

# Multilevel analysis of individual, household, and community factors influencing COVID-19 vaccination intention: evidence from the 2021 Korea Community Health Survey

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## ABSTRACT

**Objectives:** This study aimed to investigate the combined effects of individual, household, and community-level factors on coronavirus disease 2019 (COVID-19) vaccination intention using a multilevel analysis.

**Methods:** This cross-sectional study analyzed raw data from the 2021 Korea Community Health Survey and regional statistics from 255 health centers, with a final sample of 229,216 individuals. Multilevel analysis was conducted, focusing on individual, household, and community-level factors. Individual-level factors included demographics, health status, and COVID-19 concerns; household-level factors included income and marital status; and community-level factors included city type and vaccination rates.

**Results:** At the individual level, significant differences were observed across all variables. At the household level, higher vaccination intention was associated with households of 4 or more members and a monthly income of 4 million Korean won or more. At the community level, higher flu vaccination rates, greater concern about COVID-19 infection, and higher COVID-19 vaccination rates were linked to increased vaccination intention.

**Conclusion:** This study highlights that COVID-19 vaccination intention is influenced by factors at the individual, household, and community levels. Vaccination strategies that integrate household and community-level approaches may be more effective. Policymakers should consider both individual and social health factors when designing vaccination policies.

**Keywords:** COVID-19; Intention; Multilevel analysis; Vaccination

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## Introduction

Nearly 5 years have passed since the World Health Organization (WHO) declared the severe acute respiratory syndrome coronavirus 2 virus an international public health emergency, yet the burden of the coronavirus disease 2019 (COVID-19) pandemic continues to have uneven impacts at the population level. On January 30, 2020, the WHO declared COVID-19 the sixth Public Health Emergency of International Concern (PHEIC) in history. Since then, the world, including the Republic of Korea, has grappled with the pandemic. In May 2023, the WHO officially announced the end of the COVID-19 PHEIC, transitioning from an emergency response to a long-term management framework [1].

The COVID-19 vaccine, introduced in 2021, was expected to be a key strategy for mitigating the pandemic's impact and reducing its spread [2]. However, achieving this goal requires a sufficient vaccination rate [3]. Unfortunately, widespread vaccine hesitancy or rejection has emerged due to distrust in vaccine effectiveness and concerns about potential side effects. This hesitancy has also fueled resentment toward government policies, leading to social conflict during the early stages of vaccine rollout [4]. Consequently, numerous studies have been conducted on vaccine safety and strategies to promote vaccination [5,6].

Systematic reviews from other countries have identified factors associated with vaccine hesitancy or rejection, including younger age, lower education levels, and lower socioeconomic status. However, individuals exist within complex social contexts where interactions between personal and environmental factors shape behavior [7]. Vaccine-related knowledge, attitudes, and perceptions can vary significantly based on individual characteristics and the social environment [8,9].

In the Republic of Korea, dozens of studies have explored factors influencing vaccination, but most focus solely on individual-level factors. To date, no study has examined how both individual and community characteristics affect COVID-19 vaccination intentions. This study aims to fill this gap by investigating the individual, household, and community-level factors influencing COVID-19 vaccination intentions among the general population in the Republic of Korea. Using multilevel analysis, we assess the combined impact of these factors on vaccination intentions. By doing so, we aim to contribute to strengthening the Republic of Korea's public health emergency response system and provide foundational data for developing effective vaccination policies against COVID-19 and future emerging infectious diseases.

## HIGHLIGHTS

- A multilevel analysis was conducted to identify individual, household, and community-level factors influencing individuals' intentions to receive the coronavirus disease 2019 (COVID-19) vaccine.
- At the household level, individuals with 4 or more household members and a monthly household income exceeding 4 million Korean won showed a higher intention to get vaccinated.
- At the community level, higher flu vaccination rates, greater concern about COVID-19 infection, and higher COVID-19 vaccination rates were associated with increased vaccination intention.

## Materials and Methods

### Study Population and Datasets

This study employed a cross-sectional design and defined communities for multilevel analysis using administrative units divided into 255 Public Health Center (PHC) districts nationwide. The analysis utilized raw data from the 2021 Korea Community Health Survey (KCHS) and publicly available statistics for the 255 PHCs, provided by national agencies such as Statistics Korea. The public statistics were based on data as of the end of 2021 and were obtained online through the national statistics portal of Statistics Korea (<http://kostat.go.kr>), the KCHS website (<http://chs.kdca.go.kr>), and the Republic of Korea's COVID-19 Dashboard (<http://ncov.kdca.go.kr>). The KCHS is a nationwide health survey conducted by the Korea Disease Control and Prevention Agency since 2008. It aims to produce representative health statistics for all local governments, specifically all PHC districts. The KCHS uses a stratified 2-stage cluster sampling method, with residential areas and households serving as sequential sampling units for each local government [10]. The 2021 KCHS was conducted from August 16 to October 31, 2021, and a total of 229,242 individuals completed the survey. Of these, 229,216 were included in the analysis after excluding 26 individuals who did not respond to the question regarding COVID-19 vaccination intention.

### Variables

All individual- and household-level variables, excluding community-level variables, were analyzed using raw data from the 2021 KCHS. Survey items in the KCHS were validated for validity and reliability by expert members of the Korea Disease Control and Prevention Agency's Indicators Division. The outcome variable, COVID-19 vaccination intention, was

categorized into 2 groups: those who intended to receive the vaccine, and those who did not. This categorization was based on responses to 2 questions in the KCHS: (1) “Have you been vaccinated against COVID-19?” (yes/no) and (2) “Are you willing to be vaccinated against COVID-19?” (very likely, likely, not likely, very unlikely). Responses of “very likely” and “likely” were categorized as likely to get vaccinated. At the time of the survey, vaccination opportunities were provided according to government policy priorities. Vaccination intention was defined as including individuals who had already been vaccinated or intended to get vaccinated in the future, while non-intention included those who had not been vaccinated and had no intention of doing so.

The following individual- and household-level factors influencing vaccination intention were selected based on a literature review and additional variables of interest to the researchers [2–6]: Individual-level factors included sociodemographic variables (age, sex, social assistance recipients, education level, economic activity status, attitude toward social assets, understanding of health information), health-related variables (subjective health level, subjective obesity level, history of annual flu vaccination, health exam history in the past 2 years), and COVID-19-related variables (staying home when sick, concern about COVID-19 infection, subjective score of COVID-19's impact on daily life, and income change due to COVID-19). Age was categorized into 3 groups: 19–49, 50–64, and  $\geq 65$ . Education level was divided into middle school or less, high school, and bachelor's degree or higher. Attitudes toward social assets were classified into quartiles by summing the scores of 7 items: trust in neighbors, help from neighbors, youth safety level, natural environment, living environment, public transportation status, and medical facility status. Each item was measured on a dichotomous scale (1=dissatisfaction, 2=satisfaction). Understanding of health information was categorized as very difficult, difficult, easy, and very easy. Subjective health level was categorized as poor, average, and good. Subjective obesity level was divided into obese, normal weight, and thin. Concern about COVID-19 infection was divided into not concerned, somewhat concerned, and concerned. The subjective score of COVID-19's impact on daily life was measured in 10-point increments out of 100 and classified into  $\leq 30$  points, 40–60 points, and  $\geq 70$  points. Household-level factors included monthly household income, marital status, children living together, spouse living together, and number of household members. Marital status was categorized as married, divorced or widowed, and unmarried.

Community-level factors included residential city type, population density, proportion of the elderly, flu vaccination rate, cumulative number of confirmed COVID-19 cases,

cumulative number of COVID-19 deaths, concern rate for COVID-19 infection, practice rate for social distancing, COVID-19 vaccination rate, and number of COVID-19 vaccination centers. Residential city type was divided into 3 categories: metropolitan city, small or medium-sized city, and rural county. Other community-level factors, except for residential city type, were classified into quartiles based on the distribution of the 255 PHCs.

## Data Analysis

Data analysis was conducted using STATA/SE ver. 17 (StataCorp.) while accounting for the complex sample design. Associations between individual-, household-, and community-level factors and vaccination intention were analyzed using the chi-square test. To identify factors influencing vaccination intention at the individual, household, and community levels, multilevel analysis was employed using a random intercept model that did not consider the variance of the regression coefficient. First, the need for multilevel analysis was confirmed by checking whether the community-level variance was significant through the null model (empty model). Next, the effect of individual-level variables on vaccination intention was examined using the individual-level model (model 1), and the effect of household-level variables was verified using the individual-household-level model (model 2). Finally, the effect of community-level variables was assessed in the individual-household-community-level model (model 3) while controlling for individual- and household-level variables. The explanatory variables included in each model were selected based on the results of univariate analysis, a review of previous research, and consideration of multicollinearity between variables. Adjusted odds ratios (aORs) and 95% confidence intervals (95% CIs) were obtained for all predictors retained in each model. Statistical significance was determined at a  $p$ -value of  $< 0.05$ .

The Institutional Review Board (IRB) of Kyungpook National University Hospital approved the study protocol and waived the requirement for informed consent (IRB No. 2023-01-013).

## Results

### Individual, Household and Community Factors Affecting Intention for COVID-19 Vaccination

#### Individual factors

By age group, the intention to receive the COVID-19 vaccine was highest among individuals aged 50 to 64 (98.0%), followed by those aged 65 and older (97.1%) and those aged 19 to 49 (94.6%). Vaccine intention was higher among individuals who were not social assistance recipients (96.1%) and those with active economic activity status (96.7%) ( $p < 0.001$ ). Regarding education level, the highest intention was

observed among those with a middle school education or less (96.9%), followed by those with a bachelor's degree or higher (96.2%) and high school graduates (95.6%). In terms of understanding health information, the highest intention was among those who found it easy (96.2%), followed by those who found it difficult (95.9%), very easy (95.7%), and very difficult (92.6%). For attitudes toward social assets, higher quartiles were associated with a higher proportion of individuals with vaccination intention ( $p < 0.001$ ). In terms of subjective health level, the proportion of individuals with vaccination intention was highest among those with an average health level (96.4%), followed by those with a good health level (96.2%) and a poor health level (93.5%). For subjective obesity level, the proportion was highest among those who were thin (96.4%), followed by those with a normal weight (96.2%) and those who were obese (94.2%) ( $p < 0.001$ ). The proportion of individuals with vaccination intention was higher among those with a history of annual flu vaccination (97.9%) and those who had a health exam in the past 2 years (97.0%) ( $p < 0.001$ ). Concern about COVID-19 infection was higher among those who were somewhat concerned (96.3%) and concerned (96.3%) compared to those who were not concerned (93.8%). Additionally, a higher subjective score of COVID-19's impact on daily life was associated with a higher proportion of individuals with vaccination intention ( $p < 0.001$ ) (Table 1).

### Household factors

For monthly household income, the proportion of individuals with vaccination intention was highest among those with an income of 2–2.99 million Korean won (KRW) (97.3%), followed by those with an income of 4 million KRW or more (96.6%), 1–1.99 million KRW (96.1%), 3–3.99 million KRW (95.8%), and less than 1 million KRW (95.4%) ( $p < 0.001$ ). By marital status, the proportion was highest among married individuals (96.8%), followed by those who were divorced or widowed (96.3%) and unmarried (93.9%) ( $p < 0.001$ ). The proportion of individuals with vaccination intention was also higher among those living with a spouse (96.7%) ( $p < 0.001$ ) (Table 2).

### Community factors

The proportion of individuals with vaccination intention was generally higher with increased rates of practicing social distancing (Q4, 96.4%; Q2, 96.1%; Q3, 96.0%; Q1, 95.4%) ( $p = 0.004$ ), while other variables did not show significant differences (Table 3).

## Factors Affecting Intention to Receive the COVID-19 Vaccine

To identify individual, household, and community-level

factors influencing the intention to receive the COVID-19 vaccine, multilevel analysis was conducted, with the results presented in Tables 4 and 5. First, in the null model, which did not include explanatory variables, the variance in vaccination intention between communities was estimated to determine whether differences existed across communities. The results showed statistically significant variances at both the household and community levels, indicating the presence of group-level variability. This suggests that community-level effects on vaccination intention exist, highlighting the need to estimate these effects through multilevel analysis.

In model 1, the community-level intraclass correlation coefficient (ICC) was 0.019, and the household residual ICC was 0.149, showing no change compared to the null model. However, in model 2, the community ICC decreased to 0.013, and in model 3, it further decreased to 0.007, while the household ICC decreased to 0.143. This indicates that including individual, household, and community-level variables explained additional variability in vaccination intention across communities and households.

At the individual level, all variables showed significant differences. The intention to receive the COVID-19 vaccine was higher among older individuals, specifically those aged 65 and older (aOR, 3.21; 95% CI, 2.92–3.53) and those aged 50 to 64 years (aOR, 2.53; 95% CI, 2.35–2.73). It was also higher among individuals with an active economic activity status (aOR, 1.80; 95% CI, 1.70–1.89) and those who found understanding health information easy (aOR, 1.93; 95% CI, 1.72–2.17), very easy (aOR, 1.85; 95% CI, 1.63–2.10), or difficult (aOR, 1.76; 95% CI, 1.56–1.99) compared to those who found it very difficult. Attitudes toward social assets were positively associated with higher quartiles (Q4: aOR, 1.58; 95% CI, 1.47–1.69; Q3: aOR, 1.37; 95% CI, 1.28–1.47; Q2: aOR, 1.22; 95% CI, 1.14–1.30).

Regarding the subjective health level, higher vaccination intention was found for those with good (aOR, 2.24; 95% CI, 2.09–2.41) or average health (aOR, 2.11; 95% CI, 1.97–2.35) compared to poor health. Subjective obesity level showed higher intention among those who were thin (aOR, 1.62; 95% CI, 1.52–1.74) or of normal weight (aOR, 1.33; 95% CI, 1.25–1.42) compared to those who were obese. Vaccination intention was also higher among individuals who had a health exam history in the past 2 years (aOR, 2.11; 95% CI, 2.00–2.22) and increased with higher subjective scores of COVID-19's impact on daily life ( $\geq 70$  points: aOR, 1.28; 95% CI, 1.20–1.37; 40–60 points: aOR, 1.25; 95% CI, 1.18–1.33). Concern about COVID-19 infection was associated with higher vaccination intention among those who were concerned (aOR, 1.99; 95% CI, 1.87–2.12) or somewhat concerned (aOR, 1.74; 95% CI, 1.62–1.87) compared to those who were not concerned. At

**Table 1.** Individual characteristics of study subjects

Variable	Category	Vaccination non-intention	Vaccination intention	Total	<i>p</i> <sup>a)</sup>
Total		7,874 (4.0)	221,342 (96.0)	229,216	
Age (y)	19–49	4,471 (5.4)	81,479 (94.6)	85,950	<0.001
	50–64	1,399 (2.0)	67,384 (98.0)	68,783	
	≥65	2,004 (2.9)	72,479 (97.1)	74,483	
Sex	Female	4,231 (4.1)	120,492 (95.9)	124,723	0.0736
	Male	3,643 (3.9)	100,850 (96.1)	104,493	
Social assistance recipient	No	7,250 (3.9)	212,406 (96.1)	219,656	<0.001
	Yes	624 (6.4)	8,936 (93.6)	9,560	
Education level	Middle school or less	2,077 (3.1)	73,406 (96.9)	75,483	<0.001
	High school	3,775 (4.4)	96,122 (95.6)	99,897	
	Bachelor's degree or higher	2,022 (3.8)	51,814 (96.2)	53,836	
Economic activity status	None	4,160 (5.3)	81,585 (94.7)	85,745	<0.001
	Active	3,714 (3.3)	139,757 (96.7)	143,471	
Attitudes toward social assets	Q1	2,779 (5.5)	53,614 (94.5)	56,393	<0.001
	Q2	1,920 (4.2)	50,055 (95.8)	51,975	
	Q3	1,675 (3.2)	53,984 (96.8)	55,659	
	Q4	1,499 (2.5)	63,689 (97.5)	65,188	
Understanding health information	Very difficult	422 (7.4)	5,457 (92.6)	5,879	<0.001
	Difficult	1,626 (4.1)	44,734 (95.9)	46,360	
	Easy	4,090 (3.8)	122,995 (96.2)	127,085	
	Very easy	1,736 (4.3)	48,156 (95.7)	49,892	
Subjective health level	Poor	2,139 (6.5)	36,666 (93.5)	38,805	<0.001
	Average	2,797 (3.6)	94,583 (96.4)	97,380	
	Good	2,938 (3.8)	90,093 (96.2)	93,031	
Subjective obesity level	Obese	1,885 (5.8)	37,203 (94.2)	39,088	<0.001
	Normal weight	3,327 (3.8)	100,717 (96.2)	104,044	
	Thin	2,662 (3.6)	83,422 (96.4)	86,084	
History of annual flu vaccination	No	5,539 (6.0)	87,476 (94.0)	93,015	<0.001
	Yes	2,335 (2.1)	133,866 (97.9)	136,201	
Health exam history in the past 2 years	No	3,776 (6.7)	53,828 (93.3)	57,604	<0.001
	Yes	4,098 (3.0)	167,514 (97.0)	171,612	
Ability to stay home when sick	Possible	7,563 (4.0)	213,588 (96.0)	221,151	0.287
	Impossible	311 (4.3)	7,754 (95.7)	8,065	
Concern about COVID-19 infection	Not concerned	1,856 (6.2)	30,985 (93.8)	32,841	<0.001
	Somewhat concerned	1,785 (3.7)	50,067 (96.3)	51,852	
	Concerned	4,233 (3.7)	140,290 (96.3)	144,523	
Subjective score of COVID-19's impact on daily life	≤30 Point	1,741 (5.2)	37,432 (94.7)	39,173	<0.001
	40–60 Point	3,292 (3.9)	98,641 (96.1)	101,933	
	≥70 Point	2,841 (3.4)	85,269 (96.5)	88,110	
Income change due to COVID-19	No	5,055 (3.9)	143,502 (96.1)	148,557	0.0873
	Yes	2,819 (4.2)	77,840 (95.8)	80,659	

Data are presented as *n* (weighted %).<sup>a)</sup>*p*-value was calculated using the Pearson chi-square test with the svy command.

the household level, the intention to receive the vaccine was higher in households with 4 or more members compared to those with only one member (aOR, 1.16; 95% CI, 1.05–1.28). It was also higher among those with a monthly household income of 4 million KRW or more compared to those with an income below 1 million KRW (aOR, 1.22; 95% CI, 1.11–1.35).

No significant associations were found for other variables.

At the community level, higher vaccination intention was associated with a higher flu vaccination rate in Q4 compared to Q1 (aOR, 1.13; 95% CI, 1.01–1.26), greater concern about COVID-19 infection (Q4 compared to Q1: aOR, 1.13; 95% CI, 1.01–1.25; Q3: aOR, 1.11; 95% CI, 1.01–1.25), and higher COVID-19



**Table 2.** Household-level characteristics of the study subjects

Variable	Category	Vaccination non-intention	Vaccination intention	Total	<i>p</i> <sup>a)</sup>
Total		7,874 (4.0)	221,342 (96.0)	229,216	
Monthly household income (10,000 KRW)	< 100	1,355 (4.6)	32,556 (95.4)	33,911	< 0.001
	100–199	1,183 (4.9)	23,248 (96.1)	24,431	
	200–299	1,209 (4.7)	33,239 (97.3)	34,448	
	300–399	1,198 (4.2)	50,517 (95.8)	51,715	
	≥ 400	2,929 (3.4)	90,782 (96.6)	93,711	
Marital status	Married	4,128 (3.2)	147,364 (96.8)	151,492	< 0.001
	Divorced or widowed	1,367 (3.7)	36,803 (96.3)	38,170	
	Unmarried	2,379 (6.1)	17,175 (93.9)	39,554	
Children living together	No	6,119 (4.0)	177,986 (96.0)	184,105	0.8986
	Yes	1,764 (4.0)	43,356 (96.0)	45,120	
Spouse living together	No	3,979 (5.2)	81,143 (94.8)	85,122	< 0.001
	Yes	3,895 (3.3)	140,199 (96.7)	144,094	
No. of household members	1 Person	1,582 (4.5)	38,372 (95.5)	39,954	0.0551
	2–3 Persons	4,356 (4.0)	130,683 (96.0)	135,039	
	≥ 4 Persons	1,936 (3.8)	52,287 (96.2)	54,223	

Data are presented as *n* (weighted %).

KRW, Korean won.

<sup>a)</sup>*p*-value is calculated using the Pearson chi-square test with the *svy* command.

vaccination rates (Q3 compared to Q1: aOR, 1.33; 95% CI, 1.21–1.45; Q4: aOR, 1.18; 95% CI, 1.06–1.32; Q2: aOR, 1.12; 95% CI, 1.02–1.23).

## Discussion

This study aimed to comprehensively examine how individual, household, and community characteristics influence individuals' intention to receive the COVID-19 vaccine through multilevel analysis. While previous studies have primarily focused on individual factors, this study is unique in its simultaneous analysis of various factors, including household and community characteristics, that impact vaccine intention. The results confirm that not only individual characteristics but also household and community characteristics play significant roles in shaping vaccination intentions. This finding suggests that the decision to get vaccinated is not determined solely by individual factors but is also influenced by the social context of the household and community in which the individual resides. Therefore, when developing vaccination recommendation policies and campaigns, it is essential to adopt a socio-ecological approach that considers not only individual characteristics but also household- and community-level factors. This study provides valuable foundational data for creating more effective and comprehensive vaccination policies.

Individual characteristics, including age, sex, education level, understanding of health information, social assistance recipient status, economic activity status, attitudes toward

social assets, subjective health level, subjective obesity level, health exam history, concern about COVID-19 infection, and subjective scores of COVID-19's impact on daily life, showed significant associations with vaccination intention.

The observation that vaccination intention increases with age is consistent with previous studies [11–13] and can be explained by several factors. Initially, vaccination policies targeted older adults [11], and outreach efforts and public health messages specifically aimed at this population have further emphasized the importance of vaccinations [14]. Furthermore, the risk of severe illness and death from COVID-19 infection is reported to be higher in older adults [15]. Therefore, older adults have demonstrated a higher willingness to be vaccinated against COVID-19, driven by their heightened perception of the threat of severe illness [16].

It was also observed that individuals with lower understanding of health information were less likely to intend to get vaccinated, which aligns with existing research linking lower understanding of health information to reduced vaccination intention [17]. Since understanding of health information generally correlates with educational attainment, it may seem counterintuitive that individuals with higher education levels exhibit lower vaccination intention. However, this discrepancy could stem from factors such as differing perceptions of vaccine safety and necessity among highly educated individuals. Previous studies have shown that higher education is typically linked with greater COVID-19 vaccination intention, while older adults are more likely to have lower education levels. This suggests that lower-educated older adults, who were mandated to

**Table 3.** Community level characteristics for study subjects

Variable	Category	Vaccination non-intention	Vaccination intention	Total	<i>p</i> <sup>a)</sup>
Total		7,874 (4.0)	221,342 (96.0)	229,216	
Residential city type	Metropolitan city	2,654 (4.1)	65,758 (95.9)	68,412	0.1703
	Small/medium-sized city	3,228 (3.9)	86,139 (96.1)	89,367	
	Rural county	1,992 (3.2)	69,445 (96.8)	71,437	
Population density	Q1	1,845 (4.2)	55,719 (95.8)	57,564	0.8111
	Q2	1,951 (3.9)	59,403 (96.1)	61,354	
	Q3	2,039 (4.1)	52,647 (95.9)	54,686	
	Q4	2,039 (4.0)	53,573 (96.0)	55,612	
Proportion of older adults	Q1	2,134 (3.9)	58,803 (96.1)	60,937	0.635
	Q2	2,139 (4.2)	55,582 (95.8)	57,721	
	Q3	1,885 (3.8)	54,397 (96.2)	56,282	
	Q4	1,616 (4.0)	52,560 (96.0)	54,176	
Vaccination rate for flu	Q1	2,270 (4.1)	56,401 (95.9)	58,671	0.1621
	Q2	2,189 (4.0)	55,033 (96.0)	57,222	
	Q3	1,891 (3.7)	54,700 (96.3)	56,591	
	Q4	1,524 (3.2)	55,208 (96.8)	56,732	
No. of cumulative confirmed COVID-19 cases	Q1	1,573 (3.0)	55,793 (97.0)	57,366	0.2297
	Q2	1,973 (3.7)	55,399 (96.3)	57,372	
	Q3	2,158 (4.0)	55,144 (96.0)	57,302	
	Q4	2,154 (4.0)	54,154 (96.0)	56,308	
No. of cumulative COVID-19 deaths	Q1	1,629 (3.4)	55,781 (96.6)	57,410	0.2297
	Q2	1,915 (3.6)	55,490 (96.4)	57,405	
	Q3	2,114 (4.1)	54,913 (95.9)	57,027	
	Q4	2,200 (4.0)	54,306 (96.0)	56,506	
Proportion of individuals concerned about COVID-19 infection	Q1	2,294 (4.3)	57,857 (95.7)	60,151	0.1601
	Q2	1,967 (4.0)	53,835 (96.0)	55,802	
	Q3	1,921 (3.8)	55,817 (96.2)	57,738	
	Q4	1,692 (3.7)	53,833 (96.3)	55,525	
Rate of practicing social distancing	Q1	2,217 (4.6)	55,220 (95.4)	57,437	0.004
	Q2	1,914 (3.9)	57,124 (96.1)	59,038	
	Q3	2,116 (4.0)	57,546 (96.0)	59,662	
	Q4	1,692 (3.6)	51,452 (96.4)	53,144	
COVID-19 vaccination rate	Q1	3,059 (4.3)	74,029 (95.7)	77,088	0.085
	Q2	1,832 (4.0)	50,482 (96.0)	52,314	
	Q3	1,706 (3.8)	52,611 (96.2)	54,317	
	Q4	1,277 (3.5)	44,220 (96.5)	45,497	
No. of COVID-19 vaccination centers	Q1	2,099 (4.2)	58,827 (95.8)	60,926	0.447
	Q2	2,196 (4.0)	59,545 (96.0)	61,741	
	Q3	2,155 (4.0)	62,508 (96.0)	64,663	
	Q4	1,424 (3.8)	40,462 (96.2)	41,886	

Data are presented as *n* (weighted %).<sup>a)</sup>*p*-value is calculated using the Pearson chi-square test with the svy command.

be vaccinated at the time of the survey, may have already been vaccinated regardless of their personal intentions. Consequently, these groups may have been classified as having vaccination intention according to the study's operational definition, or it may be due to the fact that higher education levels correspond to a more accurate understanding of information [18]. Therefore, from an educational standpoint,

it is essential to enhance accessibility by providing clear and straightforward information about the effectiveness, safety, and administration of vaccines to vulnerable populations.

The finding that individuals with no economic activity status or those receiving social assistance have lower vaccination intentions aligns with previous research indicating that socially disadvantaged groups tend to have lower vaccination

**Table 4.** Factors affecting COVID-19 vaccination intention according to multilevel analysis-1

Variable	Category	Model 1 <sup>a)</sup>	Model 2 <sup>b)</sup>	Model 3 <sup>c)</sup>	Model 4 <sup>d)</sup>
Level 1. Individual factors					
Age (y)	50-64 (ref: 19-49)		2.45 (2.29-2.63)	2.53 (2.35-2.76)	2.53 (2.35-2.73)
	≥65 (ref: 19-49)		2.98 (2.74-3.26)	3.26 (2.98-3.57)	3.21 (2.92-3.53)
Sex	Male (ref: female)		0.94 (0.89-0.99)	0.95 (0.91-0.99)	0.95 (0.90-0.99)
Social assistance recipient	Yes (ref: no)		0.70 (0.64-0.78)	0.75 (0.68-0.83)	0.76 (0.68-0.84)
Education level	High school (ref: middle school or less)		0.94 (0.87-1.02)	0.91 (0.84-0.99)	0.92 (0.85-0.99)
	Bachelor's degree or higher (ref: middle school or less)		0.85 (0.80-0.94)	0.81 (0.74-0.89)	0.82 (0.75-0.90)
Economic activity status	Active (ref: none)		1.83 (1.73-1.92)	1.80 (1.71-1.90)	1.80 (1.70-1.89)
Understanding health information	Difficult (ref: very difficult)		1.74 (1.54-1.96)	1.75 (1.55-1.98)	1.76 (1.56-1.99)
	Easy (ref: very difficult)		1.90 (1.69-2.14)	1.91 (1.70-2.16)	1.93 (1.72-2.17)
	Very easy (ref: very difficult)		1.85 (1.63-2.10)	1.86 (1.64-2.11)	1.85 (1.63-2.10)
Attitudes toward social assets	Q2 (ref: Q1)		1.23 (1.15-1.31)	1.26 (1.14-1.30)	1.22 (1.14-1.30)
	Q3 (ref: Q1)		1.39 (1.30-1.49)	1.37 (1.28-1.46)	1.37 (1.28-1.47)
	Q4 (ref: Q1)		1.61 (1.50-1.73)	1.59 (1.48-1.71)	1.58 (1.47-1.69)
Subjective health level	Average (ref: poor)		2.13 (1.99-2.27)	2.10 (1.97-2.25)	2.11 (1.97-2.25)
	Good (ref: poor)		2.28 (2.12-2.45)	2.24 (2.09-2.40)	2.24 (2.09-2.41)
Subjective obesity level	Normal weight (ref: obese)		1.34 (1.25-1.42)	1.33 (1.25-1.42)	1.33 (1.25-1.42)
	Thin (ref: obese)		1.63 (1.52-1.74)	1.62 (1.52-1.73)	1.62 (1.52-1.74)
Heath exam history in the past 2 years	Yes (ref: no)		2.13 (2.02-2.24)	2.10 (1.71-1.90)	2.11 (2.00-2.22)
Subjective score of COVID-19's impact on daily life	40-60 Points (ref: ≤30 points)		1.27 (1.19-1.35)	1.26 (1.18-1.34)	1.25 (1.18-1.33)
	≥70 Points (ref: ≤30 points)		1.30 (1.22-1.39)	1.29 (1.21-1.38)	1.28 (1.20-1.37)
Concern about COVID-19 infection	Somewhat concerned (ref: not concerned)		1.75 (1.63-1.88)	1.74 (1.62-1.87)	1.74 (1.62-1.87)
	Concerned (ref: not concerned)		2.01 (1.89-2.14)	1.99 (1.87-2.12)	1.99 (1.87-2.12)

Data are presented as adjusted odds ratio (95% confidence interval).

COVID-19, coronavirus disease 2019; ref, reference.

<sup>a)</sup>Null model, <sup>b)</sup>individual model, <sup>c)</sup>individual-household model (2-level), <sup>d)</sup>individual-household-community model (3-level).

intentions [19,20]. The disparity in vaccination intentions from a socioeconomic perspective leads to differential outcomes in the practice of infection prevention measures, subsequently increasing the risk of COVID-19 infection among different groups [21]. As noted in previous research, socioeconomically vulnerable groups face higher COVID-19 infection risks, lower medical accessibility, and increased risk of severe illness and death. Consequently, lower socioeconomic conditions contribute to disproportionately negative effects on infection risk, treatment, and mortality, exacerbating the burden on vulnerable groups and leading to increased health inequities [19,22]. Therefore, it is crucial to strengthen safety nets for socially vulnerable groups during crises like COVID-19, ensuring that these populations are better protected and supported to mitigate the heightened risks they face.

It was found that a more positive attitude toward social assets was associated with a greater intention to get vaccinated. Although no studies have directly examined the relationship between social assets and vaccination intention, existing research indicates that social assets are linked to positive changes in health status [23,24]. Therefore, it can be

interpreted that a more positive attitude toward social assets positively influences vaccination intention. Furthermore, strengthening social assets and building trust in everyday life can help communities respond more effectively to infectious disease crises. A strong foundation of social trust and support networks enhances cooperation and compliance with public health measures, contributing to a more resilient and coordinated response during pandemics. These efforts not only improve crisis management but also support higher vaccination rates, as individuals in trusted and well-connected communities are more likely to accept and participate in vaccination programs.

The finding that higher subjective health levels are associated with greater vaccination intention is consistent with previous research [25]. A likely explanation for this association is that individuals with very poor health may have concerns about the safety of the COVID-19 vaccine and potential side effects [26].

Therefore, it is necessary to provide reliable information about the effectiveness and safety of vaccination to groups in need of health management. Additionally, there is a need for intervention strategies and practical support systems



**Table 5.** Factors affecting COVID-19 vaccination intention by multilevel analysis-2

Variable	Category	Model 1 <sup>a)</sup>	Model 2 <sup>b)</sup>	Model 3 <sup>c)</sup>	Model 4 <sup>d)</sup>
Level 2. Household factors					
Spouse living together	Yes (ref: no)			1.03 (0.97–1.10)	1.03 (0.97–1.10)
Children living together	Yes (ref: no)			0.95 (0.88–1.02)	0.95 (0.88–1.02)
No. of household members	2–3 Persons (ref: 1 person)			0.97 (0.90–1.04)	0.97 (0.90–1.05)
	≥4 Persons (ref: 1 person)			1.16 (1.05–1.27)	1.16 (1.05–1.28)
Monthly household income (unit: 10,000 KRW)	100–199 (ref: <100)			1.00 (0.91–1.10)	1.00 (0.91–1.10)
	200–299 (ref: <100)			1.01 (0.91–1.11)	1.01 (0.92–1.12)
	300–399 (ref: <100)			1.03 (0.93–1.14)	1.03 (0.93–1.15)
	≥400 (ref: <100)			1.22 (1.11–1.35)	1.22 (1.11–1.35)
Level 3. Community factors					
Vaccination rate for flu	Q2 (ref: Q1)				0.95 (0.87–1.05)
	Q3 (ref: Q1)				1.04 (0.95–1.15)
	Q4 (ref: Q1)				1.13 (1.01–1.26)
Proportion of individuals concerned about COVID-19 infection	Q2 (ref: Q1)				1.05 (0.95–1.15)
	Q3 (ref: Q1)				1.11 (1.01–1.23)
	Q4 (ref: Q1)				1.13 (1.01–1.25)
Practice rate for social distancing	Q2 (ref: Q1)				1.09 (0.99–1.21)
	Q3 (ref: Q1)				1.06 (0.96–1.17)
	Q4 (ref: Q1)				1.07 (0.96–1.19)
COVID-19 vaccination rate	Q2 (ref: Q1)				1.12 (1.02–1.23)
	Q3 (ref: Q1)				1.33 (1.21–1.45)
	Q4 (ref: Q1)				1.18 (1.06–1.32)
Variance (community)		0.074±0.011	0.051±0.009	0.051±0.009	0.028±0.007
Variance (household)		0.497±0.034	0.530±0.037	0.525±0.037	0.523±0.037
Chi-square		617.0	504.8	500.2	414.86
p-value		<0.001	<0.001	<0.001	<0.001
Residual ICC <sup>e)</sup> (community)		0.019	0.019	0.013	0.007
Residual ICC (household)		0.149	0.149	0.149	0.143

Data are presented as adjusted odds ratio (95% confidence interval) or mean ± standard deviation.

COVID-19, coronavirus disease 2019; ref, reference; KRW, Korean won.

<sup>a)</sup>Null model, <sup>b)</sup>individual model, <sup>c)</sup>individual-household model (2-level), <sup>d)</sup>individual-household-community model (3-level), <sup>e)</sup>Intraclass correlation coefficient.

that can facilitate actual vaccination. Implementing clear support measures to address potential side effects following vaccination would also be beneficial.

The finding that individuals who perceive themselves as thin had higher vaccination intentions than those who perceived themselves as obese is inconsistent with some previous studies examining the relationship between body mass index and vaccination intention [27]. This discrepancy may be due to differences between perceived obesity and actual obesity levels, as identified in prior research [27]. It is also possible that those who perceive themselves as obese are more concerned about vaccine side effects, which may lead them to avoid vaccination. Further research is needed to explore these possibilities.

The observation that individuals who have undergone a health exam in the past 2 years have higher vaccination intentions suggests that a general interest in one's health status can influence vaccination practices [28]. Providing

opportunities for individuals to assess their basic health status and fostering an environment that encourages ongoing health management can help promote vaccination.

The finding that individuals who were concerned or somewhat concerned about COVID-19 infection had higher vaccination intentions than those who were not concerned is consistent with previous research [20]. Risk perception is a crucial factor influencing risk behavior, and individuals with lower risk perception tend to engage in riskier behaviors or reduce preventive actions [29]. A lack of awareness about the risk of COVID-19 infection can lead to vaccine refusal, so educational interventions to improve risk perception are necessary. However, overstating the risk of infection can lead to fear and anxiety, potentially causing individuals to disengage from public health measures or distrust health information [30]. Therefore, it is essential to provide accurate and balanced information about the risks of infection, emphasizing realistic threats without causing unnecessary

alarm. Clear and factual communication can help improve public understanding, support informed decision-making, and promote vaccination.

The finding that a higher subjective COVID-19 daily life impact score was associated with greater vaccination intention aligns with previous research, which suggests that individuals who view COVID-19 as a serious threat are more likely to get vaccinated [11]. Shmueli [31] defined perceived severity as an individual's belief about the difficulties a disease may cause medically and socially, such as pain or missed workdays. In this context, the subjective COVID-19 daily life impact score can be considered an important predictor of COVID-19 vaccination intention.

In terms of household characteristics, monthly household income and the number of household members showed a significant association with vaccination intention. Individuals from households with 4 or more members were found to have a higher likelihood of vaccination, suggesting that family members may influence the decision to get vaccinated [32]. Previous research indicates that fear or anxiety related to new infectious diseases often arises from concerns about the risk of infection for oneself or family members [33,34]. Additionally, the worry of being a potential transmission route to other family members can increase vaccination intention, as individuals may feel responsible for protecting those around them. This may explain the association between having a larger number of family members and a higher level of vaccination intention. Promoting vaccination through family-oriented strategies could thus be an effective approach.

It was found that individuals with a monthly household income of 4 million KRW or more were more likely to intend to get vaccinated compared to those with an income below 1 million KRW, but no significant results were observed in other income groups. A possible explanation for this may be that socioeconomic factors affect an individual's ability to engage in health-promoting and disease-preventing behaviors and to effectively utilize healthcare services [22]. Higher household income not only reflects better economic status, but may also indicate a greater number of economically active individuals within the household. Therefore, the combined impact of household income and concerns about infection among economically active members might exert a complex influence on vaccination intention.

In terms of community factors, higher COVID-19 and influenza vaccine coverage rates in an area, along with greater concerns about COVID-19 infection, were associated with an increased likelihood of vaccination. This is largely due to the formation of a distinct social identity within

vaccination groups, where individuals align their attitudes and behaviors with those of the group [35]. Studies have demonstrated a positive correlation between the intention to vaccinate and the vaccination rates among friends and family, underscoring the significant role of social influence in shaping vaccination behaviors [36]. Observing community members getting vaccinated without experiencing adverse effects diminishes personal hesitations and motivates others to do the same. Higher community vaccination rates enhance the perception of safety and reinforce social norms, making individuals feel more comfortable and supported in their decision to vaccinate [37]. Networking with others who accept the COVID-19 vaccine is a strong predictor of vaccination intention, as it reinforces the perception of vaccination as a normative and safe behavior [38]. Conversely, the public goods dilemma occurs when some individuals opt out of vaccination, relying on the high vaccination rates of others to provide sufficient herd immunity [39]. This behavior reflects a tendency to avoid perceived costs, such as side effects, while still benefiting from community protection. This underscores the importance of fostering positive social influence and engaging the community to promote higher vaccination rates, particularly among hesitant populations. Encouraging community involvement and addressing concerns with accurate information can help mitigate hesitancy and ensure broader vaccine uptake.

This study has several limitations. First, a substantial number of participants were already vaccinated in accordance with government policies at the time of the survey. This precludes a uniform assessment of vaccination intentions across all participants, potentially limiting the generalizability of the study results. Second, there is a time discrepancy of up to 5 months in the measurement of individual, household, and some community factors. The KCHS, which provided data on individual and household factors, was conducted from August to October 2021, while demographic factors such as the aging rate and population density were measured in December 2021. Third, the study did not consider factors such as knowledge and attitudes toward COVID-19 or vaccines, which could influence vaccination intention. Fourth, common issues associated with survey-based research, such as non-response bias and social desirability bias, cannot be ruled out, and thus the results should be interpreted with caution. Finally, since the data were collected in 2021, the results may not fully reflect subsequent changes in the COVID-19 situation or related policies. Nevertheless, we believe the findings remain significant as they capture the patterns of vaccination intention during the early stages of the COVID-19 vaccine rollout.

Despite these limitations, this study's strength lies in its

multilevel analysis of individual, household, and community-level factors, which distinguishes it from previous research that focused solely on individual factors affecting COVID-19 vaccination intention. The results suggest that promoting COVID-19 vaccination requires a social-ecological approach that considers not just individual factors but also household and community networks. Additionally, in pandemic crisis situations, it is crucial to develop tailored policies for high-risk groups identified through this study to protect the health rights of socially vulnerable populations.

## Conclusion

The multilevel analysis of this study demonstrated that variables at the individual, household, and community levels affected the intention to receive the COVID-19 vaccine. Therefore, strategies for encouraging individual COVID-19 vaccination are likely to be more effective when combined with household and community-level approaches. It is essential to integrate both individual and social health factors into vaccination policies to reflect these interconnected elements.

## Notes

### Ethics Approval

This study was approved by the Institutional Review Board of Kyungpook National University Hospital (No. 2023-01-013) and performed in accordance with the principles of the Declaration of Helsinki.

### Conflicts of Interest

The authors have no conflicts of interest to declare.

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### Availability of Data

The datasets analyzed during the current study are available on the websites of Community Health Survey (<https://chs.kdca.go.kr>).

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