Social Science & Medicine 286 (2021) 114335

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

A multi-national test on self-reported compliance with COVID-19 public health measures: The role of individual age and gender demographics and countries' developmental status

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ARTICLE INFO

Keywords:
COVID-19
Age
Gender
Public health measures
Compliance
Human development index

ABSTRACT

Rationale/objective: The COVID-19 pandemic has brought far-reaching consequences on individual and societal levels. Social distancing and physical hygiene constitute effective public health measures to limit the spread of the virus. This study investigated age and gender demographics, in tandem with national levels of human development, as crucial factors influencing self-reported compliance with COVID-19-related public health measures.

Methods: The present study leveraged a large multi-national sample that ranged across the adult lifespan (18–100 years) and comprised 45,772 women and men from 66 countries/territories. Data were collected in Spring (2020) during the earlier phase of the COVID-19 pandemic. Self-reports of compliance with two public health measures (spatial distancing and physical hygiene) were assessed via online survey. Human Development Index (HDI), developed by the United Nations Development Program, was used as a proxy of a country's achievement in key dimensions of human development.

Results: Older age, female gender, and lower HDI were independently associated with greater self-reported compliance. A significant three-way interaction further revealed that self-reported compliance was lowest in young males from well-developed countries, while highest among females across all ages from less-developed countries.

Conclusion: The study offers an integration of individual-level and country-level demographic predictors of self-reported compliance and allows for robust testing in a large multi-national adult lifespan sample for enhanced generalizability. The results highlight the potential of data-driven, tailored (i.e., towards specific demographics, countries) health campaigns and public policies in the fight against a global pandemic.

1. Introduction

Across the world, people have been experiencing the far-ranging consequences of the COVID-19 pandemic since its origins at the end of 2019. Many have discovered that these consequences can permeate all aspects of life, including physical health, mental health, social interactions as well general public sentiments on society and politics (Van Bavel et al., 2020a). The success of public health measures to reduce coronavirus spread relies on behavioral compliance on country, state, and individual levels. For example, adherence to spatial distancing, including shelter-in-place orders, closures of schools and public venues, and the ban on large gatherings, has significantly contributed to reducing the spread of COVID-19 around the globe (e.g., United States: Courtemanche et al., 2020; Finland: Kuitunen et al., 2020; China: Wang et al., 2020). Similarly, wearing face masks has slowed the transmission of the virus (Chen et al., 2020), especially when adopted by pre-symptomatic individuals (MacIntyre and Chughtai, 2020). As COVID-19 continues to pose a significant public health threat worldwide, and in anticipation of similar future viral outbreaks, it is critical to understand the factors that contribute to compliance with public health measures aimed at mitigation of transmission risk.

A united front against the COVID-19 pandemic via endorsement of effective public health measures is especially relevant for individuals at risk for severe complications from COVID-19, such as adults aged 65

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https://doi.org/10.1016/j.socscimed.2021.114335
Received 22 March 2021; Received in revised form 29 July 2021; Accepted 19 August 2021
Available online 20 August 2021

years and older. Across the world, many more older adults than younger adults have died from COVID-19 (Yanez et al., 2020). As of June 2021, the COVID-19 pandemic had claimed more than 3.8 million lives world-wide and more than 550,000 lives in the United States (World Health Organization, 2021), with more than 75% of reported deaths in the United States being individuals 65 years or older (CDC, 2021). A meta-analysis using samples from five countries found that the mortality rate due to COVID-19 increased in an exponential manner from less than 1% in individuals in their 40s to nearly 30% in individuals older than 80 years (Bonanad et al., 2020). This risk of COVID-19 mortality in older adults is likely heightened by comorbidities prevalent at older ages (Ssentongo et al., 2020). Not surprisingly, previous studies documented better compliance with COVID-19 public health measures among older than younger adults (Brankston et al., 2021; Daoust, 2020; but see Clark et al., 2020).

There also are striking differences between men and women globally, with males more likely to die of COVID-19 than females (Chen et al., 2020; Wenham et al., 2020). Also, women have better compliance with COVID-19 public health policies (Galasso et al., 2020), greater usage of preventive care services such as blood pressure and cholesterol checkups or the flu shot (Vaidya et al., 2012; Sobol et al., 2020), and less risk-taking behavior (Pawlowski et al., 2008) than men. As such, understanding the role of gender in health behaviors is likely critical to mitigating the spread of COVID-19. These gender differences in compliance have been discussed in the context of an impact of gender stereotypes (e.g., wearing a face mask represents a sign of weakness) on behaviors in medical settings (Capraro and Barcelo, 2020).

Individual-level demographic (i.e., age and gender) differences in compliance with public health measures may further vary among countries at different levels of development. The large majority of previous studies on demographic differences in compliance with public health measures was based on data from a single country (Brankston et al., 2021; Sobol et al., 2020; Uddin et al., 2021) or a small group of countries (Clark et al., 2020), representing only a narrow scope of cultural backgrounds and regional variety. Also, these studies did not examine the impact of individual-level predictors, like age and gender, as a function of country-level predictors (e.g., a country's developmental status) on compliance with public health measures during the COVID-19 pandemic.

Another shortcoming is that prior work was not able to compare these patterns in a large multi-national sample that included countries of different developmental status. Understanding whether these relationships hold in less developed countries is especially important since these countries are the last to receive large quantities of the vaccine during the current pandemic. Moreover, people from more developed countries have longer life expectancy, higher education levels, and better living conditions (Stanton, 2007). These advantages may facilitate a country's overall compliance with health-protective measures.

Thus, age and gender differences in compliance with public health measures during the COVID-19 pandemic may be less pronounced in more developed countries. However, two recent studies found higher COVID-19 infection and/or mortality rates in more developed countries (Huang et al., 2020; Shahbazi and Khazaei, 2020). Of note, the limited capacity for screening and detecting COVID-19 in some countries, especially less developed countries, as well as differences in reporting practice and case calculation across countries, challenge the comparability of statistics pertaining to COVID-19 infection and/or mortality rates across nations/territories. This somewhat counterintuitive evidence of higher COVID-19 infection and/or mortality rates in more developed countries, combined with a lack of research on the association between public health compliance and national levels of human development, warrants the study of the impact of a country's development status on the association between age/gender and compliance with COVID-19 public health measures.

1.1. Current research

The present study offered unique opportunities to broaden the conceptual scope of previous investigations, enhance generalizability of the findings, and assure robust testing by determining the role of individual age and gender demographics, in interplay with national levels of human development, on self-reported compliance with COVID-19 public health measures in a large ($N = 45{,}772$) adult lifespan sample of women and men. Participants were surveyed in the early phases of the pandemic across 66 countries/territories. Based on previous findings regarding age and gender differences in adherence to public health policies (Chen et al., 2020; Ssentongo et al., 2020; Wenham et al., 2020), we expected that older adults and women would report greater willingness to comply with public health measures to contain the COVID-19 pandemic than young adults and men, respectively.

We used the Human Development Index (HDI), developed by the United Nations Development Program, as a proxy of a country's achievement in key dimensions of human development (i.e., life expectancy, education, gross national income per capita; Dasic et al., 2020; Engineer et al., 2008; Human Developments Report, n.d.), to examine the interplay of this country-level demographic predictor with effects of individual age and gender on self-reported compliance with public health measures targeted at containing the COVID-19 pandemic across a large variety of nations, varying in developmental status. We predicted that age- and gender-demographic differences would be more pronounced in countries with lower HDI scores.

2. Methods

This report leveraged data from a publicly available, large-scale, multi-national dataset (see Van Bavel et al., 2020b). Data were collected during the earlier phase of the pandemic (April to May 2020) by a synchronized international team of researchers. Only information and measures relevant for the present analysis are reported here. We retrieved the data on January 18th, 2021.

2.1. Participants

The original dataset consisted of 46,769 individuals across 67 countries/territories, with nationally representative samples from 30 countries, convenience samples from 34 countries, and a combination of both sampling approaches from 3 countries. The present analysis comprised 45,772 individuals from 66 countries/territories (Mean Age $= 43.08$ yrs, $SD = 16.05$; range: 18–100 years; 51.95% females). 833 individuals (all from Taiwan) were excluded from the present analysis due to missing HDI data. In addition, data from 139 individuals were not included as they reported gender as 'other', and we did not have sufficient statistical power to analyze this category across countries.

2.2. Procedures and measures

The protocol was approved by the ethics board at the University of Kent. Below, we introduce measures used in the present analysis (see Van Bavel et al., 2020b for a report about the larger project). After consent, participants completed the online survey with questionnaires/scales presented in randomized order.

Self-Reported Compliance with Public Health Measures was computed using two individual scales, measuring self-reported compliance with spatial distancing and self-reported compliance with physical hygiene, respectively (see Table 1 for sample items and descriptive statistics). Each scale was measured via five items on an 11-point Likert scale (0 = *Strongly disagree*, 5 = *Neither agree nor disagree*, 10 = *Strongly agree*). Cronbach's α across the ten items was 0.81, suggesting a decent internal consistency among these two facets of public health measures. We therefore computed the average across all 10 items to indicate overall self-reported compliance with public health measures, with higher

Table 1
Sample items and descriptive statistics of the individual scales aggregated in the *Self-Reported Compliance with Public Health Measures* composite.

Individual Scale	Sample Item	Mean (*SD*)	Cronbach's α
Spatial Distancing	*During the coronavirus pandemic, I have been staying at home as much as practically possible.*	8.35 (*1.69*)	0.73
Physical Hygiene	*During the coronavirus pandemic, I have been washing my hands longer than usual.*	7.93 (*1.89*)	0.79

Note. Each individual scale comprised five items for self-report using an 11-point Likert scale (0 = *Strongly disagree*; 5 = *Neither agree nor disagree*, 10 = *Strongly agree*). *Self-Reported Compliance with Public Health Measures*, the central outcome in this report, was computed as the average of the two scales.

scores reflecting higher self-reported compliance ($M = 8.14$, $SD = 1.51$).

Chronological Age (continuous; measured in years) and *Gender* (categorical: 1 = *Male*, 2 = *Female*; 3 = *Other*) were collected via two self-report items.

Human Development Index is an indicator of achievement in critical dimensions of human development, including life expectancy, education, and gross national income per capita (i.e., standard of living). Higher HDI scores reflect a higher development status of a country. The HDI used in this analysis was from 2018 and can be retrieved at http://hdr.undp.org/en/content/table-1-human-development-index-and-its-components-1. Among the 189 countries/territories with HDI data, countries/territories included in the present dataset covered a range from 1st to 166th in HDI ranking ($M = 0.80$, $SD = 0.12$, $Min = 0.51$, $Max = 0.95$), with 35 countries/territories falling into 'very high', 18 into 'high', 11 into 'medium', and 2 into 'low' regarding their developmental status. See the Supplementary Materials for the distribution of the HDI data in the current sample.

2.3. Analyses

We used multilevel modeling to accommodate for the nested data structure (i.e., individuals nested within countries; Enders and Tofighi, 2007). Self-reported compliance with COVID-19 public health measures (across spatial distancing and physical hygiene) constituted the outcome variable. Participant age (centered within country) and participant gender (factorial variable) served as level-1 predictors and country HDI (grand mean centered) served as level-2 predictor. Following recent findings by Daoust (2020), we examined both the linear and the quadratic effect of age in our model. We also considered the interactions between all predictors. There were very few cases (208; i.e., 0.45% of all cases in the dataset) with missing information on one (or more) of the central variables. We conducted Little's MCAR test (Li, 2013; Little, 1988) and confirmed that data were missing completely at random ($\chi^2(8) = 11.10$, $p = 0.20$), therefore we used listwise deletion in our analyses. We furthermore conducted multiple imputation on the central variables in the model (i.e., self-reported compliance with public health measures, age, gender). Results from the model using multiple imputation were consistent with results from the model with listwise deletion of cases with missing data. We report the respective parameter estimates for these two models in Table S1 in the Supplementary Materials to allow for a direct comparison. All analyses conducted were well powered given the large sample size.

3. Results

We first examined the relationships between age as well as gender and self-reported compliance with COVID-19 public health measures. The linear effect of age was significant ($B = 0.013$, $z = 8.90$, $p < 0.001$, 95% CI = [0.010, 0.016], Cohen's $f^2 = 0.016$), indicating that, overall, older age was associated with greater self-reported compliance. In addition, the quadratic effect of age was significant ($B = -0.0002$, $z = -3.56$, $p < 0.001$, 95% CI = [-0.0003, −0.0001], Cohen's $f^2 = 0.0008$), in that the linear increase in self-reported compliance with age was less pronounced in later life. There also was a significant gender main effect ($B = 0.51$, $z = 12.44$, $p < 0.001$, 95% CI = [0.43, 0.59], Cohen's $f^2 = 0.03$), in that, overall, females reported greater compliance than males.

We then examined the relationship between national levels of human development with self-reported compliance with COVID-19 public health measures. Individuals in countries with lower HDI, overall, reported greater self-reported compliance than individuals in countries with higher HDI, as reflected in a significant main effect for HDI ($B = -2.44$, $z = -4.51$, $p < 0.001$, 95% CI = [-3.51, −1.38], Cohen's $f^2 = 0.00004$). Furthermore, the interaction between gender and HDI was significant ($B = 0.64$, $z = 2.51$, $p = 0.012$, 95% CI = [0.14, 1.15], Cohen's $f^2 = 0.0005$), such that gender differences in self-reported compliance were more pronounced in countries with higher HDI.

These main effects and two-way interaction were further qualified by a significant three-way interaction between age (linear effect), gender, and HDI ($B = 0.04$, $z = 2.69$, $p = 0.007$, 95% CI = [0.012, 0.074], Cohen's $f^2 = 0.0003$; as shown in Fig. 1). To understand if the associations between age as well as gender and self-reported compliance with public health measures varied across nations, we decomposed this significant three-way interaction. Older age in males was associated with greater self-reported compliance ($B = 0.013$, $z = 9.28$, $p < 0.001$, 95% CI = [0.010, 0.016], Cohen's $f^2 = 0.016$). This effect did not vary across HDI levels ($B = -0.004$, $z = -0.22$, $p = 0.823$, 95% CI = [-0.038, 0.031], Cohen's $f^2 < 0.001$). In contrast, while older age in women was also associated with greater self-reported compliance ($B = 0.011$, $z = 8.38$, $p < 0.001$, 95% CI = [0.008, 0.013], Cohen's $f^2 = 0.016$), this effect did vary across HDI levels ($B = 0.039$, $z = 2.90$, $p = 0.004$, 95% CI = [0.013, 0.066], Cohen's $f^2 = 0.001$): In particular, in countries with lower HDI, older age in females did not affect self-reported compliance levels; in countries with higher HDI, however, older age was associated with greater self-reported compliance among females. These findings support that associations between age as well as gender and self-reported compliance with COVID-19 public health measures varied across national levels of human development.

4. Discussion

Public health policies around the world have been focused on curtailing the devastating effects of COVID-19. Individual- and population-level compliance are crucial in successful implementation of policies aimed at mitigating the risk of transmission. Here, we leveraged a unique dataset from a large-scale international collaboration, comprising a wide age range of male and female adults who were surveyed about their willingness to adopt public health measures during the earlier phase of the pandemic to contain the coronavirus spread. Replicating prior work, we found that older adults and women were more likely to report compliance with COVID-19 public health measures. We also observed a significant interaction between these three factors in that self-reported compliance was lowest in younger adults from well developed countries, while self-reported compliance was highest among females across all ages from less developed countries.

All effects reported held for a model with covariates. The covariates were participants' general health condition (continuous: 0 = *Extremely bad*, 10 = *Extremely good*), marital status (categorical: 1 = *Single*, 2 = *In a relationship*, 3 = *Married*), employment (categorical: 0 = *Unemployed*, 1 = *Employed*), tested positive for COVID (categorical: 1 = *No*, 2 = *Yes*), knowing someone who tested positive for COVID (categorical: 1 = *No*, 2 = *Yes*), country's sampling approach (categorical: 0 = *Convenience sample*, 1 = *Representative sample*), and political ideology (continuous: 0 = *Extremely liberal/left-leaning*, 5 = *Neither liberal/left-leaning nor conservative/right leaning*, 10 = *Extremely conservative/right-leaning*) at both the participant and the country level. The participant level of political ideology was the individual's score centered within the country. The country level of political ideology was the averaged individual score

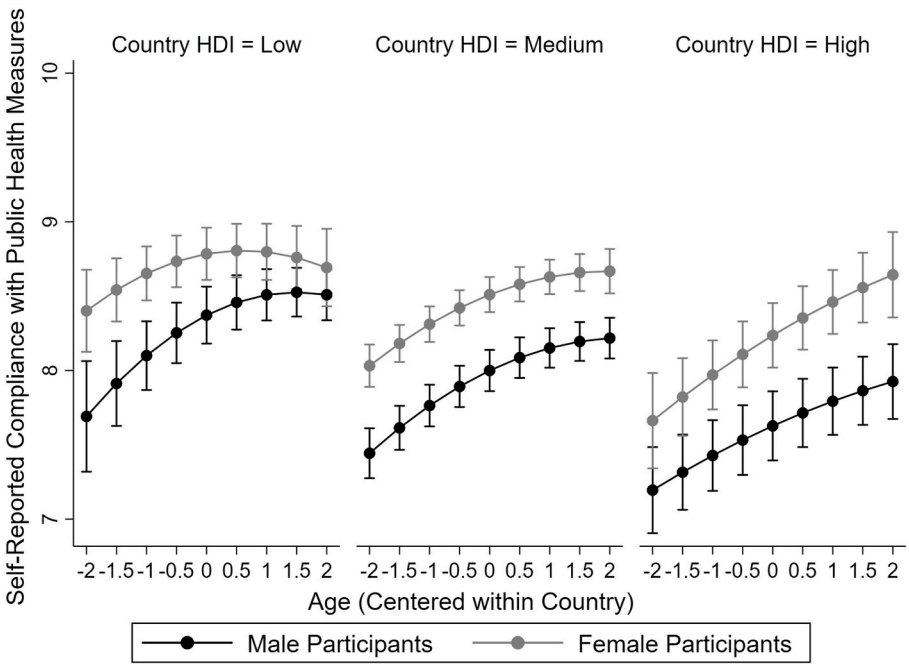

Fig. 1. Self-reported compliance with COVID-19 public health measures as a function of participant age, participant gender, and the country's human development index (HDI). The y-axis indicates self-reported compliance with public health measures (theoretical range: 0–10; mean across spatial distancing and physical hygiene). The x-axis indicates standard deviation from the country-centered mean age. Low, medium, and high HDI reflect −1.5, 0, and 1.5 standard deviations, respectively, from the HDI grand mean. Error bars indicate 95% confidence intervals.

from within a country centered within the grand mean.

Supporting our hypothesis, older age was associated with greater self-reported compliance with the public health measures of spatial distancing and physical hygiene. These results align with prior findings on greater health-related compliance among older adults (Sutherland et al., 2018) and are extended here to COVID-19 public health measures. Older adults' vulnerability to COVID-19 may enhance their subjective risk perceptions for severe disease, and they may be more inclined to engage in public-health behaviors such as social distancing and hygiene to protect themselves from infection. Additionally, older adults typically show more conscious concern for others and future generations (Cheng, 2009) and are often more motivated to engage in prosocial behavior (Bailey et al., 2021). These underlying motivations (i.e., having the well-being of other people and society at large in mind) could have contributed to older adults' greater self-reported compliance with COVID-19 public health measures; an interpretation that future research could specifically test.

Interestingly, the observed increase in self-reported compliance with age was not only linear in nature. Consistent with Daoust (2020), we found a significant quadratic age effect in addition to the positive linear age effect. The quadratic effect of age suggested relatively higher self-reported compliance with COVID-19 public health measures in late middle-aged, compared to younger and older, adults. Middle-aged individuals are approaching an age characterized by heightened vulnerability to severe consequences from COVID-19 while still often extensively exposed to risks (such as in work and family life; not yet retired and able to retrieve from public life) and may therefore be particularly motivated to adhere to protective measures.

However, our age effects diverged from prior work finding no age effect in compliance with public health measures in an international sample (Clark et al., 2020). The differences in findings may be due to methodological variations across studies, including the time of data collection (according to the pre-registration by Clark et al., the larger part of their study was completed by April 25th, 2020, thus earlier than the present data collection). Therefore, it is possible that a considerable portion of their participants was not yet fully aware of the severity of COVID-19 and/or the effectiveness of spatial distancing and physical hygiene in containing the virus. In line with this possibility, in Clark et al., the mean score of self-reported compliance was overall low (e.g., lower than 3 on a 5-point scale from 1 = *Very disagree* to 5 = *Very agree*), while in the present study, as shown in Fig. 1, even the young males from well developed countries, that is the group with the lowest self-reported compliance, reported compliance higher than 7 on a 11-point scale from 0 = *Strongly disagree to 10* = *Strongly agree*.

In line with prior research, we found that women overall reported greater compliance than men. Similar processes related to increased generativity and prosociality among women compared to men (Bailey et al., 2021) may have contributed to these gender differences. It is also possible that gender stereotypes and gender roles contributed to the observed differences between women and men in compliance with COVID-19 public health measures. For example, a recent study found that men were less willing to wear a face mask than women because men compared to women were more likely to believe that wearing a face mask represents a sign of weakness (Capraro and Barcelo, 2020). Additionally, societal norms typically still associate women with the role of the informal caregiver within families (Connor et al., 2020). Possibly influenced by these social expectations, women may be more willing to adopt healthy behaviors to keep themselves and others (e.g., in their family) safe.

Multi-generational households are more common in less developed countries and communities (National Institute on Aging, 2011), and younger women in these contexts typically not only take care of themselves and their children but also elder family members. In line with this interpretation, women in countries with lower HDI, independent of their age, were highly compliant with public health measures geared towards reducing coronavirus transmission risk. Additionally, it is also possible that restrictions related to external (i.e., outside the home) work contexts, and likely particularly so in low HDI countries, could have contributed to men being less willing (or able) to comply with protective public health measures, as in low HDI countries men typically constitute the paid workforce (World Bank, 2012).

Somewhat unexpectedly, it was the younger adults in countries with higher HDI, and among those particularly the younger males, who reported the least compliance with protective public health measures. Future research should specifically explore this low willingness to comply among this demographic group; by, for example, considering subjective health risk perception (Smith, 2006) and/or conspiracy theory beliefs (Romer and Jamieson, 2020) in their impact on protective health behavior adoption.

4.1. Strengths and limitations

The present analysis was exclusively based on self-report. The patterns observed in this study should be replicated via behavioral and more objective data (e.g., use of personal protective equipment, use of public transportation, travel, visitor count at tourist attractions). While social desirability may have affected our participants' self-reported willingness to comply with COVID-19 public health measures, recent work by Daoust et al. (2021) suggests a homogeneous impact of social desirability across age, gender, and education; that is social desirability is unlikely to explain the age and gender variations in self-reported compliance with COVID-19 public health measures observed in our study and supports the use of self-report in this line of investigation (Larsen et al., 2020).

The current dataset had a uniquely wide global representation. However, some countries/territories such as from Africa and Southeastern Asia/Middle Asia were less well represented, somewhat limiting the generalization of the findings globally. Furthermore, HDI as a reflection of national levels of human development in the present study was highly correlated with national representativeness of the sample. However, as our control analysis showed, effects reported here were not accounted for by sampling approach (convenience sample vs. representative sample).

At the time of this data collection some countries were already significantly affected by the pandemic while others were not (yet). Thus, future work could consider the impact of variables such as objective case numbers/death toll and/or specific restrictions in place as well as the extent to which information about COVID-19 was distributed at time of data collection on compliance with public health measures.

5. Conclusion

The large majority of previous studies on public health behavior during the COVID-19 pandemic was based on data from a single country or a small group of countries, representing a narrow scope of cultural backgrounds. Also, previous work did not systematically integrate individual-level predictors, like age and gender, with country-level predictors (e.g., national levels of human development) on self-reported compliance with COVID-19 public health measures in a large sample that allows for robust testing of effects of interest. Thus, our study goes importantly beyond previous research by determining the role, and interplay, of age, gender, and HDI on self-reported compliance with COVID-19 public health measures in a sample that spans across a very wide range of cultural backgrounds and country-developmental levels. In addition to offering a wider scope than previous studies, adding methodological strength, our study leveraged a large dataset (N = 45,772) of women and men covering a wide age range for a robust test of the effects of interest, offering broader generalizability than previous approaches. We found that age and gender, in tandem with national levels of human development, affect individuals' self-reported compliance with COVID-19 public health measures. These findings have potential for translational impact by highlighting the importance for governments and health organizations to design health campaigns and public policies based on data and tailor them towards specific demographics and nations, instead of applying a one-size-fits-all approach in their fight against future vial outbreaks and global pandemics.

Declaration of competing interest

All authors declare no competing interests.

Acknowledgment

We appreciate the willingness of all participants to contribute to this research and all research labs involved in data collection and for data management.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2021.114335.

Funding

J.V. Bavel was supported by a grant from the John Templeton Foundation (#61378); T. Lin, A. Heemskerk, and N.C. Ebner were supported by NIH/NIA grant 1R01AG057764; E. Harris was supported by the Social Science and Humanities Research Council of Canada (752-2018-0213). This report uses data from Van Bavel et al. (2020; https://psyarxiv.com/ydt95/for details).

Data sharing

All measures will be made publicly available upon publication at the Open Science Framework website upon publication of Van Bavel et al. (2020; https://psyarxiv.com/ydt95/for details). Data collection was initiated in response to the COVID-global pandemic and started as early and to the extent that was logistically possible. Design and analysis plans for this report were not preregistered.

Credit author statement

Tian Lin: Conceptualization, Methodology, Formal Analysis, Writing – Original Draft, Writing –, Review & Editing, Visualization, Elizabeth A. Harris: Investigation, Resources, Data Curation, Writing – Review & Editing, Amber Heemskerk: Writing – Original Draft, Writing – Review & Editing, Jay J. Van Bavel: Conceptualization, Investigation, Writing – Review & Editing, Supervision, Project administration, Funding acquisition, Natalie C. Ebner: Conceptualization, Methodology, Writing – Review & Editing, Supervision, Funding acquisition.

References

Bailey, P.E., Ebner, N.C., Stine-Morrow, E.A.L., 2021. Introduction to the special issue on prosociality in adult development and aging: advancing theory within a multilevel framework. Psychol. Aging 36 (1), 1–9.

Brankston, G., Merkley, E., Fisman, D.N., Tuite, A.R., Poljak, Z., Loewen, P.J., Greer, A.L., 2021. Socio-demographic disparities in knowledge, practices, and ability to comply with COVID-19 public health measures in Canada. Can. J. Public Health 112 (3), 363–375.

Bonanad, C., Garcia-Blas, S., Tarazona-Santabalbina, F., Sanchis, J., Bertomeu-González, V., Facila, L., Ariz, A., Núñez, J., Cordero, A., 2020. The effect of age on mortality in patients with COVID-19: a meta-analysis with 611,583 subjects. J. Am. Med. Dir. Assoc. 21 (7), 915–918.

Capraro, V., Barcelo, H., 2020. The effect of messaging and gender on intentions to wear a face covering to slow down COVID-19 transmission. J. Behav. Econ. Policy 4 (Special Issue 2), 45–55.

Centers for Disease Control and Prevention, 2021. June 9). COVID-19 Provisional Counts - Weekly Updates by Select Demographic and Geographic Characteristics. Centers for Disease Control and Prevention. https://www.cdc.gov/nchs/nvss/vsrr/covid_weekly/index.htm.

Chen, N., Zhou, M., Dong, X., Qu, J., Gong, F., Han, Y., Zhang, L., 2020. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 395 (10223), 507–513. https://doi.org/10.1016/S0140-6736(20)30211-7.

Cheng, S.T., 2009. Generativity in later life: perceived respect from younger generations as a determinant of goal disengagement and psychological well-being. J. Gerontol. B Psychol. Sci. Soc. Sci. 64 (1), 45–54. https://doi.org/10.1093/geronb/gbn027.

Clark, C., Davila, A., Regis, M., Kraus, S., 2020. Predictors of COVID-19 voluntary compliance behaviors: an international investigation. Global Trans. 2, 76–82.

Connor, J., Madhavan, S., Mokashi, M., Amanuel, H., Johnson, N.R., Pace, L.E., Bartz, D., 2020. Health risks and outcomes that disproportionately affect women during the Covid-19 pandemic: *a review*. Soc. Sci. Med. 266, 113364. https://doi.org/10.1016/j.socscimed.2020.113364.

Courtemanche, C., Garuccio, J., Le, A., Pinkston, J., Yelowitz, A., 2020. Strong social distancing measures in the United States reduced the COVID-19 growth rate. Health Aff. 39 (7), 1237–1246. https://doi.org/10.1377/hlthaff.2020.00608.

Daoust, J.F., 2020. Elderly people and responses to COVID-19 in 27 Countries. PloS One 15 (7), e0235590.

Daoust, J., Bélanger, É., Dassonneville, R., Lachapelle, E., Nadeau, R., Becher, M., et al., 2021. A guilt-free strategy increases self-reported non-compliance with COVID-19

preventive measures: experimental evidence from 12 countries. PloS One 16 (4), e0249914.
Dasic, B., Devic, Z., Denic, N., Zlatkovic, D., Ilic, I.D., Cao, Y., Le, H.V., 2020. Human development index in a context of human development: review on the western Balkans countries. Brain Behav. 10 (9), e01755 https://doi.org/10.1002/brb3.1755.
Enders, C.K., Tofighi, D., 2007. Centering predictor variables in cross-sectional multilevel models: a new look at an old issue. Psychol. Methods 12 (2), 121–138. https://doi.org/10.1037/1082-989X.12.2.121.
Engineer, M., King, I., Roy, N., 2008. The human development index as a criterion for optimal planning. Indian Growth Dev. Rev. 1 (2), 172–192. https://doi.org/10.1108/17538250810903774.
Galasso, V., Pons, V., Profeta, P., Becher, M., Brouard, S., Foucault, M., 2020. Sex differences in COVID-19 attitudes and behavior: panel evidence from eight countries. Proc. Natl. Acad. Sci. U. S. A 117 (44), 27285–27291. https://doi.org/10.1073/pnas.2012520117.
Huang, J., Teoh, J.Y., Wong, S.H., Wong, M., 2020. The potential impact of previous exposure to SARS or MERS on control of the COVID-19 pandemic. Eur. J. Epidemiol. 35 (11), 1099–1103. https://doi.org/10.1007/s10654-020-00674-9.
Human development reports (n.d.). Retrieved February 22, 2021, from. http://hdr.undp.org/en/content/human-development-index-hdi.
Kuitunen, I., Artama, M., Mäkelä, L., Backman, K., Heiskanen-Kosma, T., Renko, M., 2020. Effect of social distancing due to the COVID-19 pandemic on the incidence of viral respiratory tract infections in children in Finland during early 2020. Pediatr. Infect. Dis. J. 39 (12), e423–e427.
Larsen, M., Nyrup, J., Petersen, M.B., 2020. Do survey estimates of the public's compliance with COVID-19 regulations suffer from social desirability bias? J. Behav. Pub. Admin. 3 (2), 1–9.
Li, C., 2013. Little's test of missing completely at random. STATA J. 13 (4), 795–809.
Little, R.J., 1988. Missing-data adjustments in large surveys. J. Bus. Econ. Stat. 6 (3), 287–296.
MacIntyre, C.R., Chughtai, A.A., 2020. A rapid systematic review of the efficacy of face masks and respirators against coronaviruses and other respiratory transmissible viruses for the community, healthcare workers and sick patients. Int. J. Nurs. Stud. 108, 103629. https://doi.org/10.1016/j.ijnurstu.2020.103629.
National Institute on Aging, 2011. Global Health and Aging, vol. 22. World Health Organization. Published October 2011. Updated January 22, 2015. Retrieved February 12, 2021, from. www.nia.nih.gov/research/publication/global-health-and-aging/preface.
Pawlowski, B., Atwal, R., Dunbar, R.I.M., 2008. Sex differences in everyday risk-taking behavior in humans. Evol. Psychol. 6, 29–42. https://doi.org/10.1177/147470490800600104.
Romer, D., Jamieson, K.H., 2020. Conspiracy theories as barriers to controlling the spread of COVID-19 in the U.S. Soc. Sci. Med. 263, 113356. https://doi.org/10.1016/j.socscimed.2020.113356.
Shahbazi, F., Khazaei, S., 2020. Socio-economic inequality in global incidence and mortality rates from coronavirus disease 2019: an ecological study. New Microb. New Infect. 38, 100762. https://doi.org/10.1016/j.nmni.2020.100762.
Sobol, M., Blachnio, A., Przepiórka, A., 2020. Time of pandemic: temporal perspectives related to compliance with public health regulations concerning the COVID-19 pandemic. Soc. Sci. Med. 265, 113408.
Stanton, E.A., 2007. The human development index: a history. PERI Work.Pap. 85.
Smith, R.D., 2006. Responding to global infectious disease outbreaks: lessons from SARS on the role of risk perception, communication and management. Soc. Sci. Med. 63 (12), 3113–3123. https://doi.org/10.1016/j.socscimed.2006.08.004.
Ssentongo, P., Ssentongo, A.E., Heilbrunn, E.S., Ba, D.M., Chinchilli, V.M., 2020. Association of cardiovascular disease and 10 other pre-existing comorbidities with COVID-19 mortality: a systematic review and meta-analysis. PloS One 15 (8), e0238215. https://doi.org/10.1371/journal.pone.0238215.
Sutherland, J.J., Morrison, R.D., McNaughton, C.D., Daly, T.M., Milne, S.B., Daniels, J.S., Ryan, T.P., 2018. Assessment of patient medication adherence, medical record accuracy, and medication blood concentrations for prescription and over-the-counter medications. JAMA Netw. Open 1 (7), e184196. https://doi.org/10.1001/jamanetworkopen.2018.4196.
Uddin, S., Imam, T., Khushi, M., Khan, A., Moni, M.A., 2021. How did socio-demographic status and personal attributes influence compliance to COVID-19 preventive behaviours during the early outbreak in Japan? Lessons for pandemic management. Pers. Indiv. Differ. 175, 110692.
Vaidya, V., Partha, G., Karmakar, M., 2012. Sex differences in utilization of preventive care services in the United States. J. Wom. Health 21 (2), 140–145. https://doi.org/10.1089/jwh.2011.2876.
Van Bavel, J.J., Baicker, K., Boggio, P.S., Capraro, V., Cichocka, A., Cikara, M., Willer, R., 2020. Using social and behavioural science to support COVID-19 pandemic response. Nat. Hum. Behav. 4 (5), 460–471.
Van Bavel, J.J., Cichocka, A., Capraro, V., Sjåstad, H., Nezlek, J.B., Alfano, M., Palomäki, J., 2020. National Identity Predicts Public Health Support during a Global Pandemic. September 2. https://doi.org/10.31234/osf.io/ydt95. Results from 67 nations.
Wang, Y., Tian, H., Zhang, L., Zhang, M., Guo, D., Wu, W., MacIntyre, C.R., 2020. Reduction of secondary transmission of SARS-CoV-2 in households by face mask use, disinfection and social distancing: a cohort study in Beijing, China. BMJ Glob. Health 5 (5), e002794. https://doi.org/10.1136/bmjgh-2020-002794.
Wenham, C., Smith, J., Morgan, R., 2020. COVID-19: the gendered impacts of the outbreak. Lancet 395 (10227), 846–848. https://doi.org/10.1016/S0140-6736(20)30526-2.
World Bank, 2012. World Development Report 2012: Gender Equality and Development. The World Bank. Retrieved March 7, 2021, from. https://gsdrc.org/document-library/world-development-report-2012-gender-equality-and-development/.
World Health Organization. (n.d.). WHO coronavirus (COVID-19) dashboard. World Health Organization. https://covid19.who.int/.
Yanez, N.D., Weiss, N.S., Romand, J.A., Treggiari, M.M., 2020. COVID-19 mortality risk for older men and women. BMC Publ. Health 20 (1), 1742. https://doi.org/10.1186/s12889-020-09826-8.