보건교육건강증진학회지 제42권 제1호(2025. 3) pp.83-98
Korean J Health Educ Promot, Vol.42, No.1 (2025)
https://doi.org/10.14367/kjhep.2025.42.1.83

Behavioral determinants of hand hygiene practices during the COVID-19 pandemic: Insights from the 2020 Community Health Survey

Rang-Hee Kwon*, Minsoo Jung**†

* Researcher, Public Healthcare Planning & Evaluation Team, National Medical Center,
** Associate Professor, Department of Health Science, Dongduk Women's University

Objectives: This study examined the impact of conventional health behaviors on hand hygiene practices during the COVID-19 pandemic using data from the 2020 Community Health Survey (N=210,089). **Methods:** Smoking, drinking, and physical activity were assessed as predictors of hand hygiene behavior. For statistical analysis, hierarchical logistic regression analysis was performed while controlling for confounders. **Results:** Men and older individuals were found to be less likely to practice hand hygiene, while higher education levels increased the likelihood. Smokers and frequent drinkers were less likely to maintain hand hygiene, whereas those engaging in more physical activity and those vaccinated against influenza were more likely to practice it. Conversely, individuals with unsatisfactory medical experiences had lower hand hygiene rates. The study suggests that those with healthier behaviors, such as physical activity and vaccination acceptance, were more likely to engage in proper hand hygiene during the pandemic. However, those with health-risk behaviors, such as smoking and frequent drinking, were less compliant. **Conclusion:** The findings highlight the need for tailored non-pharmacological interventions targeting high-risk groups who may continue these behaviors during new infectious disease outbreaks. This emphasizes the importance of promoting overall health behaviors to improve preventive measures in future pandemics.

Key words: COVID-19, conventional health behaviors, hand hygiene practices, non-pharmaceutical interventions

Ⅰ. Introduction

As of July 21, 2024, a total of over 775 million people worldwide have been confirmed with SARS-CoV-2 (hereinafter referred to as "COVID-19"), with more than seven million fatalities reported (World Health Organization [WHO], 2024a). By December 2024, approximately 70.6% of the global population had received at least one dose of a COVID-19 vaccine. Despite this progress, the emergence of new variants, such as the Omicron sub-variant XEC, continues to pose challenges to controlling the pandemic (WHO, 2024b). In this prolonged pandemic scenario, non-pharmaceutical interventions (NPIs) play a critical role in curbing the spread of infectious diseases. These interventions include hand hygiene, mask-wearing, social distancing, disinfection, ventilation, and isolation —measures that are relatively simple and cost-effective (Imai et al., 2020). Given the lengthy development and distribution timelines for vaccines and treatments for emerging infectious diseases such as COVID-19, NPIs remain essential tools to mitigate the spread of the virus. To reduce COVID-19 transmission, most countries have implemented personal preventive measures, such as hand hygiene and mask-wearing, as well as broader NPI strategies like physical distancing to reduce contact between individuals (Bedford et al., 2020). However, despite observed variations in the

Corresponding author: Minsoo Jung
Department of Health Science, College of Natural Science, Dongduk Women's University, 60, Hwarang-ro 13-gil, Seongbuk-gu, Seoul, 02748, Republic of Korea
Tel: +82-2-940-4483, Fax: +82-2-940-4480, E-mail: mj748@dongduk.ac.kr
• Received: October 21, 2024 • Revised: December 24, 2024 • Accepted: December 30, 2024

adoption of non-pharmaceutical interventions across different population groups, there remains a paucity of research on the determinants influencing NPI adherence (Doung-Ngern et al., 2020; McGrail, Dai, McAndrews, & Kalluri, 2020).

Hand hygiene includes practices such as handwashing and disinfection aimed at maintaining clean hands (WHO, 2009). From a behavioral science perspective, it is a health behavior performed before and after meals, after using the restroom, and upon returning home, helping to prevent the spread of infectious diseases through contact (Knell, Robertson, Dooley, Burford, & Mendez, 2020; Wollast, Schmitz, Bigot, Brisbois, & Luminet, 2024). Even before COVID-19, hand hygiene was key in preventing the transmission of respiratory and waterborne diseases such as hepatitis A, dysentery, influenza, and food poisoning (Aiello, Coulborn, Perez, & Larson, 2008; Tambekar & Shirsat, 2009). A survey conducted during the COVID-19 pandemic found that only 30% of individuals used soap when washing their hands (Cho, 2021), indicating a gap in knowledge about effective hand hygiene. This suggests a need for improved health education to promote proper hand hygiene and prevent infectious diseases (Jo & Jung, 2020; Jung, Park, Park, & Jang, 2022).

The COVID-19 pandemic has highlighted the urgent need to examine determinants of hand hygiene practices as a cornerstone of infection prevention. While prior studies based on the theory of planned behavior explored preventive intentions and behaviors during the pandemic, specific investigations into hand hygiene remain limited (Chung, Lee, & Nam, 2021; Kim, Yoon, & Sohn, 2021). Research on Southeast Asian adolescents identified links between health behaviors and hygiene practices but lacked generalizability to other populations, such as those in Korea (Peltzer & Pengpid, 2014). Traditional health behaviors, including smoking cessation, alcohol reduction, and physical activity, serve as critical predictors of health outcomes and are central to national health policies aimed at improving lifespan and equity (Kang, 2007; Kim, Lee, Jeon, Lee, & Hong, 2016; Whitby et al., 2007). These behaviors are influenced by personal factors (e.g., knowledge, attitudes) and social contexts (e.g., family, community) and often cluster together, offering opportunities for targeted interventions (Michaelsen & Esch, 2023; Poortinga, 2007; Pronk et al., 2004). While previous studies have primarily associated these behaviors with non-communicable diseases, their relationship to communicable disease prevention, such as hand hygiene, warrants further exploration (Lee et al., 2012; Mechanic & Cleary, 1980; Park & Cha, 2016). Personal hygiene practices not only protect individuals but also contribute to family and community health (Park et al., 2008).

Socioeconomic disparities exacerbate barriers to health-promoting resources, with vulnerable populations experiencing higher risks of smoking, drinking alcohol, and reduced access to physical activity, as well as limited availability of hand hygiene resources such as soap and sanitizer (Borg et al., 2009; Goyal et al., 2020; Kim, J., 2020; Nandi, Glymour, & Subramanian, 2014; Pickering, Boehm, Mwanjali, & Davis, 2010). Furthermore, simply providing hygiene materials does not ensure behavioral change without sufficient education and resources to address the gap between knowledge and practice (Anderson et al., 2008; Jo & Jung, 2020; Patton et al., 2018; Rabbi & Dey, 2013). Understanding the interrelation of health behaviors and their predictive value for hand hygiene adoption is crucial for designing effective interventions to reduce health inequities and disease transmission (Kim et al., 2016; Mechanic & Cleary, 1980; Park et al., 2008). In 2022, Korea transitioned its COVID-19 response from a pandemic to an endemic approach. However, the complete eradication of COVID-19 may take considerable time or may not be feasible at all. In this context,

understanding and fostering the autonomous practice of non-pharmaceutical interventions (NPIs) have become increasingly important, yet related research remains limited. Hand hygiene, the most fundamental infection prevention behavior, plays a critical role during the COVID-19 pandemic. This study utilized national data from 2020 to examine the determinants influencing individual hand hygiene practices during the pandemic.

Ⅱ. Methods

1. Dataset

The research data used raw data from the 2020 Community Health Survey conducted by the Korea Disease Control and Prevention Agency (KDCA) (n=210,089). The community health survey has been conducted annually at public health centers across the country since 2008 to produce health statistics at the city, county, and district level necessary for establishing local health care plans. The Community Health Survey is a standardized survey conducted in 253 public health centers across the country and produces objective health statistics that can be compared across regions. The population of the community health survey is adults aged 19 years or older, and a representative sample of 900 people on average is selected from each public health center. The community health survey is conducted through household visits and 1:1 interviews by trained investigators, and an average of 220,000 people participate in the survey each year. The 2020 survey was conducted from August 16 to October 31, and for a limited time, 45 additional questions related to COVID-19 were surveyed along with essential indicators.

2. Study design

This study is a cross-sectional study using secondary data.

3. Analytical framework

This study leverages a behavioral science framework suggesting that positive health behaviors promote other healthy practices (Kang, 2007; Mechanic & Cleary, 1980). Such behaviors, encompassing activities like regular exercise and hand hygiene, mitigate health risks, while risky behaviors, including smoking and excessive drinking alcohol, increase susceptibility to disease. Investigating the co-occurrence of these behaviors aids in designing holistic health promotion strategies (Prochaska, 2008; Prochaska, Spring, & Nigg, 2008).

Grounded in the Structural Influence Model (Lin, Jung, McCloud, & Viswanath, 2014), this cross-sectional study analyzes survey data to identify factors influencing handwashing practices. Previous research highlights the clustering of health behaviors (Busch, Van Stel, Schrijvers, & de Leeuw, 2013; Mawditt, Sacker, Britton, Kelly, & Cable, 2016; Murphy et al., 2019; Rabel et al., 2019) and the role of sociodemographic variables, such as gender, age, education, and socioeconomic status (SES), in shaping hygiene practices (Jo & Jung, 2020; Qorbani et al., 2016; Suen, So, Yeung, Lo, & Lam, 2019; Wong & Lee, 2019). Lower SES is often associated with a higher prevalence of unhealthy behaviors and limited healthcare access, resulting in unmet healthcare needs and negative perceptions of the healthcare system (Choi & Kim, 2008; Dumith, Muniz, Tassitano, Hallal, & Menezes, 2012; Huh & Lee, 2016; Ishikawa, Kondo, Kawachi, & Viswanath, 2016; Pampel, Krueger, & Denney, 2010; Woo, Sohn, Kim, & Choi, 2020).

Influenza vaccination uptake, a proxy for healthcare access, is influenced by SES and correlates with protective behaviors such as hand hygiene (Byeon et al., 2016; Stedman-Smith, Kingsbury, Dubois, & Grey, 2017; Takayama, Wetmore, & Mokdad, 2012). During the COVID-19 pandemic, vaccinated individuals were more likely to adopt preventive measures, including

social distancing, mask-wearing, and handwashing (Hall et al., 2023). Consequently, this study incorporates healthcare access, including vaccination status, as a moderating variable to examine its influence on adherence to hand hygiene practices. By exploring the interplay between health-related behaviors—such as smoking, drinking alcohol, physical activity, and influenza vaccination—this study provides insights into the determinants of hand hygiene during the pandemic.

4. Measures

1) Independent variables

Previous research has categorized smoking, alcohol consumption, and physical inactivity as health risk behaviors, while balanced nutrition and regular physical activity are classified as health-promoting behaviors (Park, Jun, & Kim, 2015). However, whether hand hygiene practices are positively influenced by health-promoting behaviors or negatively by health risk behaviors remains unclear. This study examines these associations by analyzing the impacts of smoking, alcohol consumption, and physical inactivity as health risk behaviors (Kang, Sung, & Kim, 2010). Smoking experience was assessed using three questions: "How many cigarettes have you smoked in your life so far?", "Have you ever smoked a heated tobacco product?", and "Have you ever used a liquid-type e-cigarette containing nicotine?" Respondents were classified as having smoking experience if they answered "yes" to any of these questions. Those who responded negatively to all three were classified as having no smoking experience. Alcohol consumption frequency was measured by asking, "How often have you drunk alcohol in the past year?" Respondents with no lifetime drinking alcohol experience or who had not consumed alcohol in the past year were classified as "never drinkers." Other responses were categorized as "less than once a month," "2 to 3 times a month," "2 to 3 times a week," and "4 or more times a week." Physical activity, a health-promoting behavior, was assessed using two questions: "During the past week, on how many days did you engage in vigorous physical activity that made you feel more tired or out of breath than usual?" and "During the past week, on how many days did you engage in moderate-intensity physical activity that made you slightly short of breath for more than 10 minutes?" In the Community Health Survey, physical activity was measured in three areas: vigorous activity, moderate activity, and walking. However, walking was excluded from the analysis as it is often less indicative of voluntary physical activity. To address potential overlap between vigorous and moderate activities due to unclear distinctions, responses to the two categories were combined. The summed values (0–14 days) were categorized into five levels: 'low,' 'middle-low,' 'middle,' 'middle-high,' and 'high.' To account for the effects of socioeconomic status (SES) on hand hygiene practices, educational attainment was included as a covariate in the statistical model. However, income level was excluded due to its substantial missing values and multicollinearity with educational attainment.

2) Dependent variables

To measure the level of hand hygiene practice during the COVID-19 pandemic, six questions were used: (1) "How often did you wash your hands before eating in the past week?" (2) "How often did you wash your hands after using the bathroom in the past week?" (3) "How often did you wash your hands after returning home from going out in the past week?" (4) "When you usually wash your hands, do you thoroughly wash them under running water for at least 30 seconds?" (5) "When you usually wash your hands, how often do you use soap or hand sanitizer?" and (6) "During the past week, on average, how many times

per day have you used hand sanitizer outside the home?" Responses were scored on a 4-point scale, with 1 indicating "rarely" and 4 indicating "always." The scores from all items were summed to create a continuous variable ranging from 6 to 24 points. Two questions required additional processing to align with this scoring system. For the question "Do you thoroughly wash your hands under running water for at least 30 seconds?" the original 5-point response scale was adapted to match the 4-point system, with the response "I did not wash my hands at all" treated as equivalent to "rarely." For the question "During the past week, on average, how many times per day have you used hand sanitizer outside the home?" the original response range (0 to 99) was categorized into four groups (0–24 times, 25–49 times, 50–74 times, 75–99 times) and scored on a 4-point scale. The dependent variable, hand hygiene practice, was based on the total handwashing practice scores, which were categorized into two groups: "poor" and "good" hygiene practices. This classification reflected the statistical distribution and characteristics of the responses and was informed by prior research (Park et al., 2008). The reliability of the six items used for assessing hand hygiene practice was confirmed with a Cronbach's alpha coefficient of 0.742.

3) Moderators

Moderators in this study included respondents' influenza vaccination status and their experience with unmet medical needs. Influenza vaccination status was assessed by asking, "Have you received an influenza vaccination in the past year?" Responses were categorized as either "vaccinated" or "unvaccinated." Unmet medical needs were determined using the question, "In the past year, have you ever needed medical treatment (examination or treatment) at a hospital or clinic (excluding dentistry) but were unable to receive it?" Responses were classified as either "experienced" (indicating unmet medical needs) or "inexperienced" (indicating no unmet medical needs).

5. Statistical analysis

The statistical analysis for this study was conducted as follows. First, descriptive statistics were used to summarize the general characteristics of the respondents. Second, chi-square tests were performed to examine the associations between general characteristics and hand hygiene practices. Third, hierarchical multiple logistic regression analysis was employed to analyze the effects of socioeconomic status, health risk behaviors, health promotion behaviors, influenza vaccination status, and unmet medical needs on hand hygiene practices, while controlling for sociodemographic variables such as gender and age. The logistic regression model underwent diagnostic checks to ensure its validity. Finally, the moderating effects of influenza vaccination status and unmet medical needs on the relationship between traditional health behaviors and hand hygiene practices were evaluated using the verification method outlined by Baron and Kenny (Baron & Kenny, 1986; Park & Jeon, 2006). All statistical analyses were conducted using SPSS version 25.0. Given that the Community Health Survey sample was obtained using a complex sampling design, we accounted for stratification variables, cluster variables, and sampling weights in our statistical calculations.

6. Ethical consideration

The community health survey raw data is secondary data disclosed to the public and is not subject to human subject research based on Article 2, Paragraph 2 of the Enforcement Rules of the Bioethics and Safety Act, and is therefore excluded from IRB review. The original IRB approval number from the Korea Disease Control and Prevention Agency was 2016-10-01-P-A.

Ⅲ. Results

1. General characteristics of the sample

The general characteristics of the respondents are as follows 〈Table 1〉. Gender was 44.5% male and 55.5% female. The largest age group was 70 years or older at 24.0%. In terms of educational attainment, high school graduation was the most common at 33.4%. Those with no smoking experience accounted for 65.2%, while those with smoking experience accounted for 34.8%. The majority (43.3%) did not drink alcohol at all. In the case of physical activity, the majority (72.0%) were 'Lowest' who rarely practice it. Those who had been vaccinated against influenza in the past year were 59.7% of all respondents, and those who had not been vaccinated were 40.3%. Those who experienced unmet medical care in the past year were 5.6%, and those who did not experience it were 94.4%.

〈Table 1〉 General characteristics of the sample

N=210,089

Variables		Categories	Frequency	%
Socio-demographic characteristics	Gender	Men	93,576	44.5
		Women	116,513	55.5
	Age	19-29	21,562	10.3
		30-39	22,238	10.6
		40-49	32,352	15.4
		50-59	41,010	19.5
		60-69	42,519	20.2
		≥ 70	50,408	24.0
Socio-economic status	Educational attainment	Elementary school or less	51,721	24.6
		Middle School graduation	23,623	11.2
		High school graduation	70,177	33.4
		College or post-graduate	64,568	30.8
Health risk behaviors	Smoking	Never	13,7074	65.2
		Ever	73,015	34.8
	Drinking alcohol	Never	90,989	43.3
		〈 1/mo	45,760	21.8
		2~3 times/mo	36,501	17.4
		2~3 times/wk	25,261	12.0
		≥ 4 times/wk	11,578	5.5
Health promotion behaviors	Physical activity	Low	151,123	72.0
		Middle-low	30,274	14.4
		Middle	20,042	9.5
		Middle-high	4,629	2.2
		High	4,021	1.9
Influenza vaccination		Not vaccinated	84,595	40.3
		Vaccinated	125,494	59.7
Unmet medical care		Did not experience	198,375	94.4
		Experienced	11,714	5.6
Hand hygiene practices		Poor	102,669	48.9
		Good	107,420	51.1
Total			210,089	100.0

2. Association between health behaviors and hand hygiene practices

The results of examining the relationship between health behaviors and hand hygiene practices are as follows 〈Table 2〉. In terms of gender, women practiced hand hygiene better than men (χ^2=3,560.697, p<.001). In terms of age, people in their 60s were found to practice hand hygiene best (χ^2=5,478.389, p<.001). The higher the level of education, the better the tendency was to wash hands (χ^2=4,431.531, p<.001). In terms of health risk behaviors, the group with no smoking experience (χ^2=2,629.858, p<.001) and the group with low drinking alcohol frequency (χ^2= 1,092.906, p<.001) practiced good hand hygiene. In the case of health promotion behavior, the more physical activity the person practiced better hand hygiene (χ^2= 89.438, p<.001). In the case of influenza vaccination, the vaccinated group was found to keep hand hygiene

〈Table 2〉 Association between health behaviors and hand hygiene practices

Unit: Frequency (%)

Variables		Categories	Poor	Good	χ^2
Socio-demographic characteristics	Gender	Men	52,525 (51.2)	41,051 (38.2)	3,560.697***
		Women	50,144 (48.8)	66,369 (61.8)	
	Age	19-29	9,595 (9.3)	11,967 (11.1)	5,478.389***
		30-39	8,577 (8.4)	13,661 (12.7)	
		40-49	13,996 (13.6)	18,356 (17.1)	
		50-59	19,223 (18.7)	21,787 (20.3)	
		60-69	20,654 (20.1)	21,865 (20.4)	
		≥ 70	30,624 (29.8)	19,784 (18.4)	
Socio-economic status	Educational attainment	Elementary school or less	31,720 (30.9)	20,001 (18.6)	4,431.531***
		Middle School graduation	12,246 (11.9)	11,377 (10.6)	
		High school graduation	32,937 (32.1)	37,240 (34.7)	
		College or post-graduate	25,766 (25.1)	38,802 (36.1)	
Health risk behaviors	Smoking	Never	61,392 (59.8)	75,682 (70.5)	2,629.858***
		Ever	41,277 (40.2)	31,738 (29.5)	
	Drinking alcohol	Never	44,747 (43.6)	46,242 (43.0)	1,092.906***
		< 1/mo	20,497 (20.0)	25,263 (23.5)	
		2~3 times/mo	17,280 (16.8)	19,221 (17.9)	
		2~3 times/wk	13,106 (12.8)	12,155 (11.3)	
		≥ 4 times/wk	7,039 (6.9)	4,539 (4.2)	
Health promotion behaviors	Physical activity	Low	74,698 (72.8)	76,425 (71.1)	89.438***
		Middle-low	14,346 (14.0)	15,928 (14.8)	
		Middle	9,685 (9.4)	10,357 (9.6)	
		Middle-high	2,066 (2.0)	2,563 (2.4)	
		High	1,874 (1.8)	2,147 (2.0)	
Influenza vaccination		Not vaccinated	40,746 (39.7)	43,849 (40.8)	28.036***
		Vaccinated	61,923 (60.3)	63,571 (59.2)	
Unmet medical care		Did not experience	96,332 (93.8)	102,043 (95.0)	135.718***
		Experienced	6,337 (6.2)	5,377 (5.0)	
Sum			102,669 (100.0)	107,420 (100.0)	

Note. *** p<.001

〈Table 3〉 Hierarchical multiple logistic regression analysis of determinants affecting hand hygiene practice

Variables		Model I		Model II		Model III		Model IV	
		OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Socio-demographic characteristics	Gender (ref. Women)	0.507***	0.498-0.517	0.573***	0.559-0.588	0.566***	0.553-0.581	0.562***	0.548-0.576
	Age	0.979***	0.972-0.986	0.972***	0.966-0.979	0.974***	0.967-0.981	0.954***	0.947-0.961
Socio-economic status	Education	1.382***	1.368-1.396	1.390***	1.376-1.404	1.390***	1.375-1.404	1.402***	1.388-1.417
Health risk behaviors	Smoking (ref. Never)			0.888***	0.865-0.911	0.889***	0.866-0.912	0.904***	0.881-0.927
	Drinking alcohol			0.944***	0.937-0.952	0.943***	0.936-0.951	0.948***	0.941-0.956
Health promotion behaviors	Physical activity					1.056***	1.045-1.066	1.057***	1.046-1.067
Moderators	Influenza vaccination (ref. Not vaccinated)							1.220***	1.196-1.245
	Unmet medical care (ref. Did not experience)							0.765***	0.736-0.795

Note. *** p<.001

well (χ^2=28.036, p=<.001), and in the case of unmet medical care, the inexperienced group was found to keep hand hygiene relatively well (χ^2=135.718, p<.001).

3. Hierarchical multiple logistic regression analysis of determinants affecting hand hygiene practice

The results of a multiple logistic regression analysis of factors affecting hand hygiene practice are as follows <Table 3>. According to Model I, men were 0.507 times less likely to practice hand hygiene than women (95% CI=0.498-0.517). In terms of age, older people were 0.979 times less likely to practice hand hygiene than younger people (95% CI=0.972-0.986). The highly educated group was 1.382 times more likely to practice hand hygiene than the less educated group (95% CI=1.368-1.396). According to Model II, which additionally introduced health risk behaviors, smokers were 0.888 times less likely to practice hand hygiene than non-smokers (95% CI=0.865-0.911). The group with high drinking alcohol frequency was 0.944 times less likely to practice hand hygiene than the group with low drinking alcohol frequency (95% CI=0.937-0.952). In Model III, which additionally included health promotion behaviors, the group with a high level of physical activity was 1.056 times more likely to practice hand hygiene than the group with low physical activity (95% CI=1.045-1.066). Lastly, according to IV, which added variables related to respondents' access to medical care, the group that had been vaccinated against influenza was 1.220 times more likely to practice hand hygiene than the group that had not been vaccinated (95% CI=1.196-1.245). The group with unmet medical experience was 0.765 times less likely to practice hand hygiene than the group with no experience (95% CI=0.765-0.795).

4. Moderating effect of influenza vaccination between health behavior and hand hygiene practice

First, the results of hierarchical regression analysis to verify the moderating effect of influenza vaccination are as follows <Table 4>. Model 1 inputs the independent variables educational attainment, smoking, drinking alcohol, and physical activity along with potential confounding variables gender and age. In Model 2, the moderator, influenza vaccination status, was entered. In Model 3, to examine how the relationship between the independent variables of smoking, drinking alcohol, physical activity, and hand hygiene practice is adjusted by the presence of influenza vaccination, an interaction term was input in which the independent and moderating variables were mean-centered and multiplied. According to the results, there was a significant moderating effect between conventional health behaviors and hand hygiene practices depending on influenza vaccination. In other words, even smokers practiced hand hygiene more if they had ever been vaccinated against influenza. Likewise, even if they drank frequently, they practiced more hand hygiene if they had had an influenza vaccination.

Second, the results of hierarchical regression analysis to verify the moderating effect of unmet medical experience are as follows <Table 5>. Model 1 inputs the independent variables educational attainment, smoking, drinking alcohol, and physical activity along with potential confounding variables gender and age. In Model 2, the moderator, unmet medical experience, was entered. In Model 3, to examine how the relationship between the independent variables of smoking, drinking alcohol, physical activity, and hand hygiene practice varies depending on the presence or absence of unmet medical experience, an interaction term was input in which the independent and moderating variables were

〈Table 4〉 Moderating effect of influenza vaccination between health behavior and hand hygiene practice

Variables		Model I		Model II		Model III	
		β	t	β	t	β	t
Socio-demographic characteristics	Gender (ref. Women)	-0.135	-45.231***	-0.134	-45.075***	-0.135	-45.392***
	Age	-0.021	-7.302***	-0.036	-12.275***	-0.035	-11.895***
Socio-economic status	Education	0.180	63.952***	0.186	65.601***	0.184	64.881***
Health risk behaviors	Smoking (ref. Never)	-0.027	-9.071***	-0.024	-8.212***	-0.023	-7.749***
	Drinking alcohol	-0.034	-14.408***	-0.031	-13.188***	-0.030	-12.667***
Health promotion behaviors	Physical activity	0.023	10.738***	0.023	10.626***	0.023	10.634***
Influenza vaccination (ref. Not vaccinated)				0.046	19.597***	0.044	18.531***
Smoking×Influenza vaccination						0.007	2.959**
Drinking alcohol×Influenza vaccination						0.015	6.622***
Physical activity×Influenza vaccination						0.001	0.666

Note. ** p<.01, *** p<.001

〈Table 5〉 Moderating effect of unmet medical care between health behavior and hand hygiene practice

Variables		Model I		Model II		Model III	
		β	t	β	t	β	t
Socio-demographic characteristics	Gender (ref. Women)	-0.135	-45.231***	-0.137	-45.912***	-0.137	-45.908***
	Age	-0.021	-7.302***	-0.022	-7.693***	-0.022	-7.688***
Socio-economic status	Education	0.180	63.952***	0.179	63.659***	0.179	63.657***
Health risk behaviors	Smoking (ref. Never)	-0.027	-9.071***	-0.026	-8.650***	-0.026	-8.652***
	Drinking alcohol	-0.034	-14.408***	-0.034	-14.225***	-0.034	-14.227***
Health promotion behaviors	Physical activity	0.023	10.738***	0.024	11.016***	0.024	10.993***
Unmet medical care (ref. Did not experience)				-0.030	-14.030***	-0.030	-14.026***
Smoking×Unmet medical care						0.001	0.097
Drinking alcohol×Unmet medical care						0.001	-0.177
Physical activity×Umedical care						0.001	0.678

Note. ** p<.01, *** p<.001

mean-centered and multiplied. According to the results, there was no significant moderating effect between conventional health behaviors and experiences of unmet medical care.

Ⅳ. Discussion

Health-promoting behaviors, such as smoking cessation, reduced alcohol consumption, and physical activity, are critical for preventing chronic diseases and maintaining individual health (Alamian & Paradis,

2009). However, there is limited understanding of the relationship between non-pharmaceutical intervention (NPI) behaviors, which gained prominence during the COVID-19 pandemic, and traditional health behaviors. Given the variability in compliance with quarantine measures, understanding the determinants of these behaviors has emerged as an important public health issue. This study investigates the behavioral determinants of hand hygiene practices using data from a community health survey conducted during the COVID-19 pandemic.

The analysis revealed several key findings. First, respondents who were female, younger, or had higher education levels were more likely to practice hand hygiene. Second, individuals who smoked or consumed alcohol frequently were less likely to engage in hand hygiene. Third, higher levels of physical activity were associated with greater adherence to hand hygiene practices. Fourth, those with unmet medical needs or who had not received an influenza vaccination were less likely to practice hand hygiene. These findings indicate that individuals engaging in traditional health-promoting behaviors were also more likely to maintain good hand hygiene during the pandemic, while those with health risk behaviors were less likely to do so, rendering them more vulnerable to infection. This aligns with prior research suggesting that health-promoting lifestyles tend to cluster and correlate with better hygiene practices (de Vries et al., 2008; Kang, 2007; Shin, 2019).

This study provides new evidence that traditional health behaviors are systematically related to personal quarantine measures, such as hand hygiene, which serve as critical protections during public health emergencies like the COVID-19 pandemic. However, it is concerning that health risk behaviors, such as increased alcohol consumption, smoking, and reduced physical activity, have risen during the pandemic, potentially exacerbating health inequalities (Lesser & Nienhuis, 2020; Zajacova, Jehn, Stackhouse, Denice, & Ramos, 2020). Public health strategies must prioritize identifying vulnerable populations and monitoring disparities in NPI compliance. Despite its simplicity, barriers to hand hygiene, such as inadequate access to soap and water, persist among low-income populations and in resource-limited countries (Loftus et al., 2019).

The pandemic has also deepened socioeconomic disparities, compounded by economic losses and restricted access to healthcare (Kim, J., 2020). Vulnerable groups, such as cancer survivors and individuals with underlying health conditions, face increased unmet medical needs, further threatening their health (Balogun, Bea, & Phillips, 2020). Essential workers are disproportionately affected by chronic diseases (Pampel et al., 2010), and the structural inequalities exacerbated by COVID-19 continue to disproportionately impact these populations. In this context, behavioral science interventions are essential. Health behaviors are shaped by individual cognition and social networks. For instance, smoking often occurs in social contexts, and hand hygiene is more likely in the presence of others (Drankiewicz & Dundes, 2003; Ho et al., 2020; Jeong et al., 2007). In collectivistic societies, social norms and reference groups play a significant role in shaping behaviors (Han & Choi, 2021). Establishing hand hygiene, along with mask-wearing and cough etiquette, as social norms during infectious disease outbreaks represents a valuable public health strategy, particularly as the emphasis shifts toward personal responsibility for disease prevention (Van Bavel et al., 2020).

With the continued risk of emerging COVID-19 variants or future pandemics (COVID-X) and delays in vaccine development, early education and intervention targeting preventive behaviors are essential (Musavian, Pasha, Rahebi, Atrkar Roushan, & Ghanbari, 2014). To maximize the effectiveness of hand hygiene

interventions, comprehensive preventive behavior models are needed, supported by robust evidence on their role in suppressing infectious disease transmission (Kim, Y.-B., 2020). This study found that influenza vaccination positively moderated hand hygiene practices, even among groups engaging in health risk behaviors. Understanding the clustering of health-promoting and risk behaviors with hand hygiene is crucial for protecting vulnerable groups and reducing health disparities exacerbated by COVID-19.

This study has several limitations. First, given that cross-sectional data were used, there is a possibility of reverse causality between physical activity and hand hygiene practice. The data used in this study measured hand hygiene practice over the past week in the fall of 2020, and smoking, drinking alcohol, influenza vaccination, and unmet medical experience measured behavior over the past year. Therefore, the temporal precedence relationship, which is one of the conditions for determining causality in the regression model, was basically satisfied. However, in the case of physical activity, there is a possibility that the practice rate during the COVID-19 period was different from the past in that the practice was measured over the past week. Second, there may be recall bias in responses about hand hygiene practices. Individual hand hygiene practices are difficult to objectively observe or measure unless it is an experimentally controlled situation. Therefore, information is collected through self-administration in the survey, and in the COVID-19 situation, hand hygiene practice may act as a social norm for desirable behavior and may cause a positive recall bias.

Ⅴ. Conclusion

Hand hygiene is a fundamental preventive measure during the COVID-19 pandemic, and public health authorities have emphasized its importance in curbing the spread of the virus. However, limited research has been conducted on the behavioral determinants of hand hygiene. This study investigates the factors influencing hand hygiene practices during the pandemic and reveals that women, younger individuals, and those with higher levels of education were more likely to engage in consistent hand hygiene practices. Conversely, smokers and frequent alcohol consumers were less likely to adhere to hand hygiene recommendations. Higher levels of physical activity were positively associated with better hand hygiene practices. Moreover, individuals with unmet medical needs or who had not received influenza vaccinations were less likely to practice good hand hygiene. This study also examines the relationships between health-promoting behaviors, health risk behaviors, and hand hygiene practices during the pandemic. Individuals engaging in health-promoting behaviors were more likely to maintain good hand hygiene, while those with health risk behaviors demonstrated lower compliance, potentially increasing their vulnerability to infection. These findings underscore the need for targeted non-pharmaceutical intervention strategies, particularly for high-risk groups, including those with unmet medical needs or who are unvaccinated against influenza. Addressing these gaps will be critical for improving public health outcomes during future infectious disease outbreaks.

References

Aiello, A. E., Coulborn, R. M., Perez, V., & Larson, E. L. (2008). Effect of hand hygiene on infectious disease risk in the community setting: A meta-analysis. *American Journal of Public Health, 98*(8), 1372-1381. doi: 10.2105/AJPH.2007.124610.

Alamian, A., & Paradis, G. (2009). Clustering of chronic disease behavioral risk factors in Canadian children and adolescents. *Preventive Medicine*, *48*(5), 493-499. doi:

10.1016/j.ypmed.2009.02.015.

Anderson, J. L., Warren, C. A., Perez, E., Louis, R. I., Phillips, S., Wheeler, J., . . . Misra, R. (2008). Gender and ethnic differences in hand hygiene practices among college students. *American Journal of Infection Control, 36*(5), 361-368. doi: 10.1016/j.ajic.2007.09.007.

Balogun, O. D., Bea, V. J., & Phillips, E. (2020). Disparities in cancer outcomes due to COVID-19 - A tale of 2 cities. *JAMA Oncology, 6*(10), 1531-1532. doi: 10.1001/jamaoncol.2020.3327.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173-1182. doi: 10.1037//0022-3514.51.6.1173.

Bedford, J., Enria, D., Giesecke, J., Heymann, D. L., Ihekweazu, C., Kobinger, G., . . . Wieler, L. H. (2020). COVID-19: Towards controlling of a pandemic. *The Lancet, 395*(10229), 1015-1018. doi: 10.1016/S0140-6736(20)30673-5.

Borg, M. A., Benbachir, M., Cookson, B. D., Ben Redjeb, S., Elnasser, Z., Rasslan, O., . . . Pieridou Bagatzouni, D. (2009). Health care worker perceptions of hand hygiene practices and obstacles in a developing region. *American Journal of Infection Control, 37*(10), 855-857. doi: 10.1016/j.ajic.2009.06.003.

Busch, V., Van Stel, H. F., Schrijvers, A. J. P., & de Leeuw, J. R. J. (2013). Clustering of health-related behaviors, health outcomes and demographics in Dutch adolescents: A cross-sectional study. *BMC Public Health 13*, 1118. doi: 10.1186/1471-2458-13-1118.

Byeon, G.-R., Hur, Y.-I., Kang, J.-H., Park, A.-H., Kim, K.-W., Cho, Y.-G., . . . Kang, B.-H. (2016). Influenza vaccination status in Korean adult population in relation with socioeconomic and medical factors. *Korean Journal of Health Promotion, 16*(1), 20-31. doi: 10.15384/kjhp.2016.16.1.20.

Cho, K. S. (2021). Changes in handwashing practices in the Republic of Korea, 2013-2020. *Public Health Weekly Report, 14*(42), 2972-2987.

Choi, E. J., & Kim, C. W. (2008). Factors associated with tobacco and alcohol use. *Journal of Korean Society for Health Education and Promotion, 25*(5), 39-51.

Chung, M. A., Lee, H., & Nam, E. W. (2021). Comparison of the practice of personal hygiene prevention and social distance among Korean and Nepalese university students during the first wave of the COVID-19 pandemic. *Korean Journal of Health Education and Promotion, 38*(2), 43-53. doi: 10.14367/kjhep.2021.38.2.43.

de Vries, H., van't Riet, J., Spigt, M., Metsemakers, J., van den Akker, M., Vermunt, J. K., & Kremers, S. (2008). Clusters of lifestyle behaviors: Results from the Dutch SMILE study. *Preventive Medicine, 46*(3), 203-208. doi: 10.1016/j.ypmed.2007.08.005.

Doung-Ngern, P., Suphanchaimat, R., Panjangampatthana, A., Janekrongtham, C., Ruampoom, D., Daochaeng, N., . . . Limmathurotsakul, D. (2020). Case-control study of use of personal protective measures and risk for SARS-CoV 2 infection, Thailand. *Emerging Infectious Diseases, 26*(11), 2607-2616. doi: 10.3201/eid2611.203003.

Drankiewicz, D., & Dundes, L. (2003). Handwashing among female college students. *American Journal of Infection Control, 31*(2), 67-71. doi: 10.1067/mic.2003.6.

Dumith, S. C., Muniz, L. C., Tassitano, R. M., Hallal, P. C., & Menezes, A. M. B. (2012). Clustering of risk factors for chronic diseases among adolescents from Southern Brazil. *Preventive Medicine, 54*(6), 393-396. doi: 10.1016/j.ypmed.2012.03.014.

Goyal, M. K., Simpson, J. N., Boyle, M. D., Badolato, G. M., Delaney, M., McCarter, R., & Cora-Bramble, D. (2020). Racial and/or ethnic and socioeconomic disparities of SARS-CoV-2 infection among children. *Pediatrics, 146*(4), e2020009951. doi: 10.1542/peds.2020-009951.

Hall, P. A., Meng, G., Sakib, M. N., Quah, A. C. K., Agar, T., & Fong, G. T. (2023). Do the vaccinated perform less distancing, mask wearing and hand hygiene? A test of the risk compensation hypothesis in a representative sample during the COVID-19 pandemic. *Vaccine, 41*(27), 4027-4030. doi: 10.1016/j.vaccine.2022.10.028.

Han, J., & Choi, H.-S. (2021). The relationship between individuals' collectivistic orientation and social distancing during the COVID-19 crisis in Korea: The mediating role of subjective norm. *Korean Journal of Culture and Social Issues, 27*(3), 217-236. doi: 10.20406/kjcs.2021.8.27.3.217.

Ho, L. L. K., Li, W. H. C., Cheung, A. T., Xia, W., Wang, M. P., Cheung, D. Y. T., & Lam, T. H. (2020). Impact of COVID-19 on the Hong Kong youth quitline service and quitting behaviors of its users. *International Journal of Environmental Research and Public Health, 17*(22), 8397. doi: 10.3390/ijerph17228397.

Huh, S.-I., & Lee, H.-J. (2016). Unmet health care needs and attitudes towards health care system in Korea. *The Korean Journal of Health Economics and Policy, 22*(1), 59-89.

Imai, N., Gaythorpe, K. A. M., Abbott, S., Bhatia, S., van Elsland, S., Prem, K., . . . Ferguson, N. M. (2020). Adoption and impact of non-pharmaceutical interventions for COVID-19. *Wellcome Open Research*,

5, 59. doi: 10.12688/wellcomeopenres.15808.1.

Ishikawa, Y., Kondo, N., Kawachi, I., & Viswanath, K. (2016). Are socioeconomic disparities in health behavior mediated by differential media use? Test of the communication inequality theory. *Patient Education and Counseling, 99*(11), 1803-1807. doi: 10.1016/j.pec.2016.05.018.

Jeong, J. S., Choi, J. K., Jeong, I. S., Paek, K. R., In, H.-K., & Park, K. D. (2007). A nationwide survey on the hand washing behavior and awareness. *Journal of Preventive Medicine and Public Health, 40*(3), 197-204. doi: 10.3961/jpmph.2007.40.3.197.

Jo, E., & Jung, M. (2020). Effects of media used and e-health literacy on hand-washing of married women in East Asia. *Korean Journal of Health Education and Promotion, 37*(1), 15-24. doi: 10.14367/kjhep.2020.37.1.15.

Jung, Y. H., Park, Y. S., Park, E.-C., & Jang, S.-I. (2022). Association between years with incidence of communicable diseases focused on COVID-19 and hand hygiene among adults in South Korea: A cross-sectional study. *BMC Public Health, 22*, 1526. doi: 10.1186/s12889-022-13951-x.

Kang, E. J. (2007). Clustering of lifestyle behaviors of Korean adults using smoking, drinking, and physical activity. *Health and Social Welfare Review, 27*(2), 44-66. doi: 10.15709/hswr.2007.27.2.44.

Kang, K., Sung, J., & Kim, C. (2010). High risk groups in health behavior defined by clustering of smoking, alcohol, and exercise habits: National Heath and Nutrition Examination Survey. *Journal of Preventive Medicine and Public Health, 43*(1), 73-83. doi: 10.3961/jpmph.2010.43.1.73.

Kim, H.-S., Lee, J.-H., Jeon, H.-I., Lee, M.-S., & Hong, J.-Y. (2016). Utilizing health promotion indices of the 3rd national health plan in the 6th community health plans in South Korea. *Korean Journal of Health Education and Promotion, 33*(5), 83-91. doi: 10.14367/kjhep.2016.33.5.83.

Kim, J. (2020). Implications of the COVID-19 pandemic on health equity and healthy cities. *Korean Journal of Health Education and Promotion, 37*(4), 81-89. doi: 10.14367/kjhep.2020.37.4.81.

Kim, Y., Yoon, T., & Sohn, A. (2021). Effects of COVID-19 knowledge, risk perception, subjective norms, and perceived behavioral control on preventive action intentions and preventive action practices in college students. *Korean Journal of Health Education and Promotion, 38*(1), 25-36. doi: 10.14367/kjhep.2021.38.1.25.

Kim, Y.-B. (2020). Infectious disease prevention and personal hygiene education: Focusing on the handwashing education. *Korean Journal of Health Education and Promotion, 37*(4), 59-69. doi: 10.14367/kjhep.2020.37.4.59.

Knell, G., Robertson, M. C., Dooley, E. E., Burford, K., & Mendez, K. S. (2020). Health behavior changes during COVID-19 pandemic and subsequent "Stay-at-Home" orders. *International Journal of Environmental Research and Public Health, 17*(17), 6268. doi: 10.3390/ijerph17176268.

Lee, J.-M., Kim, W.-J., Sohn, H.-S., Chun, J.-H., Lee, M.-J., & Park, H.-S. (2012). Influences on health behaviors execution and self rated health as socioeconomic class by the age bracket. *Journal of the Korea Contents Association, 12*(6), 317-327. doi: 10.5392/JKCA.2012.12.06.317.

Lesser, I. A., & Nienhuis, C. P. (2020). The impact of COVID-19 on physical activity behavior and well-being of Canadians. *International Journal of Environmental Research and Public Health*, *17*(11), 3899. doi: 10.3390/ijerph17113899.

Lin, L., Jung, M., McCloud, R. F., & Viswanath, K. (2014). Media use and communication inequalities in a public health emergency: A case study of 2009-2010 pandemic influenza A virus subtype H1N1. *Public Health Reports, 129*(6_suppl4), 49-60. doi: 10.1177/00333549141296S408.

Loftus, M. J., Guitart, C., Tartari, E., Stewardson, A. J., Amer, F., Bellissimo-Rodrigues, F., . . . Pittet, D. (2019). Hand hygiene in low- and middle-income countries. *International Journal of Infectious Diseases, 86*, 25-30. doi: 10.1016/j.ijid.2019.06.002.

Mawditt, C., Sacker, A., Britton, A., Kelly, Y., & Cable, N. (2016). The clustering of health-related behaviours in a British population sample: Testing for cohort differences. *Preventive Medicine*, *88*, 95-107. doi: 10.1016/j.ypmed.2016.03.003.

McGrail, D. J., Dai, J., McAndrews, K. M., & Kalluri, R. (2020). Enacting national social distancing policies corresponds with dramatic reduction in COVID19 infection rates. *PLoS ONE*, *15*(7), e0236619. doi: 10.1371/journal.pone.0236619.

Mechanic, D., & Cleary, P. D. (1980). Factors associated with the maintenance of positive health behavior. *Preventive Medicine*, *9*(6), 805-814. doi: 10.1016/0091-7435(80)90023-7.

Michaelsen, M. M., & Esch, T. (2023). Understanding health behavior change by motivation and reward mechanisms: A review of the literature. *Frontiers in Behavioral Neuroscience, 17*, 1151918. doi: 10.3389/fnbeh.2023.1151918.

Murphy, J. J., MacDonncha, C., Murphy, M. H., Murphy, N., Timperio, A., Leech, R. M., & Woods, C. B. (2019).

Identification of health-related behavioural clusters and their association with demographic characteristics in Irish university students. *BMC Public Health 19*, 121. doi: 10.1186/s12889-019-6453-6.

Musavian, A. S., Pasha, A., Rahebi, S.-M., Atrkar Roushan, Z., & Ghanbari, A. (2014). Health promoting behaviors among adolescents: A cross-sectional study. *Nursing and Midwifery Studies, 3*(1), e14560.

Nandi, A., Glymour, M. M., & Subramanian, S. V. (2014). Association among socioeconomic status, health behaviors, and all-cause mortality in the United States. *Epidemiology, 25*(2), 170-177. doi: 10.1097/EDE.0000000000000038.

Pampel, F. C., Krueger, P. M., & Denney, J. T. (2010). Socioeconomic disparities in health behaviors. *Annual Review of Sociology, 36*, 349-370. doi: 10.1146/annurev.soc.012809.102529.

Park, B. G., & Jeon, S. Y. (2006). Centering effect of the transactional leadership between the social worker empowerment and social work self-efficacy in social work practice. *Korean Journal of Social Welfare, 58*(4), 341-369.

Park, D.-K., Lee, M.-S., Na, B. J., Bae, S.-H., Kim, K.-Y., Kim, C.-W., & Kim, E.-Y. (2008). Knowledge, attitude and practice of handwashing in high school students. *Journal of the Korean Society of Maternal and Child Health, 12*(1), 74-91. doi: 10.21896/jksmch.2008.12.1.74.

Park, E. J., & Cha, M. R. (2016). Korean women's health behaviors indicators: Smoking, drinking and physical activity. *Health and Welfare Forum, 235*, 25-33. doi: 10.23062/2016.05.4.

Park, E.-J., Jun, J., & Kim, N.-S. (2015). The association of multiple risky health behaviors with self-reported poor health, stress, and depressive symptom. *Health and Social Welfare Review, 35*(1), 136-157. doi: 10.15709/hswr.2015.35.1.136.

Patton, G. C., Olsson, C. A., Skirbekk, V., Saffery, R., Wlodek, M. E., Azzopardi, P. S., . . . Sawyer, S. M. (2018). Adolescence and the next generation. *Nature, 554*(7693), 458-466. doi: 10.1038/nature25759.

Peltzer, K., & Pengpid, S. (2014). Oral and hand hygiene behaviour and risk factors among in-school adolescents in four Southeast Asian countries. *International Journal of Environmental Research and Public Health, 11*(3), 2780-2792. doi: 10.3390/ijerph110302780.

Pickering, A. J., Boehm, A. B., Mwanjali, M., & Davis, J. (2010). Efficacy of waterless hand hygiene compared with handwashing with soap: A field study in Dar es Salaam, Tanzania. *The American Journal of Tropical Medicine and Hygiene, 82*(2), 270-278. doi: 10.4269/ajtmh.2010.09-0220.

Poortinga, W. (2007). The prevalence and clustering of four major lifestyle risk factors in an English adult population. *Preventive Medicine, 44*(2), 124-128. doi: 10.1016/j.ypmed.2006.10.006.

Prochaska, J. J., Spring, B., & Nigg, C. R. (2008). Multiple health behavior change research: an introduction and overview. *Preventive Medicine, 46*(3), 181-188. doi: 10.1016/j.ypmed.2008.02.001.

Prochaska, J. O. (2008). Multiple health behavior research represents the future of preventive medicine. *Preventive Medicine, 46*(3), 281-285. doi: 10.1016/j.ypmed.2008.01.015.

Pronk, N. P., Anderson, L. H., Crain, A. L., Martinson, B. C., O'Connor, P. J., Sherwood, N. E., & Whitebird, R. R. (2004). Meeting recommendations for multiple healthy lifestyle factors: Prevalence, clustering, and predictors among adolescent, adult, and senior health plan members. *American Journal of Preventive Medicine, 27*(2 Suppl.), 25-33. doi: 10.1016/j.amepre.2004.04.022.

Qorbani, M., Kelishadi, R., Djalalinia, S., Motlagh, M. E., Kasaeian, A., Ardalan, G., . . . Mahdavi, S. B. (2016). Regional disparity in hygienic behaviors of Iranian children and adolescents: The CASPIAN-IV study. *Medical Journal of the Islamic Republic of Iran, 30*, 431.

Rabbi, S. E., & Dey, N. C. (2013). Exploring the gap between hand washing knowledge and practices in Bangladesh: A cross-sectional comparative study. *BMC Public Health, 13,* 89. doi: 10.1186/1471-2458-13-89.

Rabel, M., Laxy, M., Thorand, B., Peters, A., Schwettmann, L., & Mess, F. (2019). Clustering of health-related behavior patterns and demographics. Results from the population-based KORA S4/F4 cohort study. *Frontiers in Public Health, 6*, 387. doi: 10.3389/fpubh.2018.00387.

Shin, S.-H. (2019). Relationships between health promoting lifestyle, health belief about emerging infectious disease and hygiene behavior of college students. *Journal of the Korea Convergence Society, 10*(4), 285-293. doi: 10.15207/JKCS.2019.10.4.285.

Stedman-Smith, M., Kingsbury, D. M., Dubois, C. L. Z., & Grey, S. F. (2017). Influenza vaccine uptake, hand hygiene practices, and perceived barriers in decision making: A mixed methods approach. *Workplace Health & Safety, 65*(1), 21-32. doi: 10.1177/2165079916657107.

Suen, L. K. P., So, Z. Y. Y., Yeung, S. K. W., Lo, K. Y. K., & Lam, S. C. (2019). Epidemiological investigation on hand hygiene knowledge and behaviour: A cross-sectional study on gender disparity. *BMC Public Health, 19*, 401. doi: 10.1186/s12889-019-6705-5.

Takayama, M., Wetmore, C. M., & Mokdad, A. H. (2012).

Characteristics associated with the uptake of influenza vaccination among adults in the United States. *Preventive Medicine, 54*(5), 358-362. doi: 10.1016/j.ypmed.2012.03.008.

Tambekar, D. H., & Shirsat, S. D. (2009). Hand washing: A cornerstone to prevent the transmission of diarrhoeal infection. *Asian Journal of Medical Sciences*, *1*(3), 100-103.

Van Bavel, J. J., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., . . . Willer, R. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nature Human Behaviour*, *4*(5), 460-471. doi: 10.1038/s41562-020-0884-z.

Whitby, M., Pessoa-Silva, C. L., McLaws, M.-L., Allegranzi, B., Sax, H., Larson, E., . . . Pittet, D. (2007). Behavioural considerations for hand hygiene practices: The basic building blocks. *The Journal of Hospital Infection*, *65*(1), 1-8. doi: 10.1016/j.jhin.2006.09.026.

World Health Organization. (2009). *WHO guidelines on hand hygiene in health care*. Geneva, Switzerland: Author.

World Health Organization. (2024a). *WHO Coronavirus (COVID-19) dashbord.* Accessed 2024, May 17, Retrieved from https://www.who.int/publications/m/item/covid-19-epidemiological-update-edition-167

World Health Organization. (2024b). *WHO Coronavirus (COVID-19) dashbord.* Accessed 2024, January 19, Retrieved from https://www.who.int/publications/m/item/covid-19-epidemiological-update---19-january-2024

Wollast, R., Schmitz, M., Bigot, A., Brisbois, M., & Luminet, O. (2024). Predicting health behaviors during the COVID-19 pandemic: A longitudinal study. *PLoS ONE, 19*(3), e0299868. doi: 10.1371/journal.pone.0299868.

Wong, J. S. W., & Lee, J. K. F. (2019). The common missed handwashing instances and areas after 15 years of hand-hygiene education. *Journal of Environmental and Public Health, 2019*(1), 5928924. doi: 10.1155/2019/5928924.

Woo, S., Sohn, M., Kim, G., & Choi, M. (2020). Differences in unmet healthcare needs by employment status and gender. *Health and Social Welfare Review, 40*(1), 592-616. doi: 10.15709/hswr.2020.40.1.592.

Zajacova, A., Jehn, A., Stackhouse, M., Denice, P., & Ramos, H. (2020). Changes in health behaviours during early COVID-19 and socio-demographic disparities: A cross-sectional analysis. *Canadian Journal of Public Health*, *111*(6), 953-962. doi: 10.17269/s41997-020-00434-y.

■ Rang-Hee Kwon http://orcid.org/0000-0001-8347-5260
■ Minsoo Jung http://orcid.org/0000-0003-3317-6507