The corona blues according to daily life changes by COVID-19: A partial least squares regression model

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Abstract
This study identifies determinants of the variation in depression resulting from COVID-19, specifies in detail the changes to daily life, and then compares the determinants' magnitude. The determinants were combined into three groups: first, the unpredictability of the disease and side effects by its response measures (specifically, restrictions on the freedom of movement and strain on social relationships); second, (mis)information through social media, public authorities, and mass media; and third, income reductions and other sociodemographic factors. Daily life changes were divided into four categories: travel/mobility, time at home (alone and with family), domestic activities (remote work, online shopping, food deliveries, reading, and online networking), and conflicts (with family and neighbors). We measured the total 29 predictors using data from the 2020 Seoul Survey, which is based on face-to-face interviews with a probability sample of adult residents. We made our estimations using partial least squares regression, which can analyze all original variables regardless of collinearity. The regression model found that major stressors include declines in out-of-home offline networking and the rise of domestic activities—and subsequent conflicts with family—restrictions on mobility (specifically, those of leisure travel), and income reductions. In contrast, changes

Abbreviations: covid, COVID-19; H1N1, H1N1, Hemagglutinin Type 1 and Neuraminidase Type 1; MERS, Middle East Respiratory Syndrome; OLS, ordinary least squares; PLS, partial least squares; PTSD, post-traumatic stress disorder; SARS, severe acute respiratory syndrome; U.S., United States; VIF, variance inflation factor.
1 | INTRODUCTION

The “corona blues” refers to depression caused by disruptions to daily life due to the spread of COVID-19 (hereafter, “covid”), the disease caused by the SARS-CoV-2 (2019-nCoV) coronavirus (Cho, 2020). In their meta-analysis of 12 studies in different countries and published from January through May 2020, Bueno-Notivol et al. (2021) found that depression incidence by covid is 25%, 7 times higher than the normal rate of 3.44% in 2017, which clearly highlights the extent of covid’s impact on mental health. Depression is a normal reaction to separation and uncertainty related to sudden (often negative) changes to routine (Huremović, 2019). Over the past 18 months, studies have explored the determinants of covid-based depression. However, they have tended to group changes into a single subjective perception variable when assessing the daily life changes highly important for urban policy. Accordingly, they were unable to compare the determinants’ relative magnitudes (e.g., Brooks et al., 2020; Bueno-Notivol et al., 2021; Garfin et al., 2020; Huang & Zhao, 2020; Huremović, 2019). A further limitation is that they could not analyze detailed daily life changes together as they are concurrent and collinear (e.g., Ogden, 2020; Rodríguez-Rey et al., 2020; Tull et al., 2020). This study therefore aims to identify various depression determinants in relation to the covid pandemic—particularly, listing daily life changes—followed by comparing the influences of the depression stressors.

In general, studies on the influences of covid on mental health issues, such as depression, are classified into: (1) research on the types and severity of mental health problems, and according to target populations; analyses of (2) the general population; (3) healthcare workers; and (4) vulnerable groups; and (5) studies on therapeutic interventions (Rajkumar, 2020). Among these studies, those on general populations have tended to center on several Western developed societies (Muthukrishna et al., 2020) partly due to data collection issues (Bueno-Notivol et al., 2021; Rajkumar, 2020) as well as on China (Tull et al., 2020) as the focal point of the outbreak and dispersion of the disease. In line with Venkatesh (2020), how covid affects daily lives should not be generalized to other areas. Instead, separate studies are needed in which specific urban and cultural contexts are considered. Our study area is Seoul, the capital of South Korea, where the magnitude of the covid response policy frequently changed according to the number of confirmed cases (officially at five levels, detailed measures were adjusted within each). We use data from a special covid survey conducted by the Seoul Metropolitan Government in September–October 2020. Unlike almost all previous studies, that have relied on nonprobability samples based on convenience sampling (e.g., Bueno-Notivol et al., 2021; Venkatesh, 2020; Wang et al., 2021) or snowball sampling (e.g., Helsingen et al., 2020), the survey collected a highly representative probability sample through stratified sampling.

The study is structured as follows. We will first review the literature to classify reasons for covid-based depression. How specific changes in daily routines occur, as a generalized reason, will be explored by reviewing different literature. Then, the study designs a research model with the reasons...
for depression, daily routine changes, and, for statistical control, the sociodemographic characteristics that lead to variations in the depression. Once done, we will then describe data for measuring the variables and an analytical technique for estimating the model. We will subsequently present our analytical findings, and end with their interpretation and a discussion on their implications.

2 | LITERATURE REVIEW

2.1 | Major reasons for covid-based depression

Reasons for the corona blues may fall into three groups. First, the disease is highly unpredictable (Brooks et al., 2020). This results in uncertain fears of infection. Additionally, governmental regulations for preventing infection suddenly restrict people's freedom of movement, which leads to boredom and anxiety (Huremović, 2019). The regulations also restrict facial contact, which is accompanied by the cutoff of social relationships and reduction of communications. Accordingly, this increases feelings of isolation and loneliness (Brooks et al., 2020). Suh and Kwon (2021) reported that loneliness is the most important factor in explaining the corona blues. These feelings of fear, boredom, anxiety, and loneliness directly cause or aggravate anthropophobia and insomnia (Cho, 2020). Second, the wealth of (mis)information recklessly dispersed through diverse media fosters anxiety (Gao et al., 2020; Ni et al., 2020). The third reason relates to economic damages (Lei et al., 2020). Working from home, unpaid leave, and layoffs—or reduced business operation and temporary/permanent shutdown—negatively affect incomes and revenues. This financial strain incites mental disorders. Along with income, this study considers other sociodemographic characteristics for statistical control, and to see how depression is differentiated by these (e.g., Brooks et al., 2020).

As such, in terms of reasons for disease-related depression, covid is consistent with previous pandemics. As sorted by Huremović (2019), pandemics are typically unpredictable in nature, control and personal freedom are lost, authorities send contradictory messages, and daily lives and future plans are suddenly disrupted. This then causes substantial financial impacts (Bueno-Notivol et al., 2021). Likewise, in an early stage of the current pandemic, Brooks et al. (2020) reviewed the negative impacts of quarantine on such psychological variables as PTSD (post-traumatic stress disorder), confusion, and anger based on previous Ebola, H1N1, MERS, and equine influenza pandemics. They identified, among others, the extended quarantine/lockdown periods, substantial loss of freedoms, fears of infection, inadequate information, and financial loss as psychological stressors.

2.1.1 | Unpredictability of the disease and side effects by its response measures (restrictions on the freedom of movement and strain on social relationships)

Fear of infection is among the most frequently analyzed topics in studies on the psychological effects of the pandemic (see Brooks et al., 2020). That is, social distancing and lockdown/quarantine measures resulted in increased uncertainty anxiety over one's own (and his or her family's) health, potentially causing mental disorders (Lei et al., 2020). According to a study on the H1N1 2009 influenza pandemic (Braunack-Mayer et al., 2013), this fear of uncertainty was found to be higher among parents of infants or those who are pregnant due to the fear of infecting their children.

Furthermore, pandemic response measures change normal routines in such a way as to deprive people of their control and freedom, which can lead to the deterioration of their social relationships. This can cause frustration, boredom, and isolation (Brooks et al., 2020), followed by depression.
According to Hawryluck et al. (2004), who studied the psychological influences of SARS in Toronto, Canada, these senses are worsened once people cannot perform their usual daily activities, such as grocery shopping. In their study on the effects of MERS in South Korea, Jeong et al. (2016) reported that psychological health is detrimentally affected if social and physical interactions are reduced and replaced by phones and the Internet. Among studies directly related to covid, Brooks et al. (2020) argued that depression arises from not participating in social activities.

2.1.2 | (Mis)information through social media, public authorities, and mass media

Regarding statistics on infections and deaths, response guidelines, control policies, and notable cases, information tends to be provided by public health authorities, mass media, and social media. Previous studies (Nguyen et al., 2020; Wang et al., 2021) found that regular government updates of the health information on covid can mitigate depression. Studies that analyzed previous pandemics, such as SARS (Cava et al., 2005) and Ebola (Pellecchia et al., 2015), similarly reported that a lack of public information (e.g., guidelines) can negatively affect psychological health. Focusing directly on covid, Bäuerle et al. (2020) argued that trust in governmental responses positively affects mental health and subjective knowledge on covid—despite increasing levels of fear—can lower such mental health burdens as depression.

However, excessive mass media coverage can be negative. To predict how mass media coverage on covid affects psychological disorders, Garfin et al. (2020) reviewed studies not only on previous pandemics (Ebola and H1N1), but on other collective crises, such as terrorist attacks. They concluded that repeated media coverage unintentionally affects those with a low risk of direct exposure to these events/crises and subsequently causes potentially severe mental health issues, including anxiety and stress. People who frequently consume negative reports by mass media—and social media, discussed below—and spend over 3 hours a day thinking about covid tend to feel a high mental health burden (Huang & Zhao, 2020).

As with mass media, extended exposure to social media has been reported to lead to depression (Gao et al., 2020; Ni et al., 2020). In particular, social media is capable of diffusing the fear of infection both widely and immediately (Bueno-Notivol et al., 2021; Depoux et al., 2020). The fear is amplified as misinformation posted on social media spreads more quickly, and three times more widely, than verified stories (Sommariva et al., 2018).

2.1.3 | Income reductions and other sociodemographic factors

As part of covid control actions, lockdown or quarantine measures impede work and business activities. This causes financial damages (Pellecchia et al., 2015) that threaten psychological health (Lei et al., 2020; Mihashi et al., 2009). Stress/anger and anxiety from financial losses or strain have been reported to continue for months after the easing of measures (Jeong et al., 2016).

Previous studies regarding sociodemographic characteristics that are constant to a pandemic (unlike revenue/income) have reported somewhat mixed results according to the specific study area and pandemic (Brooks et al., 2020). For instance, in a study on equine influenza in Australia, Taylor et al. (2008) reported that negative mental health is associated with younger ages, a lower education level, having children, and being female. However, in analyzing the health effects of SARS in Toronto,
Hawryluck et al. (2004) argued them to be independent of age, education, existence of children/adults in a household, and marriage.

Regarding covid and mental health, empirical findings appear to be consistent, centering on gender, age, job, education, and residential location. As a survey study implemented in China, Wang et al. (2021) reported that covid has stronger negative psychological effects on those who are female, under the age of 40, professional, and highly educated. In early February 2020, an early phase of the pandemic, Lei et al. (2020) conducted a survey of Chinese people and found a significant relationship between education level and depression. Through an online survey in Uttar Pradesh, India, Kazmi et al. (2020) examined variations in covid depression according to life situation characteristics centering on gender, age, and employment. They found significant variations by all the three variables; those who are female, younger, and unemployed suffered more acutely from depression. Moreover, based on an online survey of the general adult population in Spain, Rodríguez-Rey et al. (2020) reported that female and young populations tend to give more negative responses on psychological symptoms. Likewise, in a survey of German adults, Báuerle et al. (2020) found that females and younger people reported graver mental health burdens (such as depression and anxiety). Using Italian online survey data, Mazza et al. (2020) investigated how sociodemographics and personality affect depression and other mental health issues, and found that females tend to be more depressed. Furthermore, based on the primary data of a Chinese online survey, Huang and Zhao (2020) showed that, compared to older people, the young more frequently experience anxiety and depression. Regarding residence, Lei et al. (2020) conducted an online survey in Southwest China and noted that depression was significantly associated with living in urban Chongqing compared to rural Yunnan Province. Additionally, through an online survey in the U.S., the Pew Research Center (2020) reported that the respondent’s level of comfort in contacting people is differentiated by residence in urban areas.

As discussed above, except for qualitative reviews and commentaries, all previous covid studies on mental health have employed the chi-square test of homogeneity (Wang et al., 2021), the Pearson/Spearman correlation (Báuerle et al., 2020; Suh & Kwon, 2021; Wang et al., 2021), multiple linear regression (Nguyen et al., 2020), and multiple logistic regression (Gao et al., 2020; Mazza et al., 2020; Nguyen et al., 2020; Ni et al., 2020; Wang et al., 2021), along with descriptive statistics: for meta-analysis, weighted means (Bueno-Notivol et al., 2021; Huang & Zhao, 2020) and meta-regression (Bueno-Notivol et al., 2021). All of these studies focused on the statistical significance of research variables and none compared their magnitudes. Indeed, the complete magnitude comparison was impossible. Predictors of depression by an event tend to change together and have high collinearity. This requires variable selection or grouping, meaning that the above statistical techniques are incapable of identifying among similar variables, which is more important. A second issue is that the above-discussed quantitative studies used online surveys and recruited respondents through convenience sampling, which itself could be attributed to covid restrictions (Venkatesh, 2020). However, as acknowledged by Wang et al. (2021) and Bueno-Notivol et al. (2021), online survey of convenience samples tend to overrepresent the young and highly-educated, which harms the validity of the descriptive statistics. To overcome these limitations, this study employed partial least squares (PLS) regression which, regardless of collinearity, can retain all initially considered variables (and compare their magnitudes), and analyzed data from a probability sample that effectively represents the population.
2.2 | Daily life changes due to covid

Compared to the previous studies discussed above, another key difference of this study is that, to examine how changes to daily routines affect depression, it specifies the changes rather than combining and treating them as one variable. That is, while previous studies have considered that covid and its control measures change daily routines, and such a (general) change negatively affects mental health, they have not examined how depression is affected by each type of change. For example, Tull et al. (2020) investigated the relationship between mental health and the subjective perception of how covid influences daily lives. Similarly, Ogden (2020) measured in a survey the degree to which daily routines are changed by covid, and analyzed how it affects the perceived passage of time. Rodríguez-Rey et al. (2020) asked the survey respondents whether covid affected daily lives such as changes to routines and the cancellation of important activities, and explored whether this caused anxiety, depression, stress, and other mental disorders. None of these studies dissected what these individual changes were, or how each was associated with mental health. This study is meaningful in that, considering this tendency, it reviewed research on daily life changes without regard to mental health (i.e., those that comprehensively explored affected daily lives or specifically confirmed a particular aspect) to choose important variables, and further examined how each influenced mental health.

Specifically, this study divided changes in daily routines into four categories. First, restrictions on mobility/travel (usually concerning public transit) aimed at reducing physical contact. This resulted in a subsequent increase in the second category (and the others): mandatory/voluntary time at home (time alone was separated from that with family). Third, domestic activities [since activities are generally classified into work, shopping, and leisure (Gim, 2018), this study considered five types of activities, including working from home, online shopping, and as leisure activities, food deliveries (e.g., ordering meals online), reading (individualized activity), and online networking (social activity)]. Lastly, the expansion of conflicts (family conflicts were separated from those with neighbors).

First of all, covid studies on mobility have mainly analyzed the changes to short-length daily trips. These changes are generally attributed to governmental measures (direct controls on transportation services and regulations for eliminating travel needs, such as telecommuting and the closure of non-essential services and stores) and individuals' self-imposed travel limitations (Borkowski et al., 2021). Helsingen et al. (2020) analyzed the descriptive statistics of the data of an online snowball sample survey in Norway and Sweden. While both countries have similar population structures and medical systems, Norway implemented strong social distancing measures against the pandemic while Sweden designed relaxed measures for herd immunity. They noted increases in sedentary activities in both countries (by 69% in Norway and 50% in Sweden).

As predicted by Musselwhite et al., 2020, along with reduced travel demand, another of covid's effects on mobility is the decreased use of public transit for preventing facial contact. Meanwhile, according to the traditional derived demand theory in transportation, the variation in travel demand is flexible to the degree to which the very trip—strictly speaking, the activity at the trip destination—is mandatory/compulsory (see Gim, 2018). Indeed, Borkowski et al. (2021) confirmed that, while trip frequencies in Poland had been generally reduced because of the pandemic, the level of reduction was differentiated by the purpose and mode of the trip: Nonmandatory trips, such as those for leisure (rather than travel for commuting or grocery shopping), and transit trips (with a higher potential for transmission through physical contact) tend to be more severely reduced.

In an online survey of roughly 11,500 U.S. adults, the Pew Research Center (2020) found that most people (73% of postgraduate degree holders and 60% of bachelor's degree holders) have worked from home because of covid. However, 58% of the respondents continued physically shopping at grocery
stores. In contrast, regarding leisure, 77% were reluctant to eat out—and 91% did not want to go to crowded parties—and instead, approximately 20% have used food delivery services.

As an individualized activity, studies on how covid affects reading have mainly focused on students’ learning performance due to the closure of schools (e.g., Wyse et al., 2020). However, a handful of studies have examined how adults’ reading volume and quality has changed. Boucher et al. (2020) reported that adults generally read as a way to satisfy a desire for escapism, and that, although their reading time was extended, their reading volume was reduced because of an increased ease of distraction. Moreover, those with children tended to spend more time reading as a shared activity, but their personalized reading was rather reduced. According to an online survey of 450 Canadians (Hirchberg, 2020), 58% increased their reading due to covid, whereas 4% reduced it.

As discussed in the section “Unpredictability of the disease and side effects by its response measures,” the shift of physical social interactions to online social networking influences mental health (Duan et al., 2020). In line with the reduction of leisure opportunities because of covid, both children (Choi et al., 2021) and adults (Sun et al., 2020) have reported increasing their time spent on smartphones/Internet devices.

Regarding increases in time/activities at home and accompanied conflicts, Park et al. (2021) explored covid-induced lifestyle changes using retrospective questions in an online survey of 104 South Koreans. Through paired t-tests, they found that there were significantly fewer physical, daily living, leisure, social, and educational activities than before; indeed, only working time remained unchanged. Similarly, Zhang, Hook, et al. (2020) and Zhang, Litvinova, et al. (2020) conducted a survey in Wuhan and Shanghai and found that during the covid lockdown period, daily contacts were reduced by approximately 7–8 times, and mostly occurred at home. The excessive increase in stay-at-home time with family and domestic activities (Venkatesh, 2020)—and the consequent reduction of social activities and aggravation of social relationships (Park et al., 2021)—may result in domestic incidents, interpersonal problems, and other conflicts. Meanwhile, it is unclear if increases in time at home due to covid allowed more time socializing with the family or promoted spending time alone (Choi et al., 2021).

3 | ANALYSIS

In the literature review, this study arranged the major reasons for covid-related depression into three groups and, among them, specified changes to daily routines/activities into four categories. As shown in Table 1, the reasons were measured with seven items (and 11 personal information characteristics) and the changes with 11 items. The first reason, the “unpredictability of the disease and side effects by its response measures (restrictions on the freedom of movement and strain on social relationships)” was evaluated using three statements: (Aa) uncertain fear of infection, (Ab) boredom from not going out, and (Ac) reduction of social relationships and communications due to social distancing rules. The second reason, “(mis)information through social media, public authorities, and mass media” was operationalized with the following three statements: (Ba) confusion by unverified fake news, (Bb) frequently alarming emergency alerts, and (Bc) mass media reports about covid. The last reason, “income reductions and other sociodemographic factors” was evaluated with the statement (C) stress from income and expenditure reduction, and 11 personal information items (control variables). Particularly, income reduction was measured with an item for the above-shown subjective perception (i.e., perceived stress) as a direct reason for depression, as well as with an item for the objective reality (employees’ unpaid leave, wage reduction, and layoff, or business owners’ reduced operation, revenue reduction, and temporary/permanent shutdown) as a daily life change. As discussed in the section
### Table 1: Descriptive statistics

| Types   | Variables | Variable descriptions (units)                                      | Mean   | S.D.   | Min | Max |
|---------|-----------|-------------------------------------------------------------------|--------|--------|-----|-----|
| Dependent | Depress  | Subjective depression (0 “not depressed at all”–10 “extremely depressed”) | 6.274  | 1.749  | 1   | 10  |
| Control | Age       | Age (years)                                                        | 46.056 | 13.394 | 19  | 87  |
|         | Family    | Family members (persons)                                           | 2.734  | 1.175  | 1   | 8   |
|         | Adults    | Adults in the family (persons)                                     | 2.430  | 1.067  | 1   | 7   |
| Change  | change1   | Stay-at-home time: with family (0 “extreme decrease”–10 “extreme increase”; 5 “no change”) | 1.321  | 1.718  | −5  | 5   |
|         | change2   | Stay-at-home time: alone                                           | 0.921  | 1.873  | −5  | 5   |
|         | change3   | Domestic activities: reading                                       | 0.533  | 1.451  | −5  | 5   |
|         | change4   | Conflicts: between family members                                  | 0.379  | 1.483  | −5  | 5   |
|         | change5   | Conflicts: with neighbors                                          | 0.133  | 1.435  | −5  | 5   |
|         | change6   | Domestic activities: food deliveries                               | 1.709  | 1.550  | −5  | 5   |
|         | change7   | Domestic activities: online shopping                               | 1.681  | 1.614  | −5  | 5   |
|         | change8   | Domestic activities: online networking                             | 1.635  | 1.546  | −5  | 5   |

| Types   | Variables | Variable descriptions                                      | Codes | Code descriptions                         | f    | %   |
|---------|-----------|-------------------------------------------------------------|-------|------------------------------------------|------|-----|
| Control | Gender    | Gender                                                      | 0     | Male                                     | 1688 | 57.7|
|         |           |                                                             | 1     | Female                                   | 1237 | 42.3|
|         | Marriage  | Marital status                                              | 0     | Others                                   | 1101 | 37.6|
|         |           |                                                             | 1     | Married                                  | 1824 | 62.4|
|         | Edu       | Educational attainment                                       | 0     | <Bachelor's                               | 1347 | 46.1|
|         |           |                                                             | 1     | ≥ Bachelor's                             | 1578 | 53.9|
|         | Job       | Job types                                                   | 0     | Others                                   | 1256 | 42.9|
|         |           |                                                             | 1     | Manager, professional, and office worker | 1669 | 57.1|
|         | Fulltime  | Working fulltime                                             | 0     | No                                       | 889  | 30.4|
|         |           |                                                             | 1     | Yes                                      | 2036 | 69.6|
|         | Condo     | Housing types                                               | 0     | No                                       | 1555 | 53.2|
|         |           |                                                             | 1     | Yes                                      | 1370 | 46.8|
|         | Housing   | Housing ownership                                            | 0     | Others                                   | 1189 | 40.6|
|         |           |                                                             | 1     | Owned                                    | 1736 | 59.4|
|         | Gangnam   | Residence in Gangnam (the districts of Seocho, Gangnam, and Songpa) | 0     | No                                       | 2536 | 86.7|
|         |           |                                                             | 1     | Yes                                      | 389  | 13.3|
| Change  | Telework  | Domestic activities: working from home                       | 0     | No                                       | 2014 | 68.9|
|         |           |                                                             | 1     | Yes                                      | 911  | 31.1|
|         | Travel    | Travel modes                                                | 0     | Others                                   | 2344 | 80.1|
|         |           |                                                             | 1     | Private modes                            | 581  | 19.9|
|         | Income    | Objective income                                             | 0     | Others                                   | 1820 | 62.2|
|         |           |                                                             | 1     | Reduced                                  | 1105 | 37.8|
| Reason  | reason1   | Mass media reports about covid                                | 0     | No                                       | 2005 | 68.5|
|         |           |                                                             | 1     | Yes                                      | 920  | 31.5|
“Daily life changes due to covid,” the changes were further specified into four categories: (1) travel (modes), (2–3) stay-at-home time (2 items: alone and with family), (4–8) domestic activities (five items: working from home, online shopping, food deliveries, reading, and online networking), (9–10) conflicts (two items: between family members and with neighbors); including income changes, there were a total of 11 items.

Among the above predictors, we expected the suspected reasons for depression and daily life changes caused by COVID-19 to be collinear. As such, we checked the significance of the predicting variables in the regression model using the PLS estimation. For the traditional ordinary least squares (OLS) estimation, studies should select one of the collinear variables—which can be chosen either automatically by using a variable selection method or manually by running factor analysis to identify the optimal one in the same factor (usually with the highest loading)—or combine them into a factor as a replacement of the collinear variables. The former (variable selection) cannot analyze the other original variables of interest once dropped. A limitation of the latter (factor replacement) is that the meaning of the factor is relatively unclear and, in practice, it has a low controllability (it is uncertain which measures change the factor score and the degree of this change). Moreover, neither approach can compare the magnitudes of those in the original variable set, which is the main purpose of this study. In contrast, the PLS estimation retains the collinear variables in the model. We used a freeware [SmartPLS 2.0.M3 (https://www.smartpls.com/smartpls2/download)] for the PLS regression so as to allow readers to reproduce its analytical results. Data used for the analysis were also posted online (see below).

All variables, including a total of 29 predictors and the response variable (depression), were evaluated with data from the Seoul Survey. Beginning in 2003, it is an annual quality of life survey that recruits 20,000 households in Seoul. A supplementary citizen survey was added in 2019. Different from the main survey that carries the same items to see their transitions and trends, this citizen survey promptly changes questionnaire items according to the year’s most pressing issues. Open to the public in April 2021, the 2020 Citizen Survey included questions about covid-related perceptions and behavior.

### TABLE 1 (Continued)

| Types | Variables | Variable descriptions | Codes | Code descriptions | f   | %   |
|-------|-----------|-----------------------|-------|------------------|-----|-----|
| reason2 | Uncertain fear of infection | 0 | No | 1389 47.5 |
| reason2 | Uncertain fear of infection | 1 | Yes | 1536 52.5 |
| reason3 | Frequently alarming emergency alerts | 0 | No | 2152 73.6 |
| reason3 | Frequently alarming emergency alerts | 1 | Yes | 773 26.4 |
| reason4 | Boredom from not going out | 0 | No | 1743 59.6 |
| reason4 | Boredom from not going out | 1 | Yes | 1182 40.4 |
| reason5 | Reduction of social relationships and communications due to social distancing rules | 0 | No | 2160 73.8 |
| reason5 | Reduction of social relationships and communications due to social distancing rules | 1 | Yes | 765 26.2 |
| reason6 | Stress from income and expenditure reduction | 0 | No | 2448 83.7 |
| reason6 | Stress from income and expenditure reduction | 1 | Yes | 477 16.3 |
| reason7 | Confusion by unverified fake news | 0 | No | 2762 94.4 |
| reason7 | Confusion by unverified fake news | 1 | Yes | 163 5.6 |

Note: The mean, standard deviation, and minimum and maximum for continuous variables and the frequency and proportion for discrete (all binary) variables.
The subjects of the survey were Seoul residents over the age of 14 and the survey period was from September 14 through October 31, 2020. Notably, and as discussed in the literature review, previous studies collected responses online, whereas the survey implemented face-to-face interviews (although an online response was allowed if preferred). Moreover, as opposed to convenience sampling (employed by almost all previous studies), it recruited 5000 respondents through stratified sampling; the sampling error was ±1.39%p at the 95% confidence level.1

From the full sample of 5000 respondents, we based our selection for the empirical analysis on two criteria. First, we excluded people who were underaged, without income, and full-time students/homemakers due to their having fewer responsibilities and, consequently, lower levels of stress and mental burdens than adults with jobs (Brooks et al., 2020). That said, we did not exclude those who lost their jobs due to the pandemic. Second, while the depression item was measured at the 11-point Likert-type scale (from 0 “not depressed at all” to 10 “extremely depressed”), those who responded 0 were supposed to skip the seven questions about reasons for depression, so they were removed from this study (n = 2925). The raw data of the 2020 Citizen Survey can be freely downloaded at: http://data.seoul.go.kr/dataList/OA-15564/F/1/datasetView.do and the processed data according to the above criteria—as well as the complete results of the analysis through SmartPLS 2.0.M3 (as recommended, the bootstrapping for testing the coefficient significance set the original sample size of 2925 cases as the resample size and 5000 times as the number of resampling)—were uploaded online for readers at: https://drive.google.com/file/d/1UJp2UAclp6zVnolpIr4R4b6xbdot4aW5fT/view?usp=sharing. The ID variable can be used as a key for comparing the raw and processed data.

4 | RESULTS

Table 1 shows the descriptive statistics of the dependent variable, 11 controls (3 continuous and 8 binary variables), seven reasons for depression (all binary variables), and 11 daily life changes (8 11-point Likert-type statements and 3 binary variables). Based on a probability sample, the statistics present the characteristics of the population as they stand: as of September–October 2020, adult Seoul residents with jobs and incomes (as well as those who lost their jobs because of covid) suffering from the corona blues. Only 5.6% of the respondents cited “confusion by unverified fake news” (reason7) as a reason for their depression. This low figure can be explained by the press and concerned authorities regularly fact-checking the veracity of covid news (Chong et al., 2020). Including this variable, all had sufficient variations for inferential statistics. In any case, PLS regression is effective with small sample sizes (and low counts in a category).

Table 2 displays the regression results based on the OLS and PLS estimators. As expected, the OLS model faced considerably high collinearity between the reasons for depression variables. Consequently, no results from the model should be credited. Purely for comparison purposes, analytical results from the two estimations can be examined. First, since both models share the same structure, they have the same explained variance ($R^2 = 0.096$). Regarding this low predictive power, the purpose of this study is not to predict the depression level, but to assess the significance and relative magnitudes of the variables. Furthermore, this explained variance is no worse than what has been reported in previous studies: In four studies on the relationship between covid and depression, $R^2$ was 0.01 (Anyan et al., 2020), 0.08 (Zhang, Hook, et al., 2020), 0.018 (Martinelli et al., 2021), and 0.060 (Gámez Linares et al., 2021).

Variables with the issue of collinearity (VIF > 5) were all reasons for depression as subjectively perceived by the respondents. Among the total seven reasons, the incorrect OLS model found one to be insignificant. In contrast, the PLS model identified two more variables as insignificant; the
| Variables | OLS estimation | PLS estimation |
|-----------|----------------|----------------|
|           | Unstandardized regression coef. | Standardized regression coef. | S.E. | t | VIF | Original sample mean | Sample mean | S.E. | t |
| Gender    | 0.125**         | 0.035          | 0.064 | 1.954 | 1.045 | 0.035* | 0.035 | 0.018 | 1.954 |
| Age       | 0.000           | 0.002          | 0.003 | 0.085 | 1.937 | 0.002  | 0.002 | 0.026 | 0.081 |
| Marriage  | 0.111           | 0.031          | 0.083 | 1.337 | 1.695 | 0.031  | 0.031 | 0.023 | 1.318 |
| Edu       | −0.108          | −0.031         | 0.078 | 1.385 | 1.584 | −0.031 | −0.031 | 0.023 | 1.368 |
| Job       | 0.043           | 0.012          | 0.085 | 0.509 | 1.840 | 0.012  | 0.012 | 0.024 | 0.498 |
| Fulltime  | −0.139          | −0.037         | 0.084 | 1.644 | 1.580 | −0.037 | −0.036 | 0.023 | 1.616 |
| Family    | −0.046          | −0.031         | 0.054 | 0.852 | 4.291 | −0.031 | −0.032 | 0.036 | 0.876 |
| Adults    | −0.032          | −0.020         | 0.056 | 0.578 | 3.701 | −0.020 | −0.020 | 0.034 | 0.580 |
| Condo     | −0.172***       | −0.049         | 0.067 | 2.579 | 1.159 | −0.049*** | −0.049 | 0.018 | 2.723 |
| Housing   | 0.052           | 0.015          | 0.071 | 0.738 | 1.265 | 0.015  | 0.014 | 0.020 | 0.752 |
| Gangnam   | 0.254***        | 0.049          | 0.092 | 2.750 | 1.030 | 0.049*** | 0.049 | 0.016 | 3.002 |
| reason1   | 0.500*          | 0.133          | 0.299 | 1.670 | 20.245 | 0.133  | 0.132 | 0.100 | 1.334 |
| reason2   | 0.764***        | 0.218          | 0.295 | 2.594 | 22.668 | 0.218** | 0.217 | 0.104 | 2.093 |
| reason3   | 0.515*          | 0.130          | 0.296 | 1.740 | 17.875 | 0.130  | 0.129 | 0.093 | 1.392 |
| reason4   | 0.726**         | 0.204          | 0.295 | 2.457 | 22.014 | 0.204** | 0.202 | 0.103 | 1.973 |
| reason5   | 0.666**         | 0.167          | 0.297 | 2.240 | 17.890 | 0.167*  | 0.166 | 0.092 | 1.811 |
| reason6   | 0.837***        | 0.177          | 0.303 | 2.763 | 13.137 | 0.177** | 0.176 | 0.080 | 2.222 |
| reason7   | 0.173           | 0.023          | 0.319 | 0.543 | 5.616 | 0.023  | 0.022 | 0.052 | 0.438 |
| change1   | 0.041**         | 0.041          | 0.020 | 2.018 | 1.298 | 0.041*  | 0.041 | 0.022 | 1.848 |
| change2   | 0.077***        | 0.083          | 0.019 | 4.140 | 1.273 | 0.083*** | 0.082 | 0.021 | 3.848 |
| change3   | −0.029          | −0.024         | 0.025 | 1.156 | 1.377 | −0.024 | −0.024 | 0.022 | 1.078 |
| change4   | 0.149***        | 0.126          | 0.029 | 5.213 | 1.876 | 0.126*** | 0.127 | 0.026 | 4.780 |
| change5   | −0.012          | −0.010         | 0.029 | 0.424 | 1.763 | −0.010 | −0.010 | 0.024 | 0.418 |
| change6   | 0.078***        | 0.069          | 0.028 | 2.836 | 1.906 | 0.069*** | 0.069 | 0.025 | 2.724 |
| change7   | 0.017           | 0.016          | 0.028 | 0.608 | 2.198 | 0.016  | 0.015 | 0.027 | 0.588 |
| change8   | 0.079***        | 0.070          | 0.027 | 2.978 | 1.760 | 0.070*** | 0.070 | 0.024 | 2.949 |
| Telework  | 0.082           | 0.022          | 0.073 | 1.116 | 1.199 | 0.072  | 0.022 | 0.019 | 1.119 |
| Travel    | 0.041           | 0.009          | 0.080 | 0.512 | 1.070 | 0.009  | 0.010 | 0.018 | 0.525 |
| Income    | 0.224***        | 0.062          | 0.072 | 3.100 | 1.287 | 0.062*** | 0.062 | 0.019 | 3.229 |
| (Intercept)| 4.608***        | 0.609          | 0.609 | 7.572 |       |       |       |       |       |

\[ F(29, 2895) = 10.633 \quad (p = 0.000), \quad R^2 = 0.096, \quad RMSE = 1.671, \quad Durbin-Watson = 1.624 \]

Abbreviations: OLS, ordinary least squares; PLS, partial least squares.  
* \( p < 0.1 \), ** \( p < 0.05 \), *** \( p < 0.01 \).
p-values became generally higher and those that were significant only at the 90% confidence level in the OLS model were revealed to be insignificant. Specifically, “mass media reports about covid” (reason1) and “frequently alarming emergency alerts” (reason3) changed to have no associations with the depression variation.

The PLS regression model found six of the 11 daily change variables to be significant. In descending order of magnitude, these were: conflicts between family members (change4), stay-at-home time alone (change2), online networking (change8), food deliveries (change6), income reduction (unpaid leave, wage reduction, and layoff, or reduced operation, revenue reduction, and temporary/permanent shutdown) (income), and stay-at-home time with family (change1). In short, the major reasons for depression are declines in out-of-home offline networking and the subsequent rise in domestic activities and restrictions against the mobility instinct, as well as income reductions. However, increases in reading (change3), conflicts with neighbors (change5), online shopping (change7), working from home (telework), and travel mode changes (travel) were not associated with depression.

The finding that depression is aggravated by decreased out-of-home socializing, limited opportunities to satisfy intrinsic mobility needs, and reduced incomes was also consistently drawn from the group of variables on respondents' perceived reasons for depression. That is, the cessation of in-person social relationships and the reduction of communication due to social distancing (reason5), boredom by remaining at home (reason4), and stress from the reduction of income and expenditure (reason6) were found to be significant while the most important variable was the uncertain fear of infection (reason2).

Among the seven subjective/perceived reasons, the other three variables as insignificant were related to communication and media: mass media reports about covid (reason1), frequently alarming emergency alerts (reason3), and confusion by unverified fake news (reason7). (It is worth noting that if the OLS model had to select among collinear variables, these variables would have been unselected because of their low contributions to the explained variance, meaning that we could not have judged their significance and magnitudes. According to our PLS estimation, however, these variables were unrelated to depression.) Therefore, as stated above, considering that the uncertain fear of infection (reason2) was the strongest of the subjective reason variables—indeed the most important of all—public health planners can consider communication and public relations programs to instill confidence and surety so as to decrease depression (the programs are likely to have insignificant/negligible side effects). In their literature review on the psychological effects of previous pandemics, Brooks et al. (2020) also concluded it imperative for public health authorities to clearly provide as much information as possible for the public's mental health.

In order of relative magnitude, depression was associated with respondents' perceived reasons for depression (four variables), daily routine changes (6), and sociodemographics (3) as control variables. As an exception among the three significant sociodemographic characteristics—those not living in condominiums, females, and Gangnam residents were more depressed—Gangnam residence (standardized regression coefficient = 0.049) and condominium residence (−0.049) were slightly more important than the weakest daily change variable, stay-at-home time with the family (0.041).2 Such a tendency by the variable group can be attributed to the survey format itself. That is, empirical results suggest that reasons directly identified by the depressed respondents are more closely associated with depression than simple changes from covid and, moreover, items on the changes affect the depression variation more strongly than those on the present status.
This study sought to confirm the reasons behind cases of depression provoked by covid-related changes, and to compare their relative magnitudes. Among the changes, it particularly specified those to daily life through direct policy implementations. To measure these research variables, this study used data from a probability sample (for higher sample representativeness): A subsample of adult (self-)employed Seoul residents was extracted from the full sample of a Seoul quality of life survey. For data analysis, PLS regression was used due to its capacity to carry collinear variables of depression causes without modification.

In terms of the changes to daily life as a result of covid (total 11 variables), a notable finding is that conflicts with family were the most important depression determinant (the second most important was an increase in stay-at-home time alone). The income reduction (standardized regression coefficient = 0.062) was the fifth strongest among the six significant daily change variables. Relatively, conflicts with family (0.126) were 2.302 times more important in explaining the depression variation. Meanwhile, among the other significant variables of daily changes, this variable was significantly correlated with the above stay-at-home time alone ($r = 0.199, p = 0.000$) and time spending with family ($r = 0.281, p = 0.000$). (As expected, the correlation between time alone and time with family was insignificant: $r = 0.018, p = 0.331$.) These have two possible implications: First, the two stay-at-home time variables serve as the bases for family conflicts; and second, since the three variables are combined through correlations, the effect of any of the variables on depression is stronger than it first appears (for policy implication of collinear variables, see Gim, 2013). In contrast to family conflicts, those with neighbors were insignificant; this may be because in a highly mobile and dense city like Seoul, building a relationship with neighbors or a community is difficult per se. Therefore, to prepare for the psychologically negative effects of covid, counseling and therapeutic services at the family level should be offered where substantial conflicts may occur. As early as January 2020, the Korean Ministry of Health and Welfare organized the Integrated Psychological Support Group for COVID-19 and in September, it launched a coordination committee for a metropolitan- and provincial-level joint effort to address the depression issue, but these are centered on individuals, not families. While the Korean Ministry of Gender Equality and Family has begun to deal with the covid-related family issue since May 2021, its effort is limited to a hotline service. Instead, inter-ministrial attempts are necessary to substantially mitigate the family conflict.

As the third important daily change variable, online social networking was not a viable substitute for offline networking. Indeed, the more people use online networking services, the worse their depression. This supports the argument that the megacity Seoul has noticed the collapse of the neighborhood and community and the surge of the online alternative, followed by loneliness and depression among the general public (Gim, 2021). Also, while research on the role of online communications is divided into two perspectives—the stimulation hypothesis (online communications are positive in creating and enhancing community/social capital) and the displacement hypothesis (they are negative influences) (Valkenburg & Peter, 2007)—this result appears to support the latter. The former posits that interactions in online communities based on trust between members allow for the accumulation of social capital online, which contributes to the supplementation or enhancement of offline social capital (Ellison et al., 2007). The latter argues that online interactions expand the digital divide, impede face-to-face interactions, facilitate the atomization of the individual, and deepen feelings of isolation. Consequently, they reduce offline communication activities within families and communities (Williams, 2007). Meanwhile, inasmuch as the finding supports the displacement hypothesis, it seemingly contradicts Manuell and Cukor’s (2011) argument, that online social networking as a means of connecting with family and friends, and access to cell phones, outlets, and Wi-Fi networks for online
communication reduce anxiety, isolation sense, stress, and panic. However, their study investigated those quarantined in designated facilities and their comparison group was those who were completely blocked from communications. As such, they implied that online communication is more positive than no communication at all. In contrast, this study analyzed the potential of online as a substitute for offline communication.

As the last significant daily change variable, increased use of food delivery services (instead of eating at restaurants) aggravated depression. Considering that the daily change variables of online shopping (change7), working from home (telework), and travel mode changes (travel) were insignificant, the significance of the food deliveries variable can be explained from the perspective of the positive utility of travel (Mokhtarian & Salomon, 2001; Ory & Mokhtarian, 2005). That is, depression can likely occur if a situation, such as covid, were to deprive people of the utility of travel (produced by satisfying humanity's intrinsic mobility instinct as well as by conducting ancillary activities and anti-activities on the way to the destination). The occurrence of depression is dependent on how replaceable the utility is, which is to say how mandatory/vital such a trip is (Goulias et al., 1990).

Some examples of the intrinsic utility of travel are traveling only for enjoyment, changing to unusual routes for variety- and curiosity-seeking, enjoying the scenic beauty, feeling movement through the environment (e.g., to escape the “cabin fever” experienced from staying indoors and getting fresh air), controlling motion and moving independently, conquering daily introversion and inertia (e.g., by auto racing and lengthy bike rides), expressing one's status/identity (e.g., actively displaying a nice car or environmentally friendly traits), escaping from obligations and routines at home/work, physical exercise, and mental therapy. Examples of the ancillary activities include talking about private matters with family and friends, and listening to music or radio loudly. Examples of the anti-activities include thinking, clearing one's head, and relaxing. Along with return to normal policy attempts across the world, the issue of depression in relation to limited mobility may also be handled, but pharmaceutical and behavioral measures are still desirable to respond to an rapid increase in the compensatory travel demand and possible re-spread of the coronavirus.

Changes to daily shopping, business, and transportation (to online and private places/modes) were found to be insignificant in worsening depression. Considering unique urban settings in Seoul, the insignificance does not necessarily mean that these variables do not affect depression in general. It might be due to a lack of further evidence in the data or model. If not, the insignificance is possibly due to daily shopping and business being mandatory, and trips for these purposes occur in a fixed way (mostly predetermined destinations and routes as well as departure/arrival time) and on a regular basis (somewhat fixed trip frequencies). Therefore, as the positive utility is not highly expected, the changes appear to be more negligible in comparison to others (the reduced utility is unimportant). As nonregular leisure travel, however, trips for eating out have a higher utility (Gim, 2018) and the removal of this type of travel is likely to significantly affect depression. [Moreover, further to the above-mentioned intrinsic and on-the-way utility, a leisure trip can be accompanied by the auxiliary utility at the destination after the trip's termination (e.g., socializing and superfluously visiting nearby symbolic, cultural, and esthetic sites) (Næss, 2009).] Lastly, regarding travel modes, the shift to private modes was found to be insignificant partially because nonregular travel with higher travel utility tended to originally be made by private modes, such as cars (Gim, 2018). Hence, we would recommend further research to explore how changes in leisure activities and trips affect depression in the (post-)covid era.

This study's primary contribution is that it compared the relative magnitudes of depression determinants focusing on daily routine changes, and accordingly offered practical and academic suggestions. However, we evaluated depression with a single survey item and the findings cannot be directly compared to those of previous studies based on a multi-item measure. Moreover, using
a cross-sectional survey, we could not check variations in the effects of research variables according to changes in pandemic regulations (types and magnitudes), and cases of infection and fatality. To continue this line of investigation, we would recommend longitudinal research equipped with multiple indicators of depression.

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ENDNOTES
1 At the lowest administrative unit in Korea (tong and ban), households were clustered according to 4 housing types (detached/multi-unit houses, condominiums, multi-household houses, and row houses/others). Among a total of 89,347 clusters, the survey then chose 1000 through simple random sampling while considering the proportion of the households at the administrative district and neighborhood levels. Finally, per sampled cluster, it selected 5 households (in each cluster, households were arranged by number of household members before the selection through stratified sampling). In each of the 5000 sampled households, one member responded to the survey.

2 Standardized regression coefficients (also called β-coefficients) are used to compare the relative magnitudes of the effects of explanatory variables both in OLS (Petscher et al., 2013) and PLS (Mehmetoglu & Venturini, 2020) settings.

3 The stimulation hypothesis is sometimes called the increase hypothesis (e.g., Lee, 2009).

REFERENCES
Anyan, F., Hjemdal, O., Ernstsen, L., & Havnen, A. (2020). Change in physical activity during the coronavirus disease 2019 lockdown in Norway: The buffering effect of resilience on mental health. *Frontiers in Psychology, 11*, 3514. https://doi.org/10.3389/fpsyg.2020.598481

Bäuerle, A., Teufel, M., Musche, V., Weismüller, B., Kohler, H., Hetkamp, M., Dorrie, N., Schweda, A., & Skoda, E.-M. (2020). Increased generalized anxiety, depression and distress during the COVID-19 pandemic: A cross-sectional study in Germany. *Journal of Public Health, 42*(4), 672–678. https://doi.org/10.1093/pubmed/fdaa106

Borksowski, P., Jazdewskas-Gutta, M., & Szmelter-Jarosz, A. (2021). Lockdown: Everyday mobility changes in response to COVID-19. *Journal of Transport Geography*, 90, 102906. https://doi.org/10.1016/j.jtrangeo.2020.102906

Boucher, A., Harrison, C., & Giovanelli, M. (2020). How reading habits have changed during the COVID-19 lockdown. Retrieved from Waltham, MA. https://theconversation.com/how-reading-habits-have-changed-during-the-covid-19-lockdown-146894

Braunack-Mayer, A., Tooher, R., Collins, J. E., Street, J. M., & Marshall, H. (2013). Understanding the school community’s response to school closures during the H1N1 2009 influenza pandemic. *BMC Public Health, 13*(1), 344. https://doi.org/10.1186/1471-2458-13-344

Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. *The Lancet*, 395(10227), 912–920. https://doi.org/10.1016/S0140-6736(20)30460-8

Bueno-Notivol, J., Gracia-García, P., Olaya, B., Lasheras, I., López-Antón, R., & Santabárbara, J. (2021). Prevalence of depression during the COVID-19 outbreak: A meta-analysis of community-based studies. *International Journal of Clinical and Health Psychology, 21*(1), 100196. https://doi.org/10.1016/j.ijchp.2020.07.007

Cava, M. A., Fay, K. E., Beanlands, H. J., McCoy, E. A., & Wignall, R. (2005). The experience of quarantine for individuals affected by SARS in Toronto. *Public Health Nursing, 22*(5), 398–406. https://doi.org/10.1111/j.0737-1209.2005.220504.x

Cho, S.-A. (2020). Corona blue. In *HIRA issue. Wonju, Korea*. Korean Health Insurance Review and Assessment Service.
Choi, J., Park, Y., Kim, H.-E., Song, J., Lee, D., Lee, E., Kang, H., Ye, S., Lee, S., Ryu, S., & Lee, Y. (2021). Daily life changes and life satisfaction among Korean school-aged children in the COVID-19 pandemic. *International Journal of Environmental Research and Public Health, 18*(6), 3324. https://doi.org/10.3390/ijerph18063324

Chong, E., Kim, K., & Park, Y. (2020). An exploratory study on the differences between fact-checking and explanatory news on COVID-19: Focusing on contextuality and transparency. *Journal of Cyber Communication, 37*(3), 139–193. https://doi.org/10.36494/jcas.2020.09.37.3.139

Depoux, A., Martin, S., Karafillakis, E., Preet, R., Wilder-Smith, A., & Larson, H. (2020). The pandemic of social media panic travels faster than the COVID-19 outbreak. *Journal of Travel Medicine, 27*(3), 1–2. https://doi.org/10.1093/ jtm/taaa031

Desclaux, A., Badji, D., Ndione, A. G., & Sow, K. (2017). Accepted monitoring or endured quarantine? Ebola contacts’ perceptions in Senegal. *Social Science & Medicine, 178*, 38–45. https://doi.org/10.1016/j.socscimed.2017.02.009

Duan, L., Shao, X., Wang, Y., Huang, Y., Miao, J., Yang, X., & Zhu, G. (2020). An investigation of mental health status of children and adolescents in China during the outbreak of COVID-19. *Journal of Affective Disorders, 275*, 112–118. https://doi.org/10.1016/j.jad.2020.06.029

Ellison, N. B., Steinfeld, C., & Lampe, C. (2007). The Benefits of Facebook “friends:” Social capital and college students’ use of online social network sites. *Journal of Computer-Mediated Communication, 12*(4), 1143–1168. https://doi.org/10.1111/j.1083-6101.2007.00367.x

Garfin, D. R., Silver, R. C., & Holman, E. A. (2020). The novel coronavirus (COVID-19) outbreak: Amplification of public health consequences by media exposure. *Health Psychology, 39*(5), 355–357. https://doi.org/10.1037/ hea0000875

Gázquez Linares, J. J., Molero Jurado, M. d. M., Martos Martínez, Á., Jiménez-Rodríguez, D., & Pérez-Fuentes, M. d. C. (2021). The repercussions of perceived threat from COVID-19 on the mental health of actively employed nurses. *International Journal of Mental Health Nursing, 30*(3), 724–732. https://doi.org/10.1111/inm.12841

Gim, T.-H. T. (2013). The relationships between land use measures and travel behavior: A meta-analytic approach. *Transportation Planning and Technology, 36*(5), 413–434. https://doi.org/10.1080/03081060.2013.818272

Gim, T.-H. T. (2018). Land use, travel utility, and travel behavior: An analysis from the perspective of the positive utility of travel. *Papers in Regional Science, 97*, S169–S193. https://doi.org/10.1111/pirs.12239

Gim, T.-H. T. (2021). Partial least squares regression and importance–satisfaction analyses of the strategic drivers of happiness: A quality of life survey in Seoul, Korea. *Growth and Change, 52*(1), 567–599. https://doi.org/10.1111/ grow.12448

Goulias, K. G., Pendyala, R. M., & Kitamura, R. (1990). Practical method for the estimation of trip generation and trip chaining. *Transportation Research Record, (1285)*, 47–56. http://onlinepubs.trb.org/Onlinepubs/ trr/1990/1285/1285-006.pdf

Hawryluck, L., Gold, W. L., Robinson, S., Pogorski, S., Galea, S., & Styra, R. (2004). SARS control and psychological effects of quarantine, Toronto, Canada. *Emerging Infectious Diseases, 10*(7), 1206–1212. https://doi.org/10.3201/ eidi1007.030703

Helsingen, L. M., Refsum, E., Gjøstein, D. K., Løberg, M., Bretthauer, M., Kalager, M., & Emilsson, L., & for the Clinical Effectiveness Research, g. (2020). The COVID-19 pandemic in Norway and Sweden threats, trust, and impact on daily life: A comparative survey. *BMCPublic Health, 20*(1), 1597. https://doi.org/10.1186/s12889-020-09615-3

Hirchberg, S. (2020). The impact of COVID-19 on reading. Retrieved from https://www.booknetcanada.ca/blog/2020/4/15/the-impact-of-covid-19-on-reading

Huang, Y., & Zhao, N. (2020). Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: A web-based cross-sectional survey. *Psychiatry Research, 288*, 112954. https://doi.org/10.1016/j.psychres.2020.112954

Huremović, D. (2019). Social distancing, quarantine, and isolation. In D. Huremović (Ed.), *Psychiatry of pandemics: A mental health response to infection outbreak* (pp. 85–94). Springer International Publishing.

Jeong, H., Yim, H. W., Song, Y.-J., Ki, M., Min, J.-A., Cho, J., & Chae, J.-H. (2016). Mental health status of people isolated due to Middle East Respiratory Syndrome. *Epidemiology and Health, 38*, e2016048. https://doi.org/10.4178/epih.e2016048
Kazmi, S. S. H., Hasan, K., Talib, S., & Saxena, S. (2020). COVID-19 and lockdown: A study on the impact on mental health. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3577515

Lee, S. J. (2009). Online communication and adolescent social ties: Who benefits more from Internet use? *Journal of Computer-Mediated Communication, 14*(3), 509–531. https://doi.org/10.1111/j.1083-6101.2009.01451.x

Lei, L., Huang, X., Zhang, S., Yang, J., Yang, L., & Xu, M. (2020). Comparison of prevalence and associated factors of anxiety and depression among people affected by versus people unaffected by quarantine during the COVID-19 epidemic in Southwestern China. *Medical Science Monitor, 26*. https://doi.org/10.12659/MSM.924609

Manuell, M.-E., & Cukor, J. (2011). Mother Nature versus human nature: Public compliance with evacuation and quarantine. *Disasters, 35*(2), 417–442. https://doi.org/10.1111/j.1467-7717.2010.01219.x

Martinelli, N., Gil, S., Belletier, C., Chevalère, J., Dezecache, G., Huguet, P., & Droit-Volet, S. (2021). Time and emotion during lockdown and the Covid-19 epidemic: Determinants of our experience of time? *Frontiers in Psychology, 11*, 3738. https://doi.org/10.3389/fpsyg.2020.61619

Mazza, C., Ricci, E., Biondi, S., Colasanti, M., Ferracuti, S., Napoli, C., & Roma, P. (2020). A nationwide survey of psychological distress among Italian people during the COVID-19 pandemic: Immediate psychological responses and associated factors. *International Journal of Environmental Research and Public Health, 17*(9), 3165. https://doi.org/10.3390/ijerph17093165

Mehmetoglu, M., & Venturini, S. (2020). *Structural equation modelling with partial least squares using stata and R*. CRC Press.

Mihashi, M., Otsubo, Y., Yinjuan, K., Hoshiko, M., & Ishitake, T. (2009). Predictive factors of psychological disorder development during recovery following SARS outbreak. *Health Psychology, 28*(1), 91–100. https://doi.org/10.1037/a0013674

Mohktarian, P. L., & Salomon, I. (2001). How derived is the demand for travel? Some conceptual and measurement considerations. *Transportation Research Part A, 35*(8), 695–719. https://doi.org/10.1016/S0965-8564(00)00013-6

Musselwhite, C., Avineri, E., & Susilo, Y. (2020). Editorial JTH 16 –The Coronavirus disease COVID-19 and implications for transport and health. *Journal of Transport & Health, 16*, 100853. https://doi.org/10.1016/j.jth.2020.100853

Muthukrishna, M., Bell, A. V., Henrich, J., Curtin, C. M., Gedranovich, A., McInerney, J., & Thue, B. (2020). Beyond Western, educated, industrial, rich, and democratic (WEIRD) psychology: Measuring and mapping scales of cultural and psychological distance. *Psychological Science, 31*(6), 678–701. https://doi.org/10.1177/0956797620916782

Ness, P. (2009). Residential self-selection and appropriate control variables in land use: Travel studies. *Transport Reviews, 29*(3), 293–324. https://doi.org/10.1080/01441640802710812

Nguyen, H. C., Nguyen, M. H., Do, B. N., Tran, C. Q., Nguyen, T. T. P., Pham, K. M., Pham, L. V., Tran, K. V., Tran, T. V., Nguyen, T. T., Hoang, T. M., Nguyen, K. T., Yang, S. H., Chao, J. C. J., & Duong, T. V. (2020). People with suspected COVID-19 symptoms were more likely depressed and had lower health-related quality of life: The potential benefit of health literacy. *Journal of Clinical Medicine, 9*(4), 965. https://doi.org/10.3390/jcm9040965

Ni, M. Y., Yang, L., Leung, C. M. C., Li, N., Yao, X. I., Wang, Y., Leung, G. M., Cowling, B. J., & Liao, Q. (2020). Mental health, risk factors, and social media use during the COVID-19 epidemic and cordon sanitaire among the community and health professionals in Wuhan, China: Cross-sectional survey. *JMI R Public Health and Surveillance, 7*(5), e19009. https://doi.org/10.2196/19009

Ogden, R. S. (2020). The passage of time during the UK Covid-19 lockdown. *PLoS One, 15*(7), e0235871. https://doi.org/10.1371/journal.pone.0235871

Ory, D. T., & Mohktarian, P. L. (2005). When is getting there half the fun? Modeling the liking for travel. *Transportation Research Part A, 39*(2–3), 97–123. https://doi.org/10.1016/j.tra.2004.09.006

Park, K.-H., Kim, A.-R., Yang, M.-A., Lim, S.-J., & Park, J.-H. (2021). Impact of the COVID-19 pandemic on the lifestyle, mental health, and quality of life of adults in South Korea. *PLoS One, 16*(2), e0247970. https://doi.org/10.1371/journal.pone.0247970

Pellecchia, U., Crestani, R., Decroo, T., Van den Bergh, R., & Al-Kourdi, Y. (2015). Social consequences of Ebola containment measures in Liberia. *PLoS One, 10*(12), e0143036. https://doi.org/10.1371/journal.pone.0143036

Petscher, Y., Schatschneider, C., & Compton, D. L. (2013). *Applied quantitative analysis in education and the social sciences*. Routledge.

Pew Research Center. (2020). Most Americans say coronavirus outbreak has impacted their lives. Retrieved from Washington, DC https://www.pewresearch.org/social-trends/2020/03/30/most-americans-say-coronavirus-outbreak-has-impacted-their-lives/
Rajkumar, R. P. (2020). COVID-19 and mental health: A review of the existing literature. *Asian Journal of Psychiatry, 52*, 102066. https://doi.org/10.1016/j.ajp.2020.102066

Rodríguez-Rey, R., Garrido-Hernansaiz, H., & Collado, S. (2020). Psychological impact and associated factors during the initial stage of the coronavirus (COVID-19) pandemic among the general population in Spain. *Frontiers in Psychology, 11*, 1540. https://doi.org/10.3389/fpsyg.2020.01540

Sommariva, S., Vamos, C., Mantzarlis, A., Đao, L. U.-L., & Martínez Tyson, D. (2018). Spreading the (fake) news: Exploring health messages on social media and the implications for health professionals using a case study. *American Journal of Health Education, 49*(4), 246–255. https://doi.org/10.1080/19325037.2018.1473178

Suh, B. D., & Kwon, K. H. (2021). Impacts of the depression among the elderly in the South Korea community in COVID-19 pandemic. *Journal of Health Informatics and Statistics, 46*(1), 54–63. https://doi.org/10.21032/jhis.2021.46.1.54

Sun, Y., Li, Y., Bao, Y., Meng, S., Sun, Y., Schumann, G., Kosten, T., Strang, J., Lu, L., & Shi, J. (2020). Brief report: Increased addictive internet and substance use behavior during the Covid-19 pandemic in China. *American Journal on Addictions, 29*(4), 268–270. https://doi.org/10.1111/ajad.13066

Taylor, M. R., Agho, K. E., Stevens, G. J., & Raphael, B. (2008). Factors influencing psychological distress during a disease epidemic: Data from Australia’s first outbreak of equine influenza. *BMC Public Health, 8*(1), 347. https://doi.org/10.1186/1471-2458-8-347

Tull, M. T., Edmonds, K. A., Scamaldo, K. M., Richmond, J. R., Rose, J. P., & Gratz, K. L. (2020). Psychological outcomes associated with stay-at-home orders and the perceived impact of COVID-19 on daily life. *Psychiatry Research, 289*, 113098. https://doi.org/10.1016/j.psychres.2020.113098

Valkenburg, P. M., & Peter, J. (2007). Online communication and adolescent well-being: Testing the stimulation versus the displacement hypothesis. *Journal of Computer-Mediated Communication, 12*(4), 1169–1182. https://doi.org/10.1111/j.1083-6101.2007.00368.x

Venkatesh, V. (2020). Impacts of COVID-19: A research agenda to support people in their fight. *International Journal of Information Management, 55*, 102197. https://doi.org/10.1016/j.ijinfomgt.2020.102197

Wang, Y., Di, Y., Ye, J., & Wei, W. (2021). Study on the public psychological states and its related factors during the outbreak of coronavirus disease 2019 (COVID-19) in some regions of China. *Psychology Health & Medicine, 26*(1), 13–22. https://doi.org/10.1080/13548506.2020.1746817

Williams, D. (2007). The Impact of time online: Social capital and cyberbalkanization. *Cyber Psychology and Behavior, 10*(3), 398–406. https://doi.org/10.1089/cpb.2006.9939

Wyse, A. E., Stickney, E. M., Butz, D., Beckler, A., & Close, C. N. (2020). The potential impact of COVID-19 on student learning and how schools can respond. *Educational Measurement: Issues and Practice, 39*(3), 60–64. https://doi.org/10.1111/emip.12357

Zhang, H., Hook, J. N., Hodge, A. S., Coomes, S. P., Davis, C. W., Karwoski, L. T., ..., & Aten, J. D. (2020a). The effect of spiritual fortitude on mental health symptoms amidst the COVID-19 pandemic. *Journal of Psychology and Christianity, 39*(4), 288–300. https://doi.org/10.1037/rel0000420

Zhang, J., Litvinova, M., Liang, Y., Wang, Y., Wang, W., Zhao, S., Wu, Q., Merler, S., Viboud, C., Vespignani, A., Ajelli, M., & Yu, H. (2020b). Changes in contact patterns shape the dynamics of the COVID-19 outbreak in China. *Science, 368*(6498), 1481–1486. https://doi.org/10.1126/science.abb8001

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