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Social and Policy Determinants of COVID-19 Infection Across 23 Countries: An Ecological Study

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Objectives: This study aimed to identify the social and policy determinants of coronavirus disease 2019 (COVID-19) infection across 23 countries.

Methods: COVID-19 indicators (incidence, mortality, and fatality) for each country were calculated by direct and indirect standardization. Multivariable regression analyses were used to identify the social and policy determinants of COVID-19 infection.

Results: A higher number of doctors per population was related to lower incidence, mortality, and fatality rates of COVID-19 in 23 countries (β=-0.672, -0.445, and -0.564, respectively). The number of nurses/midwives per population was associated with lower mortality and fatality rates of COVID-19 in 23 countries (β=-0.215 and -0.372, respectively). Strengthening of policy restriction indicators, such as restrictions of public gatherings, was related to lower COVID-19 incidence (β=-0.423). A national Bacillus Calmette–Guérin vaccination policy conducted among special groups or in the past was associated with a higher incidence of COVID-19 in 23 countries (β=0.341). The proportion of the elderly population (aged over 70 years) was related to higher mortality and fatality rates (β=0.209 and 0.350, respectively), and income support was associated with mortality and fatality rates (β=-0.362 and -0.449, respectively).

Conclusions: These findings do not imply causality because this was a country-based correlation study. However, COVID-19 transmission can be influenced by social and policy determinants such as integrated health systems and policy responses to COVID-19. Various social and policy determinants should be considered when planning responses to COVID-19.

Key words: COVID-19, Social determinants of health, Health policy

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INTRODUCTION

The first outbreak of coronavirus disease 2019 (COVID-19) occurred in Wuhan, China, in December 2019. The official name of the causative virus was announced as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the World Health Organization (WHO), which later declared the situation a "global pandemic." As of December 19, 2021, the total numbers of confirmed cases and deaths worldwide were 274 213 886 and 5 349 699, respectively.

Many countries have reported daily numbers of confirmed cases and death. However, comparing the incidence or number of deaths without considering the different demographic structures in each country could lead to misinterpretation. Considering trends in COVID-19 infections from the first wave of the outbreak to now, there have been increases in secondary and tertiary infections. In addition, only a few studies have considered the population distribution and social and policy responses to COVID-19 infections in various countries. Therefore, this study aimed to assess the relationship between various social and policy determinants and COVID-19 infection indicators.

We assumed that the COVID-19 infection patterns would differ according to each country's social factors, governmental policies related to the health system and medical care, and governmental policy response against COVID-19. Thus, we examined the relationship between COVID-19 infection indicators and countries' social and policy determinants. This is a country-based ecological study; the findings are simple correlations and do not imply a factor-outcome causal association.

METHODS

Study Population

Member and non-member countries of the Organization for Economic Cooperation and Development (OECD) were selected separately. The inclusion criteria were: (1) countries where the numbers of COVID-19 cases and deaths were reported for specific 10-year age groups and (2) countries wherein the incidence and deaths were reported on a regular basis. Among the 37 countries of the OECD, 9 countries (United Kingdom, Ireland, Turkey, Hungary, Greece, Slovakia, Latvia, Slovenia, and Lithuania) that did not meet the inclusion criteria were excluded. Belgium was also excluded because of the use of different age categories, and 9 countries that only confirmed incidence (Israel, Iceland, Estonia, and New Zealand) or deaths (Poland, Spain, France, Colombia, and Luxembourg) were excluded.

Several non-OECD countries were excluded due to the low total number of confirmed cases (<100) or deaths (<50) as of September 1, 2020. The number of incident cases and deaths from COVID-19 by 10-year age intervals was obtained from each country's official COVID-19 websites (Supplemental Material 1). After September 2020, new COVID-19 cases and deaths by age group in 8 countries had not been disclosed on their official websites in some countries. Therefore, standardization for 23 countries was carried out only with the results until September 2020. Additionally, 5 non-member countries of the OECD (Cuba, Nepal, Bangladesh, the Philippines, and Romania) were included. Therefore, 23 countries were included in the study (18 OECD and 5 non-OECD countries).

In 19 countries, the 10-year specific age groups (0-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, and ≥80 years) included. In contrast, in Nepal, Austria, the Czech Republic, and the United States, the youngest group comprised patients who were 0-14 years, and the 10-year specific age groups (0-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, 76-84, and ≥85 years) included. The fatality rate for each country was defined as the number of deaths per incident COVID-19 case.

Data Collection

As surrogate social determinants for each country, the following variables were selected: the Human Development Index (HDI, 2018); gross national income (US$ per capita, 2018); infant mortality rate (per 1000 live births, 2010-2015); the elderly population (the proportion [%] of individuals aged ≥70 years); health-adjusted life expectancy (HALE; years, 2016); the age-standardized prevalence rates of hypertension (%, at age ≥18 years, 2015), obesity (%, at age ≥18 years, 2016), and tobacco smoking (%, at age ≥15 years, 2018); alcohol consumption (pure alcohol liters/capita, at age ≥15 years, 2018); and the probability of dying from 4 major non-communicable diseases (NCDs; cancer, cardiovascular diseases, diabetes mellitus, and chronic respiratory diseases, 2016). As surrogate governmental policy determinants in the health system and medical care, the following variables were selected: the number of medical doctors (per 10 000 persons, 2010-2018) and the number of nurses/midwives (per 10 000 persons), domestic general government health expenditure (GGHE, 2017), universal health care service coverage index (UHCI, 2017), and Bacillus Calmette–Guérin (BCG) vaccination policy (2020) [1-4]. As surrogate governmental policy determinants, the following variables related to national measures or the governmental response against COVID-19: school closures, workplace closures, cancellation of public events; restrictions on public gatherings, closures of public transport, stay-at-home requirements, public information campaigns, restrictions on internal movements, international travel controls, COVID-19 testing policy, the extent of contact tracing, and 2 composite indices (the government response stringency index and the containment and health index). The type, status, and application date of social and policy factors in each country are presented in Supplemental Materials 2-4 [1-5].

Statistical Analysis

The country-based standard population (CSP; per 100 000 persons) was used for direct standardization; the CSP was defined as the sum of the age-specific population numbers in the 23 study countries. The number of people by age in each country was obtained from the 2019 World Population Prospects [2]. The directly standardized rates and indirectly standardized ratios were calculated using equations (1) and (2) [6,7].

Directly standardized rate (DSR):

$$\mathrm{DSR} = \frac{\sum_i (r_i * N_i)}{\sum_i N_i} \quad (1)$$

Indirectly standardized ratio (ISR):

$$\mathrm{ISR} = \frac{\sum_i (R_i * n_i)}{\sum_i e_i} \quad (2)$$

where i is the i-th age-specific group, R_i is the i-th age-specific rate in the CSP, r_i, is the i-th age-specific rate in each country, e_i, is the number of i-th age-specific events in each country, n_i is the number of the i-th age-specific population in each country, and N_i is the number of the i-th age-specific population in the standard population.

Using direct or indirect age-standardized methods, the incidence, mortality, and fatality rates of COVID-19 in each country were calculated based on the CSP, such as the CSP-based age-standardized incidence rate (ASIR), standardized incidence ratio, the age-standardized mortality rate (ASMR), standardized mortality ratio, age-standardized fatality rate (ASFR) and standardized fatality ratio. Based on indirectly standardized ratios of <50, 50-59, or ≥100, the incidence, death, and fatality by country were classified as low, moderate, or high levels, respectively.

To identify the relationships of health indicators and policy responses to COVID-19 indicators in each country, Spearman correlation analyses, the Mann-Whitney test for 2 groups, and the Kruskal-Wallis test for ≥3 groups were conducted. Variables with a *p*-value <0.1 in the univariate analyses were selected. Since the 4 health indicators (HALE, life expectancy, elderly [%], HDI) were correlated with each other, only the proportion of the elderly (aged ≥70 years) was selected and included in the multivariable model. Workplace closure was correlated with the cancellation of public events, school closure, and stay-at-home restrictions. School closure was correlated with stay-at-home restrictions and restrictions on public gatherings. Restrictions on public gatherings were correlated with restrictions on internal movement and public transport restrictions. Therefore, 1 of the 5 above-mentioned variables for each outcome in the model was chosen, and only the variable with the largest β-value was included in the multivariate analysis for each model. Multiple regression models were constructed to select the relevant factors according to the incidence, mortality, and fatality patterns of each country. After constructing a multivariate model according to each outcome variable, non-significant explanatory variables were sequentially eliminated, starting with the variable with the highest *p*-value. When each explanatory variable reached a *p*-value <0.2, the elimination was stopped and the explanatory variables at that time were considered the relevant factors for the final model. The selected variables were as follows, according to each outcome variable (equations 3-5). Furthermore, lag periods such as 3-5 months, pre-3 months (as of June 1 or until June 1, 2020), or pre-5 months (as of April 1, 2020), were used to observe whether the prior response method or policy response was related to the COVID-19 epidemic indices as of September 1, 2020. All statistical analyses were performed using SAS version 9.4 (SAS Institute Inc.. Cary, NC, USA).

Multiple regression models for ASIR in each country (3)

$Y[ASIR_{csp}]=\alpha+\beta_1$ [Number of medical doctors]+ β_2 [Obesity prevalence]+β_3 [Tobacco smoking prevalence]+ β_4 [BCG vaccination policy]+β_5 [Public gathering restriction]

Multiple regression models for ASMR in each country (4)

$Y[ASMR_{csp}]=\alpha+\beta_1$ [Number of medical doctors]+ β_2 [Obesity prevalence]+β_3 [COVID-19 incidence]+ β_4 [Elderly aged ≥70 years]+ β_5 [Number of nurses/midwives]+β_6 [Income support]+ β_7 [Death by major NCD]

Multiple regression models for ASFR in each country (5)

$Y[ASFR_{csp}]=\alpha+\beta_1$ [Number of medical doctors]+ β_2 [Number of nurses/midwives]+β_3 [Obesity prevalence]+ β_4 [Income support]+β_5 [Elderly aged ≥70 years]

Ethics Statement

This research used public data from the websites and it does not require institutional review board approval.

RESULTS

From January 1 to September 1, 2020, 8 829 576 COVID-19 cases and 346 989 deaths were reported in the 23 countries. A comparison of age-standardized rates and ratios using the standardized method showed that there were differences among the 23 countries (Table 1). The incidence rate was highest in Chile (ASIR, 2226.1/100 000 persons), whereas the lowest incidence rate was observed in Cuba (ASIR, 34.3/100 000 persons). The lowest and highest mortality rates were observed

Table 1. The coronavirus disease 2019 indicators of incidence, mortality, and fatality across 23 countries

Incidences[1]	Incidence (/100 000)[2]	Mortality (/1 000 000)[2]	Fatality[2]	Incidence[3]	Mortality[3]	Fatality[3]
Low levels of incidence						
Low mortality and fatality						
Korea	37.3	3.2	1.39	5.8	2.1	31.7
Japan	61.5	2.8	1.66	7.6	2.0	45.4
Australia	99.4	10.4	1.60	15.2	8.0	49.4
Low mortality; but moderate fatality						
Cuba	34.3	4.3	2.35	5.0	2.6	58.2
Norway	199.2	21.2	2.14	30.5	15.0	55.6
Bangladesh	186.7	33.0	2.14	28.8	19.7	61.1
Czech Republic	228.2	26.5	2.51	31.7	15.9	62.3
Philippines	217.8	46.0	2.53	33.7	28.2	68.9
Denmark	283.6	40.8	2.50	43.3	29.9	70.0
Germany	290.0	35.5	2.23	42.2	26.2	63.7
Austria	325.0	48.8	2.85	46.0	30.8	74.3
Finland	147.1	20.3	3.28	21.4	15.1	91.9
Low mortality; but high fatality						
Nepal	111.5	15.9	5.35	20.2	10.8	137.5
Moderate mortality and fatality						
Canada	253.4	87.5	3.08	43.0	66.1	94.2
Moderate levels of incidence						
Low mortality and fatality						
Portugal	550.6	55.8	1.68	81.5	42.1	48.8
Moderate mortality and fatality						
Switzerland	425.3	70.4	2.14	68.6	53.8	64.2
Romania	418.5	97.0	2.85	69.8	53.4	71.6
Moderate mortality, but high fatality						
Netherlands	344.7	133.1	3.47	60.0	97.7	100.7
High mortality and fatality						
Italy	286.7	176.9	4.45	59.9	128.5	116.1
Mexico	437.4	512.3	10.55	68.1	298.3	280.6
High levels of incidence						
High mortality, but moderate fatality						
USA	1626.6	399.3	3.48	244.5	231.7	87.8
Chile	2226.1	401.8	3.21	345.6	240.8	78.4
High mortality, and fatality						
Sweden	746.2	202.7	3.39	123.4	153.8	100.5

Values are presented as country-based standard population (the sum of the number of the age-specific population in each country was used).
[1]The incidence, death, and fatality by country were classified as low, moderate, or high levels based on indirectly standardized ratios of <50, 50-99, and ≥100 and fatality was classified as low, moderate, or high levels based on indirectly standardized ratios of <5, 5-9.9, and ≥10.
[2]Incidence, mortality, and fatality indicators were estimated based on direct standardization.
[3]Incidence, mortality, and fatality indicators were estimated based on indirect standardization (observed cases *100 / expected cases).

in Japan and Mexico (CSP-based ASMR, 2.8, and 512.3/1 000 000 persons, respectively). The lowest and highest fatality rates were observed in Korea and Mexico, respectively (CSP-based ASFR, 1.39 and 10.55, respectively). In 3 countries (Korea, Japan, and Australia), the three COVID-19 indicators were low for mortality and fatality (<50 of each expected value by indirect standardization). Eleven countries (Cuba, Bangladesh, the Philippines, Denmark, Germany, Austria, Finland, Norway, the Czech Republic, Nepal, and Canada) had low incidence rates (<50 of each expected value by indirect standardization); however, Nepal had a high fatality rate (>100 of each expected value by indirect standardization), and the other countries had a moderate fatality rate (51-99 of the expected value by indirect standardization). Six countries (Portugal, Switzerland, Romania, the Netherlands, Italy, and Mexico) had moderate incidence, but varying mortality and fatality rates. The other 3 countries (United Staates, Mexico, and Sweden) with high incidence rates and mortality levels also had different fatality rates (United States and Chile: moderate fatality; Sweden: high fatality).

In the multivariate regression model, at the national level, the incidence of COVID-19 was found to be positively related to the prevalence of obesity and smoking (for incidence, β=0.849, p<0.001; β=0.682, p<0.001, respectively), whereas the incidence of COVID-19 was negatively related to the number of medical doctors in the population and public gathering restrictions (β=-0.672, p=0.001; β=-0.423, p=0.016, respectively). Of particular note, a BCG vaccination policy aimed at special groups or conducted in the general population in the past was positively related to COVID-19 incidence (β=0.341, p=0.042) (Table 2).

The mortality rates across 23 countries were positively correlated with the prevalence of obesity, elderly aged over 70 years, and COVID-19 incidence (β=0.470, p=0.006; β=0.209, p=0.124; β=0.655, p<0.001), whereas they were negatively correlated with the number of medical doctors, number of nurses and midwives, income support and NCD deaths (β=-0.445, p=0.008; β=-0.215, p=0.139; β=-0.362, p=0.014; β=-0.207, p=0.147)

Table 2. Social and health determinants of COVID-19 incidence rates[1] across 23 countries

Social and health determinants[2]	β	*t*-value	*p*-value	Model summary
Medical doctors (/10 000)	-0.672	-4.115	0.001	
Obesity prevalence (%)	0.849	6.124	<0.001	MLR
Tobacco smoking (%)	0.682	5.702	<0.001	$F(5,22)=12.267$
BCG vaccination policy[3]	0.341	2.204	0.042	Adjusted $R^2=0.719$
Public gathering restriction[4]	-0.423	-2.676	0.016	

COVID-19, coronavirus disease 2019; MLR, multivariable linear regression model; BCG, Bacillus Calmette–Guérin.
[1]Incidence rates per 100 000 persons (standardization using the country-based standard population).
[2]MLR model: Y[Incidence]=a+b1[Doctors]+b2[Obesity]+b3[Tobacco]+b4[BCG]+b5[Public gathering restriction].
[3]Grouped and coded from 'current national BCG vaccination policy for all' to 'current BCG vaccination for special groups or past national BCG vaccination policy for all'.
[4]Coded from 'none' to 'stay-at-home restriction' 'to required'.

Table 3. Social and health determinants of COVID-19 mortality rates[1] across 23 countries

Social and health determinants[2]	β	*t*-value	*p*-value	Model summary
Medical doctors (/10 000)	-0.445	-3.079	0.008	
Nurse/midwifery personnel (/10 000)	-0.215	-1.563	0.139	MLR
Obesity prevalence (%)	0.470	3.186	0.006	$F(7,22)=12.116$
Elderly (%)[3]	0.209	1.628	0.124	Adjusted $R^2=0.780$
COVID-19 incidence	0.655	5.276	<0.001	
Income support[4]	-0.362	-2.273	0.014	
Death by major NCDs (%)	-0.207	-1.530	0.147	

COVID-19, coronavirus disease 2019; MLR, multivariable linear regression model; NCDs, non-communicable diseases.
[1]Mortality rates per 1 000 000 persons (standardization using the country-based standard population).
[2]MLR model: Y[Mortality]=a+b1[Doctors]+b2[Obesity]+b3[COVID19 incidence]+b4[Elderly]+b5[Nurses/midwives]+b6[Income support] +b7[Death by major NCDs].
[3]People aged ≥70 years.
[4]Coded from 'none' to 'cover the lost salary'.

Table 4. Social and health determinants of COVID-19 fatality rates[1] across 23 countries

Social and health determinants[2]	β	*t*-value	*p*-value	Model summary
Medical doctors (/10 000)	-0.564	-2.489	0.023	
Nurse/midwifery personnel (/10 000)	-0.372	-1.732	0.101	MLR
Obesity prevalence (%)	0.781	3.358	0.004	F(5,22)=3.320
Income support[3]	-0.449	-1.803	0.089	Adjusted R^2=0.345
Elderly (%)[4]	0.350	1.487	0.155	

COVID-19, coronavirus disease 2019; MLR, multivariable linear regression model.
[1]Fatality rates per 1000 persons (standardization using country-based standard population).
[2]MLR model: Y[Fatality]=a+b1[Doctors]+b2[Nurses/midwives]+b3[Obesity]+b4[Income support]+b5[Elderly].
[3]Coded from 'none' to 'cover the lost salary'.
[4]People aged ≥70 years.

(Table 3). The fatality rates across 23 countries were positively correlated with the prevalence of obesity and elderly aged over 70 years (β=0.781, *p*=0.004; β=0.350, *p*=0.155), whereas they were negatively correlated with the number of medical doctors, number of nurses and midwives, and income support (β=-0.564, *p*=0.023; β=-0.372, *p*=0.101; β=-0.449, *p*=0.089) (Table 4).

DISCUSSION

We identified several social and policy determinants that could affect the incidence, mortality, and fatality rates of COVID-19 across 23 countries. It was confirmed that individual factors of each population and their health or policy responses influenced the COVID-19 indicators. In particular, the number of doctors and nurses is a fundamental factor to consider in the medical health system, and income support could be effective to control COVID-19 mortality and fatality as a policy response. Along with them, the BCG vaccination policy could be considered an efficient factor in the context of the COVID-19 outbreak.

In our study, strengthened governmental restriction policies (public gathering restrictions) were related to lower COVID-19 incidence. Each country implemented various quarantine measures to control the human-to-human transmission of COVID-19. However, not all policy control measures could be included in a multivariable model simultaneously due to overfitting [9]. Previous studies reported that the number of infected cases decreased as social distancing was strengthened by various government measures, the probability of staying at home increased by 5.8 times in countries with stronger enforcement measures, and movement in public places decreased by -18.2 units [8,9]. In a systematic review of influenza transmission, it was reported that overall travel restrictions had a limited effect on controlling influenza epidemics, especially when the R naught (R_0) was above 1.9 [10]. However, since the COVID-19 pandemic had a higher R_0 value over a longer period than the influenza epidemic, the effect of social distancing might be more powerful in the prevention of silent transmission [11,12]. These policy measures aim to limit the increase in new COVID-19 cases by minimizing social contact through blocking the social movement of people, and this policy can be seen as an important priority policy to prevent the spread of COVID-19.

Obesity, smoking, and BCG vaccination policy were positively correlated with COVID-19 incidence. Those factors could be understood as reflecting a type of individual-susceptible immunity. Generally, BCG vaccination policies aim to achieve a protective effect against tuberculosis at birth or during childhood [13], and it has been reported that BCG vaccination has a protective effect on all-cause mortality, yellow fever, and influenza [14]. It has been proposed that BCG vaccination has a protective effect against COVID-19 because BCG contains a 9-amino-acid sequence similar to that of SARS-CoV-2 [15]. In our study, BCG vaccination policies for special groups or the general population in the past were correlated with COVID-19 incidence. Both smoking and alcohol consumption behavior should be understood in the cultural context of each country. As a hypothesis, people who smoke in private smoking rooms with several smokers simultaneously could have a higher risk of COVID-19 infection [16]. Similar to smoking, alcohol is also consumed in a multi-use space; thus, both individual susceptibility-related factors and cultural behavior should be considered.

In the analysis of mortality and fatality, the number of doctors and nurses, the prevalence of obesity, the proportion of the elderly population, and income support were included as explanatory variables. Most of these variables have been suggested as relevant factors in previous studies [17-21]. The inclusion of income support implies that it is an effective response to mitigate the severity of COVID-19 [19]. In addition, COVID-19 incidence was positively correlated with COVID-19 mortality, but not with fatality. Other factors (smoking and alcohol consumption) known to be related to mortality and fatality were not significant in this study. Therefore, further research is needed for a comprehensive assessment.

In a global pandemic of an infectious disease, various environmental factors should be considered, such as genetic differences between populations and climate-related factors (e.g., humidity, temperature) [22,23]. The number of medical doctors in this study was correlated with the incidence, mortality, and fatality rates of COVID-19. Therefore, it could be suggested that the number of medical doctors may have a direct impact on COVID-19 mortality and fatality. There is also an indirect interpretation whereby a high number of medical doctors indicates a high level of public hygiene in the country. Other hygiene-related factors can reduce the transmission of infectious diseases, such as (1) handwashing, (2) sneezing etiquette and (3) personal cleanliness [23,24]. Therefore, the observed association between COVID-19 incidence and the number of medical doctors should be cautiously interpreted. In addition, some previous studies suggested that the infant mortality rate, GGHE, and UHCI, which are indicators of the national health care system, may be associated with COVID-19 indicators, but significant associations for these variables were not observed in this study [25,26]. These factors may not be sufficient factors to predict the pandemic response [27].

This study had some limitations. First, all countries in the world were not targeted, and some countries with a high prevalence (e.g., Turkey and Brazil) were excluded. The number of confirmed cases and deaths was gathered until September 1, 2020, because cases and deaths of COVID-19 by age group in 8 countries after September 2020 were not disclosed on their official websites. Therefore, the rates may have been underestimated. Second, recent cases of secondary and tertiary infections were excluded. Therefore, further research is needed, as these results may differ after vaccine-induced immunity. Third, the rates were not standardized by sex. However, to obtain fatality rates that are compatible between different countries, sex also needs to be standardized, since male patients with COVID-19 have a higher risk of a severe clinical course. However, sex and age could not be controlled simultaneously because of incomplete data. Fourth, we observed many social indicators related to the healthcare system, health infrastructure, and epidemiological indices. Instead, available lag periods, such as 3-5 months, pre-3 months (as of June 1 or until June 1, 2020), or pre-5 months (as of or until April 1, 2020), were used to observe whether the prior response method or policy response was related to the COVID-19 epidemic indices as of September 1, 2020. Fifth, possible factors related to COVID-19 infection indicators were not considered in this study, such as underlying diseases (diabetes, renal failure, cancer, and cardiovascular disease). Lastly, a careful interpretation is needed regarding the significance of the explanatory variables that were included in the multiple regression model.

This study is an ecological study and it does not imply direct causal relationships; instead, it suggests certain hypotheses. Nevertheless, these findings suggest that some social and policy determinants related to social factors, national policies for integrated health systems, and governmental policy responses against COVID-19 may contribute to reducing the incidence and improving the mortality and fatality rates of COVID-19.

SUPPLEMENTAL MATERIALS

Supplemental materials are available at https://doi.org/10.3961/jpmph.21.396.

CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

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AUTHOR CONTRIBUTIONS

Conceptualization: Jeung YD, Choi J, Park SK. Data curation: Jeung YD, Kim K, Park SK. Formal analysis: Jeung YD, Kim K, Park SK. Funding acquisition: Park SK. Methodology: Jeung YD, Kim K, Park SK. Project administration: Jeung YD, Kim K, Park

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