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Association between social capital and COVID-19 preventive behaviors: Country-level ecological study

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ABSTRACT

Background: The association between social capital and preventive behaviors against COVID-19 remains controversial. We examined the association between social capital and preventive behaviors against COVID-19 at country level.

Methods: The data on country-level social capital (i.e., social trust, group affiliations, civic responsibility, and confidence in state institutions) was obtained from a previous literature based on World Value Survey. Preventive behaviors were calculated as the percentage of people in a country who took COVID-19 preventive behaviors (i.e., physical distancing, hand hygiene, and the use of face mask) from an international survey of Facebook users, from July to October 2020 (207 data points for 9 waves of 23 countries). The scores on social capital were standardized. The association was investigated with multilevel linear regression analysis.

Results: High civic responsibility (per 1 standard deviation, SD) was associated with low percentage points of physical distancing ($\beta = -4.66$, 95% confidence interval, CI: 7.23, −2.09), hand hygiene ($\beta = -2.88$, 95% CI: 3.98, −1.78) and the use of face mask ($\beta = -3.95$, 95% CI: 5.29, −2.62). Group affiliations were associated with high percentage points of physical distancing ($\beta = 2.96$, 95% CI: 0.35, 5.58) and the use of face mask ($\beta = 1.80$, 95% CI: 0.45, 3.16). Social trust had significant positive association with performing hand hygiene ($\beta = 1.22$, 95% CI: 0.09, 2.35).

Conclusions: These results suggested that in countries with higher levels of civic responsibility, preventive behaviors should be more intensified during a pandemic.

1. Introduction

There have been 293 million cases of COVID-19 around the globe as of January 5, 2022 [1]. To prevent the spread of the disease, people are encouraged to take preventive measures even after being vaccinated due to breakthrough infection [2]. These measures include physical distancing, hand hygiene, and the use of face masks, all of which have been proven to be strongly preventive against the spread of COVID-19 [3]. According to a meta-analysis, COVID-19 infection is less likely to occur when the physical distancing is 1 m or more or when a face mask, especially an N95, is used [4]. Meanwhile, another meta-analysis on hand hygiene demonstrated a 21% reduction in transmission of respiratory infections even before the COVID-19 pandemic [5].

Social capital partially determines adherence to these preventive behaviors, but the association may vary by features of social capital measure and types of preventive behavior. Social capital is distinguished into bonding, bridging, and linking types [6,7]. Bonding refers to the trust and belonging between the individuals with similar social background whereas bridging refers to the interaction with people from different background and linking relates to the interaction with authorities in a society, such as political

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participation and political trust. During the COVID-19 pandemic, Elgar et al. reported that the association between these dimensions of social capital and the COVID-19 mortality rates [8]. They found that trust and group participations adopted the dimensions of bonding and bridging and were positively associated with the mortality, while trust on the government that reflect linking social capital was negatively associated with the mortality. Also, civic responsibility, a byproduct of social capital, was negatively associated with the mortality [8]. An early literature review argued that depending on the perceptions of the major proportion, trust is associated with higher compliance with preventive measures, such as physical distancing in some studies [9]. In the United States, higher social trust and voting participation were positively associated with physical distancing throughout the COVID-19 pandemic [10]. However, none of the previous studies have addressed the association of civic responsibility and preventive behaviors while following preventive behaviors can be acknowledged as a civic responsibility during a pandemic [11].

In addition, the effect of social capital on preventive behaviors may depend on the course of a pandemic as well as the underlying political situation and social norms of the region [12]. The collective social capital in Europe was inversely associated with COVID-19 cases and death, but the association diminished when strict lockdowns were introduced [13]. Mask-wearing, which is easily visible, becomes a subject of political polarization and social identity in the United States [14] while use of face mask has been a routine in Japan long before COVID-19 [15]. Also, physical distance may vary depending on the social structure in rural and urban areas [16,17] and law enforcement such that some countries imposed lockdown [18] whereas others just imposed movement restrictions [19]. However, most of the previous research was conducted in a single country or region to cover these aspects.

We hypothesized that social capital is associated with preventive behaviors toward COVID-19 and the association is different by types of social capital and preventive behaviors and changes overtime. This study investigated the association between social trust, group affiliations, civic responsibility, and confidence in state institutions, and preventive behaviors toward COVID-19 in different countries using time series data.

2. Methods

2.1. Data sources and variables

For the preventive behaviors against COVID-19, we used the repeated cross-sectional country-level data from the COVID-19 Beliefs, Behaviors and Norms Survey (https://covidsurvey.mit.edu/) [20], jointly implemented by Johns Hopkins University Bloomberg School of Public Health’s Center for Communication Programs, Massachusetts Institute of Technology, the World Health Organization, and Facebook’s Data for Good. This survey included the time series data of every fortnight starting from July 2020 and related to COVID-19 knowledge, attitude, and practice of Facebook users from 23 countries. These countries were selected based on whether there was a sufficient pool of Facebook users for sampling, since the target sample size was 3000 respondents in each wave. The Facebook team sent invitations to active Facebook users over 18 years old to participate. Nonresponse and coverage weights were applied to ensure that survey responses were consistent with the age and gender distribution of the corresponding administrative region [20]. For this study, we used the data from wave 1 (July 6, 2020) to wave 9 (October 26, 2020) resulting in the sample size of 207 data points for 9 waves of 23 countries and each point represented country-level data for each wave (time). The global survey assessed the preventive behaviors taken against COVID-19 with the multiple-choice question, “What measures have you taken to prevent infection from COVID-19 in the past week?“. The choices included following 11 items: 1) hand hygiene, 2) covering while coughing or sneezing, 3) avoiding close contact with patients, 4) use of face mask, 5) physical distancing for 1 m and 2 m, 6) avoiding touching eyes, nose, and mouth with unwashed hands, 7) taking herbal supplements, homeopathic remedies, flu vaccine, and antibiotics, 8) using caution to open letters and packages, 9) eating ginger, garlic and lemon, 10) cleaning or disinfecting surfaces and mobile phones, and 11) self-isolation. Among these items, we selected hand hygiene, physical distancing, and use of face mask as these measures were recommended by previous literature for the prevention of COVID-19 [3–5]. Further, we calculated the percentage of those who chose hand hygiene, physical distancing, and use of face mask for each country for nine time points.

For social capital, we used the result of factor analysis conducted and reported by Elgar and colleagues [8]. They used the individual responses from the latest wave of World Value Survey [21] to derive country-level social capital scores in 84 countries and reduced into social trust (six items for trusting others of the same or different social background, one aspect of bonding and bridging social capital), group affiliations (four items reflecting membership in a group or an organization, one aspect of bridging social capital), civic responsibility (three items reflecting one’s ideas on fulfilling the responsibilities of a citizen) and confidence in state institutions (three items related to trusting the authority, one aspect of linking social capital). Therefore, we adopted aspects of bonding and bridging social capital as social trust, group affiliations and civic responsibility and linking social capital as confidence in state institutions. We standardized the factor scores on each social capital measurement so that one unit change in social capital is equal to one standard deviation difference (i.e., Z-score). In their study [8], perceiving unfairness in claiming undue benefits, avoiding public transportation fees, cheating on taxes, and accepting bribes largely contributed to the factor of civic engagement. In our paper, we renamed the term “civic engagement” to “civic responsibility”, so as not to confuse it with the usual expression of civic engagement, which includes volunteered civic engagement and civic participation. “Civic responsibility” in this context means avoiding bribes and undue benefits from the government and regularly paying taxes.

2.2. Covariates

As covariates, we used standardized Gini coefficient as the income inequality data from the Standardized World Income Inequality Database [22], total COVID-19 death per million from July 1 to November 25 from COVID-19 data repository at Johns Hopkins University [23] since both were associated with social capital [8]. Other covariates include GDP per capita (gross domestic product at purchasing power parity (constant 2011 international dollars, at most recent year available) and proportion of population above age
65 from the World Bank, world development indicators [24]. We also adjusted for age and education status as they were previously found to be associated with the preventive behaviors in the individual level [25,26]. For education status of a country, we used the education index in 2013 which is the latest available data for most countries [27]. The education index was part of the Human Development Index and was measured by combining the mean years of schooling for adults with the expected years of schooling for students under age 25 [28]. Since we also assumed that different regimes of countries may determine the prevalence of preventive behaviors [29], we added the Democracy-Dictatorship Index (DD-Index) of a country in 2018 [30].

2.3. Statistical analysis

We could link 23 countries from the seven databases, including Bangladesh, India, Indonesia, Japan, Malaysia, Pakistan, the Philippines, Thailand, Turkey, and Viet Nam from Asia; France, Germany, Great Britain, Italy, Poland, and Romania from Europe; Egypt and Nigeria from Africa; Mexico and the United States of America from North America; and Brazil, Colombia, and Argentina from South America. First, we used Pearson correlation to examine correlations among the variables. Second, we investigated the association between preventive behaviors and social capital using the multilevel linear regression analysis with the random intercepts model, each wave as level 1 and country as level 2. Model 1 examined the association between preventive behavior and each social capital measure with wave of the survey adjusted as a continuous variable. Model 2 was adjusted for all social capital variables, Gini coefficient, total death per million from July 1, GDP per capita, and % population above age 65 in addition to Model 1. A linear time interaction was performed because prior literature showed that during a pandemic, the association between preventive behaviors and social trust increased over time [10] and the association with confidence in government decreased over time [31]. Model 3, 4, 5, and 6 included interactions between each social capital measure (i.e., social trust, group affiliations, civic responsibility, and confidence in state institutions, respectively) and wave as continuous variables. Model 7 included interactions between all social capitals and wave to examine whether the association of social capital changes with time. To confirm the changes of association between preventive behaviors and social capital measures with time, we also perform multivariate linear regression between preventive behaviors of each wave and social capital measures. We used Stata version 16.0 for all analyses.

The present study was based on country-level aggregate data available on the web or reported in a previous literature. No ethics approval was required.

3. Results

Table 1 shows the descriptive characteristics of key variables and the correlations between original values of social capital (before standardization) and preventive behaviors. The mean percentage of performing physical distancing was 72.8% (SD = 47.1, 91.6), that of hand hygiene was 85.1% (SD = 72.2, 94.2) and that of the use of face mask was 87.7% (SD = 65.5, 95.9). Social trust correlated positively with all preventive behaviors: physical distancing (r = 0.49, p < 0.05), hand hygiene (r = 0.50, p < 0.05), use of face mask (r = 0.22, p < 0.05). Civic responsibility correlated negatively with all preventive behaviors: physical distancing (r = −0.34, p < 0.05), hand hygiene (r = −0.30, p < 0.05), use of face mask (r = −0.35, p < 0.05). Group affiliations correlated positively with physical distancing (r = 0.31, p < 0.05) and the use of face mask (r = 0.22, p < 0.05), but not with hand hygiene. Confidence in state institutions did not correlate with any preventive behavior. Supplementary Table 1 shows the mean percentage of preventive behaviors and social capital measures (z-score) of participating 23 countries. The average number of respondents per wave ranged from 3014.2 in Pakistan to 3945.78 in Vietnam. Regarding preventive behaviors, Pakistan had the lowest percentage of hand hygiene (76.1%) and physical distancing (54.0%) and Egypt has the lowest percentage of using a face mask (72.5%).

The results show the means of the multilevel linear regression for the association between social capital measures and each preventive behavior. An increase in one standard deviation of social trust increased 5.38 points of physical distancing (Model 1; β = 5.38, 95% CI: 4.66, 6.02, 95% CI: 1.69, 9.07, P < 0.004); however, the association became non-significant after adjusting for other covariates (Model 2; β = 0.85, 95% CI: 0.79, 3.49, P = 0.53). According to Model 2, an increase in one standard deviation of group affiliations increased 2.96% points (β = 2.96, 95% CI: 0.35, 5.58) and civic responsibility decreased 4.66% points (β = −4.66, 95% CI: 7.23, −2.09) of physical distancing. The interaction analysis of all social capitals and wave indicated that the association between social trust and physical distancing significantly increased with time (Model 7; β = 0.29, 95% CI: 0.15, 0.44) (Fig. 1a) and that the inverse association between civic responsibility and physical distancing significantly became greater with time (Model 7; β = −0.23, 95% CI: 0.38, −0.08) (Fig. 1c).

| Variable                        | Correlations      | 1       | 2       | 3        | 4        | 5       | 6       | 7       | 8       |
|---------------------------------|-------------------|---------|---------|----------|----------|---------|---------|---------|---------|
| Social trust                    |                   |         |         |          |          |         |         |         |         |
| Group affiliations              |                   |         |         |          |          |         |         |         |         |
| Civic responsibility            |                   |         |         |          |          |         |         |         |         |
| Confidence in state institutions|                   |         |         |          |          |         |         |         |         |
| Preventive behavior: Physical distancing, % |                   |         |         |          |          |         |         |         |         |
| Preventive behavior: Hand Hygiene, % |                   |         |         |          |          |         |         |         |         |
| Preventive behavior: Use of face mask, % |                   |         |         |          |          |         |         |         |         |

Abbreviation: standard deviation, SD.

* P-value < 0.05.
Table 2
Association between social capital and preventive behavior across waves; result from multilevel linear regression.

| Variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 |
|-----------|---------|---------|---------|---------|---------|---------|---------|
|           | \(\beta\) (95% CI) | \(\beta\) (95% CI) | \(\beta\) (95% CI) | \(\beta\) (95% CI) | \(\beta\) (95% CI) | \(\beta\) (95% CI) | \(\beta\) (95% CI) |
| **Outcome: use of face mask (%)** | | | | | | | |
| Social trust (unit: 1SD) | 5.38 | (1.69, 9.07)* | -0.45 | -0.45 | -0.45 | -0.45 | -0.45 |
| Civic responsibility (unit: 1SD) | -3.81 | (-7.81, 0.20) | -3.77 | -3.77 | -3.77 | -3.77 | -3.77 |
| Confidence in state institutions (unit: 1SD) | -1.23 | (-5.50, 3.04) | -0.87 | -0.87 | -0.87 | -0.87 | -0.87 |
| Wave (continuous) | -0.77 | (-0.92, -0.61) | -0.77 | -0.77 | -0.77 | -0.77 | -0.77 |
| Interaction term: social trust X wave | 0.26 | (0.11, 0.41)* | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 |
| Interaction term: civic responsibility X wave | -0.18 | (-0.33, -0.03) | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 |
| Interaction term: confidence in state institutions X wave | 0.06 | (-0.09, 0.21) | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 |
| R-square | 0.803 | 0.807 | 0.803 | 0.805 | 0.803 | 0.810 | |
| **Outcome: perform hand hygiene (%)** | | | | | | | |
| Social trust (unit: 1SD) | 2.49 | (0.91, 4.08)* | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| Civic responsibility (unit: 1SD) | -1.50 | (-3.28, 2.43) | -2.61 | -2.61 | -2.61 | -2.61 | -2.61 |
| Confidence in state institutions (unit: 1SD) | -0.07 | (-1.96, 1.81) | -1.13 | -1.13 | -1.13 | -1.13 | -1.13 |
| Wave (continuous) | -0.44 | (-0.53, -0.35) | -0.44 | -0.44 | -0.44 | -0.44 | -0.44 |
| Interaction term: social trust X wave | 0.16 | (0.08, 0.25)* | -0.07 | -0.07 | -0.07 | -0.07 | -0.07 |
| Interaction term: civic responsibility X wave | -0.06 | (-0.14, 0.03) | -0.10 | -0.10 | -0.10 | -0.10 | -0.10 |
| Interaction term: confidence in state institutions X wave | 0.02 | (-0.07, 0.09) | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| R-square | 0.780 | 0.788 | 0.782 | 0.781 | 0.781 | 0.792 | |
| **Outcome: use of face mask (%)** | | | | | | | |
| Social trust (unit: 1SD) | 1.35 | (-0.77, 3.46) | -0.50 | -0.50 | -0.50 | -0.50 | -0.50 |
| Civic responsibility (unit: 1SD) | -2.11 | (-4.12, -0.09)* | -3.95 | -3.95 | -3.95 | -3.95 | -3.95 |
| Confidence in state institutions (unit: 1SD) | 0.65 | (-1.52, 2.82) | 1.96 | 1.96 | 1.96 | 1.96 | 1.96 |
| Wave (continuous) | -0.06 | -0.06 | -0.06 | -0.06 | -0.06 | -0.06 | -0.06 |
Table 2 (continued)

| Variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 |
|-----------|---------|---------|---------|---------|---------|---------|---------|
| β (95% CI) | β (95% CI) | β (95% CI) | β (95% CI) | β (95% CI) | β (95% CI) | β (95% CI) | β (95% CI) |
| Interaction term: social trust X wave  | (-0.21,0.09)* | (-0.20,0.08)* | (-0.21,0.09)* | (-0.21,0.09)* | (-0.21,0.09)* | (-0.20,0.08) | 0.44 |
| Interaction term: group affiliations X wave | 0.42 | (0.27,0.56)* | | | | | |
| Interaction term: civic responsibility X wave | 0.03 | 0 | (-0.12,0.19) | | | | |
| Interaction term: confidence in state institutions X wave | 0.03 | 0 | (-0.12,0.19) | | | | |
| R-square | 0.669 | 0.701 | 0.670 | 0.672 | 0.671 | 0.709 | |

Abbreviations: confidence interval, CI; standard deviation, SD.

Model 1: Adjusted for wave (continuous).
Model 2: Adjusted for wave (continuous), all social capital measures, Gini coefficient, Total death per million from July 1st, GDP per capita, education index, DD Index and % population above age 65.
Model 3: Model 2 + interaction between social trust and wave (as continuous variable).
Model 4: Model 2 + interaction between group affiliations and wave (as continuous variable).
Model 5: Model 2 + interaction between civic responsibility and wave (as continuous variable).
Model 6: Model 2 + interaction between confidence in state institutions and wave (as continuous variable).
Model 7: Model 2 + interaction between all social capitals and wave (as continuous variable).

*Significant results (P-value < 0.05).

Fig. 1. (a): Association between physical distancing and social trust across waves. (b): Association between physical distancing and group affiliations across waves. (c): Association between physical distancing and civic engagement across waves. (d): Association between physical distancing and confidence in state institutions across waves.
There were no significant changes with time in the association between group affiliations and physical distancing (Model 7; $\beta = -0.08$, 95% CI: 0.23, 0.07) nor confidence in state institutions (Model 7; $\beta = 0.06$, 95% CI: 0.09, 0.20). Supplementary Fig. 1 shows the comparison of the percentages of performing physical distancing stratified by three groups based on social trust level of countries (high, middle, and low) across waves. The percentage of performing physical distancing was more likely to increase throughout time among countries with high social trust.

Regarding hand hygiene, an increase in one standard deviation of social trust increased 1.22% points (Model 2; $\beta = 1.22$, 95% CI: 0.09, 2.35). An increase in one standard deviation of civic responsibility decreased 2.88% points of performing hand hygiene ($\beta = -2.88$, 95% CI: 3.98, -1.78). The interaction analysis indicated that the association between social trust and hand hygiene significantly increased with time (Model 7; $\beta = 0.18$, 95% CI: 0.09, 0.26) (Fig. 2a). The association of hand hygiene over group affiliations and civic responsibility decreased slightly with time (Model 7; $\beta = 0.10$, 95% CI: 0.18, -0.01) (Fig. 2b and c). Supplementary Fig. 2 compared the percentages of performing hand hygiene among countries according to the level of social trust and the percentage of hand hygiene in countries with high social trust increased throughout time.

Regarding the use of face mask, an increase in one standard deviation of group affiliations increased 1.80% points of use of face mask after adjusting for all variables (Model 2; $\beta = 1.80$, 95% CI: 0.45, 3.16). An increase in one standard deviation of civic responsibility decreased 3.95% points ($\beta = 3.95$, 95% CI: 5.29, -2.62). The interaction analysis of wave and social trust indicated that the association between social trust and the use of face mask significantly increased with time (Model 7; $\beta = 0.44$, 95% CI: 0.30, 0.58) (Fig. 3a) and the negative association between civic responsibility and use of face mask more negative with time (Model 7; $\beta = -0.17$, 95% CI: 0.31, -0.02) (Fig. 3c). There were no significant changes with time in the association between other social capital measures and the use of face mask. Supplementary Fig. 3 showed that the mean percentage of using a face mask in countries with high social trust increased sharply with time.

Supplementary Table 2 shows the association between social capital and the percentage points of preventive behaviors in each wave.

Fig. 2. (a): Association between hand hygiene and social trust across waves. (b): Association between hand hygiene and group affiliations across waves. (c): Association between hand hygiene and civic engagement across waves. (d): Association between hand hygiene and confidence in state institutions across waves.
4. Discussion

This study investigated the association between social capital and the COVID-19 preventive behaviors from July to October 2020 in 23 countries. We found that civic responsibility was inversely associated with all preventive behaviors throughout the time. The social trust was positively associated with performing hand hygiene and the interaction analyses showed that the association of social trust and all preventive behaviors significantly increased with time. Group affiliations were positively associated with performing social distancing and the use of face mask whereas confidence in state institutions had no association with preventive behaviors.

Previous studies mainly conducted in Europe and the United States have proved that transparency and organ donation is associated with better health outcomes [32], preventive behaviors [10,33] as well as less cases of COVID-19 [13]. However, when countries of diverse sociopolitical background were included, an inverse association between civic responsibility and preventive behavior was found, and this association would be explained through two mechanisms. A study on cultural bondage and COVID cases [34] found that more constrained countries had fewer cases. Also, the predominance of individualism, which diminished preventive behavior [35] and increased COVID-19 mortality [29], was correlated with more civic responsibility [36]. Thus, in countries with low individualism and civic responsibility scores, citizens were more subjected to restrictions and likely to comply with preventive measures. According to the study on tax evasion [37], in countries where citizens cheated on taxes or accepted bribes (i.e., low civic responsibility), the people were less confident on the public facilities of their country and this effect might pronounce especially during the time of a pandemic [38]. This led to a greater fear of infection on poor COVID-19 prevention policy, which result in more thorough preventative measures for self-protection [19].

In this study, social trust had positive association with only hand hygiene but not with other behaviors, which is inconsistent with previous studies [31,39]. However, interaction analysis suggested that the association between social trust and preventive behaviors had increased with time during the study period. A literature review proposed that whether social trust has a positive impact on COVID-19 preventive behaviors depends on the beliefs of most people [12]. In the early phase of a pandemic, the association between social trust and preventive behavior is likely to be low because most people are not well informed or overloaded with the information.

![Graph](image-url)
and hence unlikely to engage in preventive behaviors [40]. The association may increase over time as people’s knowledge and commitment to preventive behavior increases.

Although participation in the religious group was found to be associated with COVID-19 mortality [41], our result suggested that group affiliations had a positive association with the physical distancing and face mask use. Members of a social circle might follow preventive measures as a social identity during the pandemic [42]. Group participation may also reinforce community collectivism and increase motivation to take preventive action while reducing the fear of COVID-19 [43]. Active group participants might take preventive behaviors while maintaining the personal contact and that would increase mortality rates even with preventive behaviors compared to non-participants [8,41]. The present study did not find an association between confidence in the state and preventive behaviors. A study in Japan proved that trust in the government was associated with COVID-19 mortality only in the early stages of the pandemic and not in the later stages [44]. For the current study, the study period (July–October 2020) was the end of the first or second wave in most countries [1], and thus confidence in the state was not associated with preventive behaviors. The results of this study were inconsistent with the study that we used as the reference of measuring social capital [8] which showed that civic responsibility was negatively associated with the COVID-19 mortality and social trust and group membership were positively associated. The association between social capital and COVID-19 mortality could be explained by other factors, such as PCR test coverage and access to health care [45], rather than by preventive behaviors.

There are several limitations to this study. First, since this is an ecological study, the finding may not be applicable to the individual level. Second, social capital was measured in different years for different countries, so the values may not be comparable nor reflect the actual situation during the COVID-19 pandemic. Third, the data collected via Facebook may not reflect the entire population, especially in developing countries where younger and more socioeconomically privileged people tend to use the Internet [46]. Furthermore, since the Facebook survey was a voluntary survey conducted via the Internet, respondents would be highly aware of COVID-19 and had a high level of health awareness [47]. Therefore, it can be inferred that the above results apply to those with higher engagement in preventive behaviors rather than to the general population. Fourth, among the 84 countries that participated in the World Value Survey and had social capital scores reported in the previous study [8], the time-series data on COVID-19 preventive behaviors were available for only 23 countries. This study may be limited in the number of countries to be referred as a global comparative study. Since some of the associations shown in this study were inconsistent with previous studies, it is highly recommended to compare global trends of individual-level preventive behaviors during a pandemic.

5. Conclusions

This study found that civic responsibility of a country is negatively associated with preventive behaviors against COVID-19. Thus, we must enforce those citizens of countries with high civic-responsibility score to engage more in personal preventive behaviors. Further research using individual level data is needed.

Credit author statement

Yu Par Khin: Conceptualization, Methodology, Software, Formal Analysis, Writing- Original Draft, Visualization, Yusuke Matsuyama: Methodology, Formal Analysis, Validation, Writing- Review & Editing, Takeo Fujiwara: Validation, Writing- Review & Editing, Supervision

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijdrr.2022.103335.

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