classified “No” and “Uncertain” under “vaccine hesitancy,” and “Yes” under “vaccine acceptance,” according to the definition of vaccine hesitancy by the Strategic Advisory Group of Experts on Immunization in WHO, which is “delay in acceptance or refusal of vaccination despite the availability of vaccination services.”³ Those who answered “No” or “Uncertain” were asked why they refused or were reluctant to be vaccinated. They could choose one response from a list of possible ten options, which were as follows: “I am worried about side effects of vaccination,” “I think vaccine for COVID-19 is not safe,” “If I were infected with COVID-19, I would be fine with getting treatment,” “Disease, life, and death depend on fate,” “I will not get infected with COVID-19,” “I trust in natural healing and folk remedies,” “I am afraid of getting an injection,” “I am against vaccination itself,” “I cannot get a vaccine for religious reasons” or “others.”

Socio-demographic predictors

We explored socio-demographic variables, including age, gender, marital status, education, job status, household income, religion, political conservatism, and health status. Age was classified into young adults, middle-aged adults, and older adults, aged 20 to 39, 40 to 59, and 60 or older, respectively. Gender was coded as “male” or “female.” Marital status was classified as “having a spouse (married)” or “not having a spouse (unmarried, divorced or separated),” respectively. Education was classified as “lower than high school,” “high school graduate,” or “college graduate or higher.” Under job status, respondents were asked to choose between “have a job” or “no job.” Household monthly income was classified into “less than 3 million KRW (USD 2,700),” “more than 3 million won and less than 5 million KRW,” or “5 million KRW or more (USD 4,500).” Religion was coded as “have a religion” or “no religion.” Political conservatism was measured using a 10-point scale ranging from 1 to 10. A higher score indicates more politically conservative attitudes. The respondent selected current health status from the options “very good,” “good,” “neutral,” “bad,” or “very bad,” which collapsed into two categories: “good (very good, good, and neutral),” and “bad (bad and very bad).”

Psychological and experiential predictors

We also explored the psychological and experiential predictors of intentions to vaccinate against COVID-19. Fear of COVID-19 was probed through the following responses: “strongly fear,”

“fear,” “neutral,” “no fear,” and “no fear at all.” For the measurement variables “I am aware of the preventive guidelines of COVID-19” and “I trust the preventive measures of the government,” the participants could choose from the options “strongly disagree,” “disagree,” “neutral,” “agree,” and “strongly agree.” The ordinal responses collapsed into three categories: disagree, neutral, and agree.

Regarding experiential predictors, we probed into personal experiences due to the COVID-19 pandemic. Participants were asked about their own experience of COVID-19 infection or that of their acquaintances. Participants could answer “Yes” or “No.” We asked if medical care, besides that for COVID-19, during this pandemic was needed. If yes, they had to respond whether their needs were “met,” “delayed,” or “unmet.” The responses to the two questions were categorized as “no need,” “met,” and “unmet (delayed and unmet).” The changes due to the COVID-19 pandemic in job status, family income, family relationships, and health were also investigated. The response options for job status were listed as “no change,” “unemployed or closing business,” “change to part-time work,” “change to non-regular work,” and “suspension or temporary retirement from a job.” The last three options were categorized into “unstable job status.” The responses to household income change per month were classified as “less than 0.5 million KRW (USD 450),” “0.5 million KRW or more, and less than 1 million KRW (USD 900)” or “1 million KRW or more.” The response options indicating a change in family relationship and health were “even worse,” “worse,” “no change,” “better,” and “even better,” and were categorized under “worse,” “no change,” and “better.”

Statistical analysis

First, we descriptively presented the differences in the characteristics of the study participants according to the vaccination intention using Pearson’s chi-squared test for categorized variables and t-test for continuous variables. Descriptive statistics were calculated using cross-sectional weights to make the sample representative of the Korean dwelling population. We then performed multivariate logistic regression to identify the influencing factors associated with vaccine hesitancy toward the COVID-19 vaccination. We clustered socio-demographic, psychological, and experiential predictors as blocks and added them in a stepwise manner in the regression models. All analyses were performed with Stata 16.0, using the complex sample method to consider the clustered and stratified samples.²¹ The statistical significance was set at $p \leq .05$.

Results

Table 1 indicates that 39.8% (N = 5,189) were reluctant or refused to get vaccinated against COVID-19. Table 2 lists the reasons for vaccine hesitancy. Among the participants in the vaccine hesitancy study group, 4,044 (77.9%) were reluctant or refused to be vaccinated because of no confidence, including “safety concerns against COVID-19 vaccination” (31.6%) and “worries about the side effects of the vaccination” (46.3%). About 18.7% of the participants were reluctant or refused because of complacency toward COVID-19.

The socio-demographic characteristics of the study participants according to vaccine hesitancy are illustrated in Table 1. There were significant differences between the lower income group (43.3%) and the higher income group (40.7% and 36.8%, respectively). More people in the “bad health” category (43.8%) than those in the “good health” category (39.6%) hesitated to get vaccinated. People with no religious affiliation (43.1%) had higher vaccine hesitancy than those affiliated with a religion (31.8%). Political conservatism had more vaccine hesitancy than vaccine acceptance (mean: 5.78, SD: 1.73, vs. mean: 5.51, SD: 1.86). There were no statistical differences between the groups according to gender, age, marital status, and education.

Table 3 presents the psychological and experiential characteristics of the participants according to vaccination hesitancy. There were significant differences between the groups “vaccine acceptance” and “vaccine hesitancy” for all the characteristics except for “experience of change in family relationship.” More people who feared COVID-19 accepted the vaccination than those who did not. More people aware of the preventive guidelines for COVID-19 or trusted the government’s preventive measures accepted the vaccination than those who did not.

Among the participants, 606 (4.7%) were infected with COVID-19 or had acquaintances infected with COVID-19. About 14% of the participants had other medical care needs, besides COVID-19, during this pandemic; however, the needs of 559 (4.3%) were unmet. The group with unmet needs had a lower rate of vaccine hesitancy than that with no needs or fulfilled needs. Since the COVID-19 pandemic, the share of participants who experienced changes in job, household income, family relationships, and health status were 5.5%, 26.8%, 21.2%, and 20.4%, respectively. More people who experienced worse changes in job status, family relationships, and health status had vaccine hesitancy than those who had a better experience or no change. Among those who experienced changes in family income, the group whose family income of less than 0.5 million KRW decreased had more vaccine hesitancy than other groups who experienced no change or decrease in their income of more than 0.5 million KRW.

The estimates based on multivariate binomial logit models of hesitancy to vaccinate against COVID-19 are presented in Table 4. Model 3 presents those who had no fear of COVID-19 or those whose responses were neutral and were less likely to get vaccinated than those who feared vaccination, after controlling for other predictors (OR: 1.79, 95% CI: 1.54 ~ 2.08; OR: 2.08, 95% CI: 1.92 ~ 2.26). Those aware of the preventive guidelines for COVID-19 were more likely to get vaccinated (OR: 0.84, 95% CI: 0.72 ~ 0.97) than those not aware of them after controlling for other predictors. Trust in the government’s preventive measures was not a significant predictor in the models.

Compared with the groups that experienced no change in job status, those who experienced unstable job status were likely to have vaccine hesitancy (OR: 1.42, 95% CI: 1.18 ~ 1.70). Those with a family income of less than 0.5 million KRW were more likely to display vaccine hesitancy than those who experienced no changes (OR: 1.40, 95% CI: 1.21 ~ 1.61). The group that experienced no change in family relationships was less likely to have vaccine hesitancy than the group that experienced a better change in family relations (OR: 0.88, 95% CI: 0.79 ~ 0.98). Meanwhile, those who experienced

Table 1. Socio-demographic characteristics of participants according to vaccination hesitancy.

	Total	Vaccine acceptance	Vaccine hesitancy	p-Value
	N (%)	N (%)	N (%)	
Total	13021 (100)	7832 (60.2)	5189 (39.8)	
Gender				0.640
Female	6535 (50.2)	3917 (59.9)	2618 (40.1)	
Male	6486 (49.8)	3915 (60.4)	2570 (39.6)	
Age (years)				0.220
Young adults (20 ~ 39)	4365 (33.5)	2600 (59.6)	1765 (40.4)	
Middle-aged (40 ~ 59)	5151 (39.6)	3079 (59.8)	2072 (40.2)	
Elderly (60+)	3505 (26.9)	2153 (61.4)	1351 (38.6)	
Having a spouse				0.221
No	3713 (28.5)	2199 (59.2)	1515 (40.8)	
Yes	9307 (71.5)	5633 (60.5)	3674 (39.5)	
Family income per month				<0.001
<3 M KRW (≅USD 2,700)	3108 (23.9)	1762 (56.7)	1346 (43.3)	
≥3 M KRW & <5 M KRW	4941 (38.0)	2928 (59.3)	2012 (40.7)	
≥5 M KRW (≅USD 4,500)	4972 (38.2)	3142 (63.2)	1830 (36.8)	
Education				0.233
< high school	1244 (9.6)	729 (58.6)	515 (41.4)	
High school graduate	4217 (32.5)	2503 (59.4)	1714 (40.6)	
≥College graduate	7499 (57.9)	4545 (60.6)	2954 (39.4)	
Job status				0.006
No job	4262 (32.7)	2488 (58.4)	1774 (41.6)	
Have a job	8759 (67.3)	5344 (61.0)	3415 (39.0)	
Health status				0.031
Good	8203 (94.6)	7437 (60.4)	4881 (39.6)	
Bad	703 (5.4)	395 (56.2)	308 (43.8)	
Religion				<0.001
No religion	9313 (71.5)	5303 (56.9)	4011 (43.1)	
Have a religion	3707 (28.5)	2529 (68.2)	1178 (31.8)	
	Mean (SD)	Mean (SD)	Mean (SD)	
Political conservatism (range: 1 ~ 10)	5.62 (1.82)	5.51 (1.86)	5.78 (1.73)	<0.001

N: number; SD: standard deviation. The statistics were calculated using cross-sectional weights.

Table 2. The reasons for vaccine hesitancy (n = 5,532).

	N (%)
Confidence	4044 (77.9)
I worried about side effects after vaccination.	2402 (46.3)
I think the vaccine for COVID-19 is not safe.	1641 (31.6)
Complacency	971 (18.7)
If I were infected with COVID-19, it would be fine with getting treatment.	466 (9.0)
Disease and life or deaths depend on fate.	246 (4.7)
I will not be infected with COVID-19.	176 (3.4)
I believe in natural healing and folk remedies.	83 (1.6)
Others	174 (3.4)
I am afraid of getting an injection.	88 (1.7)
I am against vaccination itself.	69 (1.3)
I cannot get a vaccine for religious reasons.	13 (0.3)
Others	5 (0.1)

no change or worsening health status were more likely to have vaccine hesitancy than those who experienced better health status (OR: 1.13, 95% CI: 1.02 ~ 1.25; OR:1.38, 95% CI: 1.13 ~ 1.68). These factors were all significant, even after adjusting for other variables. Those who experienced unmet medical needs besides COVID-19 were more likely to accept vaccination than those who did not need medical care (OR:0.75, 95% CI: 0.62 ~ 0.91). After adjusting for socio-demographic variables, the experience of COVID-19 infection in themselves or among acquaintances was not significantly associated with accepting vaccination.

The older persons were more likely to get vaccinated than the young adults, as depicted in Model 3 (OR: 0.81, 95% CI: 0.72 ~ 0.93). Middle- and high-income groups were more likely to get vaccinated than the low-income group, even after

controlling for other variables (OR: 0.90, 95% CI: 0.81 ~ 0.99; OR: 0.84, 95% CI, 0.75 ~ 0.93). Those affiliated to a religion (OR: 0.65, 95% CI: 0.60 ~ 0.71) or who were politically conservative (OR: 1.08, 95% CI: 1.05, 1.10) were more likely to have vaccine hesitancy. Education and marital status were not significant predictors.

Discussion

In this study, we found that (1) almost 40% of the population was hesitant to get vaccinated against COVID-19, and the primary reasons were lack of confidence in the safety or fear of the side effects of the COVID-19 vaccine; (2) Vaccine hesitancy was higher among those who perceived little risk, had no or minor impacts on life due to COVID-19, or experienced

Table 3. Psychological and experiential characteristics of participants according to vaccination hesitancy.

	Total	Vaccine acceptance	Vaccine hesitancy	p-Value
	N (%)	N (%)	N (%)	
Psychological characteristics				
Fears of COVID-19 infection				<0.001
Fear	8620 (66.2)	5702 (66.2)	2918 (33.9)	
Neutral	3532 (27.1)	1672 (47.4)	1859 (52.7)	
Not fear	869 (6.7)	457 (52.6)	411 (47.4)	
Being aware of the preventive guideline of COVID-19				<0.001
Unrecognized	883 (6.8)	474 (53.7)	408 (46.3)	
Neutral	2781 (21.4)	1590 (57.2)	1191 (42.8)	
Recognized	9357 (71.9)	5768 (61.6)	3589 (38.4)	
Trust on preventive measures of the government				<0.001
Distrust	1045 (8.0)	619 (59.2)	427 (40.8)	
Neutral	3602 (27.7)	2055 (57.1)	1546 (42.9)	
Trust	8374 (64.3)	5158 (61.6)	3216 (38.4)	
	N (%)	N (%)	N (%)	
Experiential characteristics				
COVID-19 infection of oneself or acquaintances				0.002
No	12415 (95.4)	7428 (59.8)	4987 (40.2)	
Yes	606 (4.7)	404 (66.7)	202 (33.3)	
Needs for medical care besides COVID-19				<0.001
No need	11242 (86.3)	6642 (59.1)	4600 (40.9)	
Met	1220 (9.4)	806 (66.1)	414 (33.9)	
Unmet	559 (4.3)	385 (68.8)	174 (31.2)	
Changes of job status				0.013
No change	12297 (94.4)	7433 (60.5)	4864 (39.6)	
Being unstable job status	526 (4.0)	282 (53.6)	244 (46.4)	
Unemployed or closing business	198 (1.5)	117 (59.1)	81 (40.9)	
Decrease of monthly family income				<0.001
No change	9541 (73.3)	5784 (60.6)	3757 (39.4)	
<0.5 M KRW (≒USD 450)	831 (6.4)	422 (50.8)	409 (49.3)	
≥0.5 M KRW & <1 M KRW	1313 (10.1)	795 (60.6)	518 (39.4)	
≥1 M KRW (≒USD 900)	1336 (10.3)	831 (62.2)	505 (37.8)	
Change of family relationship				0.466
Better	1916 (14.7)	1158 (60.4)	759 (39.6)	
No change	10258 (78.8)	6183 (60.3)	4075 (39.7)	
Worsen	846 (6.5)	492 (58.1)	355 (41.9)	
Changes in health status				<0.001
Better	2144 (16.5)	1344 (62.7)	801 (37.3)	
No change	10371 (79.7)	6223 (60)	4148 (40)	
Worsen	505 (3.9)	265 (52.4)	241 (47.6)	

N: number; SD: standard deviation. The statistics were calculated using cross-sectional weights.

worsening health status during the pandemic; and (3) Our multivariate logistic regression analysis indicated that less fear of COVID-19 and unaware of the preventive guidelines for COVID-19 were associated with COVID-19 vaccine hesitancy. No unmet medical care needs besides COVID-19, worsening job status, family income, health status, and family relationship were also associated with COVID-19 vaccine hesitancy. In addition, younger age, no religious affiliation, political conservatism, and lower family income were also significantly associated with vaccine hesitancy.

Our study reveals that the COVID-19 vaccine hesitancy in Korea was 39.8% higher than in other countries. Recent studies in other countries reported that COVID-19 vaccine hesitancy was diverse: 14.3 ~ 24.2% in Australia,^{22,23} 36 ~ 37% in the U. K.,^{11,24} 25% in the U.S., 20% in Canada, and 16.8% in China.^{10,25} This may be explained by the lower level of fear or perceived severity of COVID-19 among Koreans. Ironically, Korea has a relatively well-controlled pandemic, as seen in the low prevalence of COVID-19 infection, absence of lockdown, and strict field epidemiologic investigations and quarantine. The situation may have lowered the level of fear or perceived severity of COVID-19, leading to higher vaccine hesitancy than

in other countries. Our results from the regression models indicated that those who were not in fear of COVID-19 were significantly associated with vaccination hesitancy in the fully adjusted model. Previous studies have consistently reported that higher perceived severity or fear of disease was associated with a low tendency of vaccine hesitancy.^{12,26} In Australia, more people were unsure or unwilling to accept a COVID-19 vaccine when restrictions had been eased in June (24.2%) than just after the lockdown (14.3%).²²

The primary reasons attributed to vaccine hesitancy pointed to a lack of confidence in the effectiveness and safety of vaccines (77.9%). Complacency responses such as “if I were infected with COVID-19, it would be fine with getting treatment” accounted for 18.7%. This finding is consistent with previous studies that reported that concerns about vaccine safety and natural immunity are the significant reasons for vaccine hesitancy.^{11,27} Previous studies showed that individuals who lack confidence had negative attitudes toward vaccination behavior.²⁸ Regarding COVID-19 vaccination in Korea, concerns about side effects or adverse events were significant barriers. General people and even health experts were also suspicious of the safety and effectiveness of the

Table 4. Odds ratios (OR) and 95% credible intervals (CI) based on multivariate binomial logit models of hesitancy to vaccination against COVID-19.

	Model 1		Model 2		Model 3	
	OR (95% CI)	p-Value	OR (95% CI)	p-Value	OR (95% CI)	p-Value
Block 1: Psychological characteristics						
Fear of COVID-19 infection						
Fear	1		1		1	
Neutral	2.04 (1.89, 2.21)	<0.001	2.03 (1.87, 2.19)	<0.001	2.08 (1.92, 2.26)	<0.001
Not fear	1.78 (1.54, 2.06)	<0.001	1.75 (1.51, 2.03)	<0.001	1.79 (1.54, 2.08)	<0.001
Being aware of the preventive rules of COVID-19						
Unrecognized	1		1		1	
Neutral	0.86 (0.74, 1.00)	0.056	0.86 (0.73, 1.00)	0.047	0.89 (0.76, 1.04)	0.155
Recognized	0.79 (0.68, 0.91)	0.001	0.79 (0.69, 0.92)	0.002	0.84 (0.72, 0.97)	0.020
Trust in preventive measures of the government						
Distrust	1		1		1	
Neutral	1.03 (0.90, 1.19)	0.675	1.04 (0.90, 1.20)	0.594	1.04 (0.90, 1.20)	0.606
Trust	0.94 (0.82, 1.07)	0.354	0.94 (0.82, 1.08)	0.386	0.98 (0.86, 1.13)	0.795
Block 2: Experiential characteristics						
COVID-19 infection of oneself or acquaintances						
Unmet needs for medical care besides COVID-19 (ref. No need)			0.78 (0.65, 0.93)	0.007	0.88 (0.73, 1.05)	0.165
Met			0.90 (0.79, 1.02)	0.090	0.95 (0.84, 1.09)	0.484
Unmet			0.69 (0.57, 0.83)	<0.001	0.75 (0.62, 0.91)	0.004
Changes of job (ref. No change)						
Being unstable job status			1.43 (1.20, 1.72)	<0.001	1.42 (1.18, 1.70)	<0.001
Unemployed or closing business			1.27 (0.94, 1.71)	0.126	1.20 (0.88, 1.63)	0.246
Decrease of monthly family income (ref. No change)						
<0.5 M KRW (=USD 450)			1.47 (1.28, 1.69)	<0.001	1.40 (1.21, 1.61)	<0.001
≥0.5 M KRW & <1 M KRW			1.04 (0.92, 1.17)	0.574	1.05 (0.93, 1.19)	0.442
≥1 M KRW (=USD 900)			0.95 (0.84, 1.07)	0.385	0.96 (0.85, 1.09)	0.558
Changes in family relationships (ref. Better)						
No change			0.88 (0.79, 0.98)	0.016	0.88 (0.79, 0.98)	0.022
Worsen			1.03 (0.87, 1.21)	0.705	1.05 (0.88, 1.24)	0.587
Changes in health status (ref. Better)						
No change			1.13 (1.02, 1.25)	0.018	1.13 (1.02, 1.25)	0.020
Worsen			1.45 (1.19, 1.76)	<0.001	1.38 (1.13, 1.68)	0.002
Block 3: Socio-demographic characteristics						
Gender (ref. Male)						
Female					0.96 (0.89, 1.03)	0.245
Age (ref. Young adults (20 ~ 39))						
Middle-aged (40 ~ 59)					0.97 (0.88, 1.07)	0.540
Elderly (60+)					0.81 (0.72, 0.93)	0.002
Having a spouse (ref. No)						
Yes					0.97 (0.88, 1.06)	0.486
Family income (ref. <3 M KRW (=USD 2,700))						
≥3 M KRW & <5 M KRW					0.90 (0.81, 0.99)	0.030
≥5 M KRW (=USD 4,500)					0.84 (0.75, 0.93)	0.001
Education (ref. < High school)						
High school graduate					1.05 (0.91, 1.21)	0.501
≥College graduate					1.00 (0.86, 1.17)	0.969
Job (ref. No job)						
Have a job					0.95 (0.87, 1.03)	0.242
Health status (ref. Good)						
Bad					1.15 (0.98, 1.35)	0.092
Religion (ref. No religion)						
Have a religion					0.65 (0.60, 0.71)	<0.001
Political conservatism					1.08 (1.05, 1.10)	<0.001

OR: odds ratio; CI: confidence interval. Model 1 was adjusted for psychological characteristics. Model 2 includes experiential characteristics as covariates in Model 1. Model 3 includes socio-demographic characteristics as covariates in Model 2.

quickly developed COVID-19 vaccines, given that developing a vaccine usually takes many years to be available to society.²⁹ Misinformation, belief in conspiracies, distrust in the health care system may also contribute to the negative attitude.^{30–32} Complacent individuals believe that they will not be infected or feel threatened by infectious diseases as they perceive low risks of diseases.³³ In the early stage of the pandemic, misinformation that the infection to COVID-19 would not cause severe illness or will be soon a kind of seasonal influenza may contribute to the attitude. Previous studies showed that feelings of invulnerability and a positive subjective personal health status are also related to complacency.³⁴

Similar to previous studies,^{11,24} a refusal to be aware of the preventive rules for COVID-19 were significantly associated with vaccine hesitancy. Those not aware of preventive rules might be less concerned with this situation and pay little attention to vaccination. Unaware of preventive rules may also reflect a distrust of the government or health system.³⁵ The previous experience of infection in themselves or an acquaintance was not significantly associated in the fully adjusted model, which is consistent with a previous study²⁴ in which the perceived severity of COVID-19 could be relatively low even with COVID-19 infection of oneself or an acquaintance, as the consequences of the disease were mild or asymptomatic in most cases.³⁶ Significant

associations between experiences of unmet medical needs and accepting vaccination may reflect a desire to overcome the inconveniences caused by the COVID-19 pandemic.

Our study revealed that worsening changes in work, family income, family relationships, and health status were associated with vaccine hesitancy. Those who experienced unstable jobs and decreased family income displayed higher vaccine hesitancy than those who experienced no change. However, compared with the groups that experienced no job or family income change and those who experienced a job loss or decreased family income presented no significant difference in vaccine hesitancy. Meanwhile, those who did not experience any change in family relationships displayed higher vaccine acceptance than those who experienced the change. Considerable life changes may encourage people to take preventive efforts, such as vaccination, to overcome the crisis; however, small life changes may drive people to avoid other visible effects such as side effects of the vaccine. A previous study indicated no significant association between the impact of the pandemic on people's daily life, work, income, and vaccine hesitancy.¹⁰ Regarding health status, similar to the previous study, those who experienced worsened health status were less likely to accept the vaccination.²⁵ Considering that the primary reason for vaccine hesitancy was the safety and side effects of the COVID-19 vaccine, they may have been concerned that their health status could deteriorate due to side effects or intolerability.

This study revealed that socio-demographic predictors, such as younger age, low income, better health, no religious affiliation, and political conservatism, were more likely to be associated with vaccine hesitancy. Previous studies have demonstrated mixed results regarding socio-demographic predictors. Wang et al. (2020) reported that males and the married were related to low vaccine hesitancy.¹⁰ Paul et al. (2021) established that women, lower education, and lower-income levels were related to higher vaccine hesitancy.¹¹ On the other hand, Taylor et al. (2020) reported that females and higher education levels were associated with low vaccine hesitancy.²⁷ In another study on vaccine hesitancy, socioeconomic factors did not influence hesitancy in only one direction.³ This may be explained by the differences in national contexts. People of different nationalities, living conditions, health systems, and governments would have different values, attitudes, and practices for vaccination.^{3,37} For example, political conservatism was a significant predictor of vaccine hesitancy; however, the direction was not consistent with that of previous studies.³⁸ This may be explained by the fact that the current ruling party is progressive. People who oppose the current government may also exhibit vaccine hesitancy.

The limitations of this study that need to be addressed are as follows. First, this study was conducted in a cross-sectional study design; therefore, causal inferences between the predictors and vaccine hesitancy cannot be determined. Second, there may be unknown confounders that we did not control for in the analysis. Third, participants may have answered in a socially desirable manner (e.g., reporting a positive attitude toward preventive measures) despite the assurance of anonymity in the responses. Finally, the survey was conducted only

once during the COVID-19 pandemic. It must be kept in mind that vaccine intention rates may fluctuate according to the pandemic situation (e.g., an additional lockdown or reports of abnormal cases due to vaccination). The recent reports of adverse events and side effects, such as thrombosis,³⁹ attributed to the COVID-19 vaccine, may lead to higher vaccine hesitancy in South Korea. Meanwhile, successful vaccination may lead to lower vaccine hesitancy. Nevertheless, this is the first study that provided information on vaccine hesitancy in South Korea. In addition, the results of this study represent the Korean population using nationally representative samples.

In conclusion, this study demonstrated that almost 40% of the population were reluctant or refused vaccination against COVID-19, and the primary reason for vaccine hesitancy was a lack of confidence in the COVID-19 vaccine. However, differences across the population subgroups are indicated. As vaccine hesitancy seems to be associated with diverse factors, a single intervention strategy cannot address vaccine hesitancy.¹ Considering that the main reasons for COVID-19 vaccine hesitancy are concerns about vaccine safety and side effects, the first strategy should be to address the need to enhance effective communication by providing evidence of the vaccine's efficacy, thereby resolving the misunderstanding among the people. The epidemiologic and socioeconomic factors associated with a high risk of vaccine hesitancy should be considered for targeted communication. In addition, policies need to be implemented to minimize the impact on people's lives, especially jobs and health status.

Disclosure statement

No potential conflict of interest was reported by the author(s).



Ethics approval and consent to participate

The Institutional Review Board of the Seoul Metropolitan Government-Seoul National University Boramae Medical Center (IRB number: 07-2021-12) approved this study.

Funding

This study was funded by the JW LEE Center for Global Medicine of Seoul National University College of Medicine and the National Assembly Futures Institute, Seoul, the Republic of Korea.

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