

Citation:

Salvador, C.E., Berg, M.K., Yu, Q., San Martin, A. & Kitayama, S. (2020) Relational mobility predicts faster spread of COVID-19: A 39 country study, *Psychological Science*, <https://doi.org/10.1177/0956797620958118>.

**Relational mobility predicts faster spread of COVID-19:
A 39-country study**

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Author Contributions: CES and SK drafted the paper; CES, MKB, and QY carried out statistical analysis; MKB, QY, and ASM provided critical revisions on the draft.

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Abstract

It has become increasingly clear that COVID-19 transmits between individuals. It stands to reason that the spread of the virus depends on sociocultural ecologies that facilitate or inhibit social contact. In particular, the community-level tendency to engage with strangers and freely choose friends, called relational mobility (RM), entails increased opportunities to interact with a larger and more variable range of others. It may therefore be associated with a faster spread of infectious diseases, including COVID-19. Here, we tested this possibility by analyzing growth curves of confirmed cases and deaths of COVID-19 in the first 30 days of the outbreaks in 39 countries. We found the growth was significantly accelerated as a function of a country-wise measure of RM. This relationship was robust either with or without a set of control variables, including demographic variables, reporting bias, testing availability, and cultural dimensions of individualism, tightness, and government efficiency. Policy implications are discussed.

Statement of Relevance

The COVID-19 pandemic has impacted all countries on the globe. However, some countries have suffered far more than some others. It is of utmost significance to understand factors explaining this cross-country variability. Here, we report the first evidence that the variation in vulnerability to COVID-19 may be due in part to cultural practices of social relationships. In particular, we found the spread of this virus depends on how broad or narrow the range of people one relates to and interacts with -- a dimension called relational mobility (RM).

Compared to their low RM counterparts, countries higher in RM showed a significantly steeper slope, indicating a faster spread of the virus during the early period of country-wise outbreaks. This evidence underscores the need for social distancing to “flatten the curve,” especially in countries that value social openness.

Introduction

Over the last several months, a novel strain of coronavirus (SARS-CoV-2) has spread across the globe causing the COVID-19 pandemic. While there is substantial cross-national variation in the damage incurred by the virus, little is known about the factors that contribute to this variation. It is commonly accepted, however, that the virus transmits through social contact. Hence, viral transmission could increase as social contact becomes more frequent and variable. We thus investigated whether country-wise vulnerability to COVID-19 might vary systematically based on social ecologies that encourage or discourage social contact.

Our focus is on relational mobility (RM), the extent to which it is easy to form new relationships and terminate current ones in any given society (Yuki & Schug, 2020). In societies low in RM, interdependence with close others is valued (Markus & Kitayama, 1991). Relationships are typically ascribed by social roles and restricted to close others (Adams, 2005). Conversely, in societies high in RM, social relationships tend to be freely chosen, and more expansive. People can form new relationships and leave former ones at will. They thus tend to be socially open (Schug et al., 2010). The resulting social ecologies would increase the opportunity for interaction with a greater number of individuals outside each person's primary social groups (e.g., close inner circle of friends). Thus, high RM may put people at particularly high risk for contracting an infectious disease like COVID-19.

We tested whether country-wise RM scores (Thomson et al., 2018) would positively predict the growth of cases and deaths due to COVID-19. The growth (the rate of increase) is unlikely to be affected by reporting biases and testing availability, as long as the latter factors are constant. It would therefore be important to examine a short initial period of growth. At the same time, it is necessary to test a sufficiently long period to obtain reliable estimates of the growth rate. To simultaneously meet these two competing demands, we analyzed the first 30 days of country-wise outbreaks in the main analysis. This analytic strategy also enabled us to capture the COVID-19 spread prior to lockdowns.

Methods

Data

Main variables. We retrieved data on daily confirmed COVID-19 cases and deaths by country from a public repository updated daily by the Johns Hopkins University Center for Systems Science and Engineering (<https://github.com/CSSEGISandData/COVID-19>). Our current results are based on data up until July 21, 2020. RM scores were obtained from Thomson et al. (2018), who measured RM by assessing the extent to which people perceive others in their local communities are socially open and, thus, seek new friendships while exiting unsatisfactory relationships. They administered a 12-item scale of RM to a large number of adults, recruited with Facebook ads, in 39 countries, and found systematic cross-cultural variation. A series of analyses with a wide range of culture-level indicators of behavioral outcomes shows the validity of the RM score. For example, RM predicts the national levels of general trust, self-disclosure, intimacy, and social support (Thomson et al., 2018).

We followed prior work (Berg et al., 2020), and included countries if they had reported at least 15 days of data, starting with the day of the first 100 confirmed cases as 'day 1'. For deaths, we included countries with at least 15 days of data, starting with the first day of at least 1 reported death as 'day 1.' All 39 countries met this criterion.

The 39 countries included are listed in Table S1, which also shows the dates for the first 100 confirmed cases, the first confirmed death, and the date of national lockdown if it was instituted, for each of the countries. In many cases, the lockdown occurred during this period. Even in those cases, it occurred more than halfway through the period. Since it takes a certain amount of time (usually several weeks, based on an estimate for the 1918 influenza pandemic by Bootsma & Ferguson, 2007) for any lockdown to have an effect, it would seem reasonable to ignore any effect of state-imposed lockdowns on the current analysis. This point is arguably valid in a robustness check with the first 15 days of data.

Demographics. Following prior work (Berg et al., 2020), several demographic variables were included as covariates. Total population was added because larger groups of people will have more cases and deaths. Median age of the total population (in years) was included since older adults are more susceptible to disease. Population density (in persons per square kilometer) was used because it is likely to foster greater social contact, resulting in greater chances of infection. Net migration (persons entering country minus persons exiting country, per 1000 people) was included so as to control for population movement. These four statistics were compiled from the United Nations Department of Economic and Social Affairs World Population Prospects 2019 (United Nations, Department of Economic and Social Affairs, Population Division, 2018). Gross domestic product (at purchasing power parity) per capita (GDP per capita in thousands), tourism rates and percent urban were included to control for economic development, the influx of foreigners and how urban the country is (The World Bank, 2019).

Cultural dimensions. Three cultural dimensions were tested as potential confounding variables. First, Hofstede's index of individualism (Hofstede, 1984) was used because its conceptual equivalent (independent self-construal) is positively correlated with RM (San Martin et al., 2019; Thomson et al., 2018), consistent with the notion that freedom to choose is an important facet of independent self-construal (Markus & Kitayama, 1991). Scores are based on responses to a series of questions asked to employees of a large IT company across countries. Scores were available for 35 of the 39 countries. Second, the efficiency in governmental operations might promote more effective coping with COVID-19. We used the World Bank's Government Efficiency Index -- an index that shows the public sector's performance in managing and regulating the political economy (retrievable at: <https://bit.ly/34IXAT9>). The index varies from 1 (very inefficient) to 5 (highly efficient). Scores were available for 34 of the 39 countries. Third, recent research suggests that the tightness (vs. looseness) of social norms could be an adaptation to threats, including pathogen threats (Gelfand et al., 2011). Tightness might then lower the growth rate of cases and deaths. The index, adopted from Gelfand et al.

(2011), is an arithmetic mean of responses to a 6-item questionnaire assessing the perceived rigidity of social norms in one's own country. Scores were available for 23 of the 39 countries tested.

BCG. Berg et al. (2020) tested 139 countries and found that those with universal Bacillus Calmette-Guérin (BCG) vaccination policies show a reduced rate of the growth of both COVID-related confirmed cases and deaths (Berg et al., 2020). We thus used BCG policy status (with or without BCG policy) as another covariate. Data was available for 37 out of the 39 countries.

Robustness Checks

Underreporting of cases. Countries may vary in underreporting due to, for example, governmental information suppression. To account for this, we adopted an underreporting index devised by Russell and colleagues (Russell et al., 2020). These researchers first computed a case fatality ratio (CFR) in each country that is adjusted for delay between admission to the hospital and death. Then they computed the ratio of the best empirical estimate of CFR (1.4%) to the adjusted CFR for each country. If this ratio is smaller than one, it indicates underreporting of cases. Some countries, such as Italy, Spain, and Morocco, show substantial underreporting (underreporting index < 10%), whereas some others, such as Norway, Israel, and South Korea, show very low underreporting (underreporting index > 50%). We used country-wise underreporting scores on April 15, 2020, downloaded from https://github.com/thimotei/CFR_calculation. This index was available for 29 of the 39 countries.

This index can be defined as a measure of inaccuracy of the report of cases. In one analysis, we used it as a weight, with the data from countries with higher values of this index weighed more than the data from those with lower values. The index can also indicate underestimation of the number of cases reported. Thus, in another analysis, we also used it as an additional covariate. These analyses were performed only for the number of confirmed cases.

Testing availability. We also adopted the number of COVID-19 tests per case. This data was obtained from: <https://ourworldindata.org/grapher/the-number-of-tests-for-each->

confirmed-case-since-5th-death. In countries such as France and Mexico, the tests per case ratio was low, suggesting that testing was not readily available. Conversely, in countries like New Zealand, Australia and Taiwan, this ratio was high, implying higher degrees of testing availability. Data was available for 29 out of the 39 countries. As with the reporting index, we conducted two analyses with these scores. First, we weighed countries with more testing more heavily presumably because more testing would lead to more accurate counts of cases. Second, we included it as a covariate since less testing can also lead to an underestimation of cases reported. These analyses were performed only for the number of confirmed cases.

15/60 days of country-wise outbreaks. In the main analyses, we focused on the initial 30-day period of country-wise outbreaks. To ensure the robustness of the pattern, we carried out two analyses that used a half (15 days) or twice as many days (60 days) as in our standard analysis.

Interpolation of RM data with cultural distance scores. In a recent study, Muthukrishna and colleagues (2020) offered an index of cultural distance between each of the pairs of 80 countries. The distance index is based on geometric distance across many attitudinal items culled from the World Value Survey. The 80 countries tested by Muthukrishna et al. (2020) included 34 of the 39 countries for which RM scores were available. By averaging the RM scores for the 34 countries after weighting each RM score with the inverse of the cultural distance score of each of the countries, we interpolated the RM score for each of the 46 (= 80-34) countries. For example, consider one of the 80 countries tested by Muthukrishna et al. (2020) that did not have an RM score (designated as RM_j). This country has a cultural distance score (designated as D_{ij} , where $i = 1$ to M) with each of the M countries with RM scores (designated as RM_i). The RM score for this country was computed by the following formula:

$$RM_j = \frac{\sum_{i=1}^m RM_i * \frac{1}{D_{ij}}}{\sum_{i=1}^m \frac{1}{D_{ij}}}$$

In this instance, $M = 34$. The RM scores imputed for the 46 countries were used to repeat the same set of analyses for the 85 (= 39 + 46) countries.

To assess the validity of this procedure, we repeated the same procedure for the 34 countries for which the RM scores were available. In this case, to interpolated the RM score for a target country by averaging the RM scores for the remaining 33 countries (i.e., all countries for which RM scores were available minus the target country) after weighting each score with the inverse of the cultural distance between the target country and each of the 33 countries. In this instance, $M = 33$. The correlation between actual RM scores and the interpolated RM scores was .596, $p < .001$.

Statistical Analysis

All analyses were conducted on up to 30 days of data from each country. Linear mixed effect models with restricted maximum likelihood estimation were used to analyze both the number of cases and deaths. We natural log-transformed both cases and deaths since the growth of cases and deaths is known to be exponential in an early period of a pandemic. Day was centered so that main effects could be interpreted as differences at the mean day of the growth curve. Total population was natural log-transformed to reduce skewness. All demographic and cultural variables were z-scored. We estimated both a random intercept and random slope across days to allow for the heterogeneity of growth curves across countries. We included another random effect that accounts for countries being nested in Geographic regions defined by the World Bank (The World Bank, 2019), because these nations are not independent and have some shared cultural and political history.

We tested three models. Model 1 included Day, RM, the Day x RM interaction. To control for population size, both Population size and its interaction with Day were also included. Model 2 added all the demographic variables to Model 1. All demographic variables were

available for all 39 countries, with the exception of the Tourism measure for Taiwan. Model 3 included only those covariates that had an interaction with Day at $p < .10$ in Model 2. We report the statistics from Model 3 in the text. All other statistics can be found in relevant tables. Regarding the remaining covariates (e.g., cultural values, BCG policy status, underreporting, and testing availability), data were often missing for some countries. Thus, to retain the maximal number of countries, they were tested one at a time in a separate analysis. When a full model failed to converge, we dropped the intercept-slope covariance of the random effects (Country and Geographic region). This is arguably the most conservative strategy, as the covariance terms would be automatically dropped once one of the two terms defining the covariances was dropped (Bates et al., 2018). When the model still did not converge, we dropped the Geographic region as a nesting factor although this happened only in for a few robustness checks. Correlations among the cultural and demographic variables are given in Figure S1.

Results

Main Analysis

Confirmed cases. Results are summarized in Table 1-A. The main effect of Day was significant, $b = .121$, $p = .006$, showing an increase in COVID-19 cases over time. Importantly, it was qualified by a significant Day by RM interaction, $b = .112$, $p = .002$. Fig.1-A shows the growth of confirmed cases in the natural log scale. Countries higher in RM showed a faster growth of confirmed cases over time compared to countries low in RM. The main effect of RM was also significant, $b = 1.80$, $p = .010$. This main effect, however, is a necessary consequence of the steeper slope in the high (vs. low) RM countries. Hence, in and by itself, it does not carry any theoretical significance. The beta coefficients indicating the growth rate are plotted in Fig. 1-B, which shows that the relationship between the growth rate and RM is robust and unlikely to be due to any outliers. Among the demographic variables, total population (designated as Population), migration and tourism had an impact on the growth rate. Countries with larger populations had a faster rate of the growth of confirmed cases, as indicated by the Day x

Population interaction, $b = .021$, $p = .003$. Moreover, countries with more migration and tourism had a faster rate of the growth of confirmed cases, as indicated by the Day x Migration and Day x Tourism interaction, $b = .014$, $p = .017$ and $b = .024$, $p = .001$, respectively. The remaining covariates had no significant effect on the growth rate of confirmed cases.

RM accounted for a sizable amount of variance in the number of confirmed cases. We hypothesize that RM fosters a higher rate of the increase by Day (as captured by the Day x RM interaction) and, by so doing, increases the number of cases by the end of the study period. Hence, the total amount of variance explained by RM is the sum of the variance explained by the Day x RM interaction and the RM main effect (obtained by subtracting the variance explained by a model including Day only from a model including Day, RM, and Day x RM). This combined variance was 8.4%.

Deaths. Results are summarized in Table 1-B. The main effect of Day was significant, $b = .149$, $p = .002$, showing an increase in the number of deaths across time. The Day x RM interaction was also significant, $b = .144$, $p = .010$. Deaths increased over time, and were greater for countries high in RM (Figure 1-C). This effect was statistically significant in both Models 1 and 3 although it was marginal in Model 2. As shown in Figure 1-D, it is not due to any outliers. As in the analysis of confirmed cases, the Day x Population interaction was significant, $b = .031$, $p = .004$, showing that countries with larger populations had a higher growth rate of deaths. Other demographic variables had no effect. RM accounted for 7.5% of the variance in the number of deaths.

Controlling for Other Cultural Variables

Individualism. In an analysis performed on 35 of the 39 countries, after controlling for individualism, we found a significant Day x RM interaction for cases, $b = .084$, $p = .010$ (Table S2-A). This interaction was marginal for deaths, $b = .101$, $p = .063$ (Table S2-B).

Government efficiency. In an analysis performed on 34 of the 39 countries, after controlling for government efficiency, the Day x RM interaction remained significant for both

cases and deaths respectively, $b = .116$, $p = .001$ and, $b = .115$, $p = .032$ (see Tables S3-A and B).

Tightness. In an analysis performed on 23 of the 39 countries, after controlling for Tightness, the Day x RM interaction was significant for cases and non-significant for deaths, $b = .100$, $p = .014$ and $b = .096$, $p = .112$, respectively (Table S4-A and B). The weaker Day x RM interaction may be due to diminished sample size (= 23).

BCG. In an analysis performed on 37 of the 39 countries, after controlling for BCG policy status, the Day x RM interaction was significant for cases, $b = .088$, $p = .004$ (Table S5-A). This effect was no longer significant for deaths, $b = .083$, $p = .160$ (Table S5-B).

Robustness Checks

Underreporting of cases. In an analysis performed on confirmed cases on 29 out of the 39 countries, with the Russell et al. (2020) underreporting index as a weighting factor, the Day x RM interaction remained significant, $b = .095$, $p = .004$ (Table S6-A). When the underreporting index was used as an additional covariate, the Day x RM interaction remained significant, $b = .080$, $p = .025$ (Table S6-B)

Testing availability. In an analysis performed on cases for 29 out of the 39 countries, with the test availability index as a weighting factor, the Day x RM interaction remained significant, $b = .085$, $p = .015$ (Table S7-A). When it was used as an additional covariate, the Day x RM interaction remained significant, $b = .076$, $p = .026$ (Table S7-B).

The first 20 cases. In an analysis performed on 38 out of the 39 countries, with the 20 (rather than 100) cases as the cutoff, the Day x RM interaction remained significant for cases, $b = .131$, $p = .010$ (Table S8).

The first-15 days of country-wise outbreaks. When the data from the first 15 (rather than 30) days were analyzed, the Day x RM interaction remained significant for cases, $b = .118$, $p = .029$ (Table S9-A). This interaction was no longer significant for deaths, $b = .134$, $p = .172$, plausibly due to the reduced amount (one half) of data included in this analysis (Table S9-B).

The first-60 days of country-wise outbreaks. When the data from the first 60 (rather than 30) days were analyzed, the Day x RM interaction remained significant for cases, $b = .039$, $p = .038$ (Table S10-A) and deaths, $b = .086$, $p = .001$ (Table S10-B).

Interpolation of RM data with cultural distance scores. Lastly, we examined whether the same results were present if we increased the number of countries from 39 to 85 by using the interpolated RM scores for 46 countries for which the RM scores were unavailable. As shown in Table S11, the Day x RM interaction was significant for both cases and deaths, $b = .090$, $p = .007$ and $b = .113$, $p = .022$, respectively.

Discussion

Our findings show that each country's social openness (called relational mobility, RM) positively predicts the growth rate of both confirmed cases and deaths of COVID-19 during an early period of country-wise outbreaks. The results for cases were robust across a number of analyses that controlled for underreporting, testing availability, demographic variables, and cultural traits such as individualism, tightness, and government efficiency. Although a comparable effect for deaths was less robust when the inclusion of covariates necessitated a reduction of the number of countries that could be included, it was significant in the main analysis that included all the 39 countries. The RM effect was sizable. RM accounted for approximately 8% of variance for both cases and deaths. To illustrate, the U.S. is among the highest in RM. If it had been low in RM, comparable to Japan (one of the lowest in RM), the deaths at the end of the 30-day study period would have been 8.2% (281) of the actual number reported (3417).

The COVID-19 pandemic has proven extremely difficult to contain. Without any vaccines available, the only viable defense against the virus is to keep sufficient physical distance from others, particularly, strangers. Our data suggests that this practice of social distancing could prove indispensable in countries high in RM. In such countries, individuals might seek new friends and acquaintances outside of their primary groups (Thomson et al., 2018); they might be

more outgoing (Kim et al., 2018); and they might not easily suppress emotions in face-to-face encounters (Kraus & Kitayama, 2019). These psychological propensities could make social ecologies particularly vulnerable to infectious disease.

Some limitations must be noted. First, we focused only on an early period of outbreaks to minimize various confounds. Second, country is admittedly a crude unit of analysis. Third, our sample size was limited by the availability of RM scores. Nevertheless, our data is the first to show a substantial effect of socio-cultural ecologies on the peril of infectious disease.

In closing, since RM is an important expression of the values of independence, egalitarianism, and freedom of movement and choice (Inglehart & Baker, 2000; Markus & Kitayama, 1991), the present findings may be posing a fundamental challenge to all countries aspiring to promote these values. Expertise of social and behavioral sciences (Van Bavel et al., 2020) may therefore be strongly called for to devise strategies to fight against infectious disease without compromising the core values of democracy.

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Table 1.

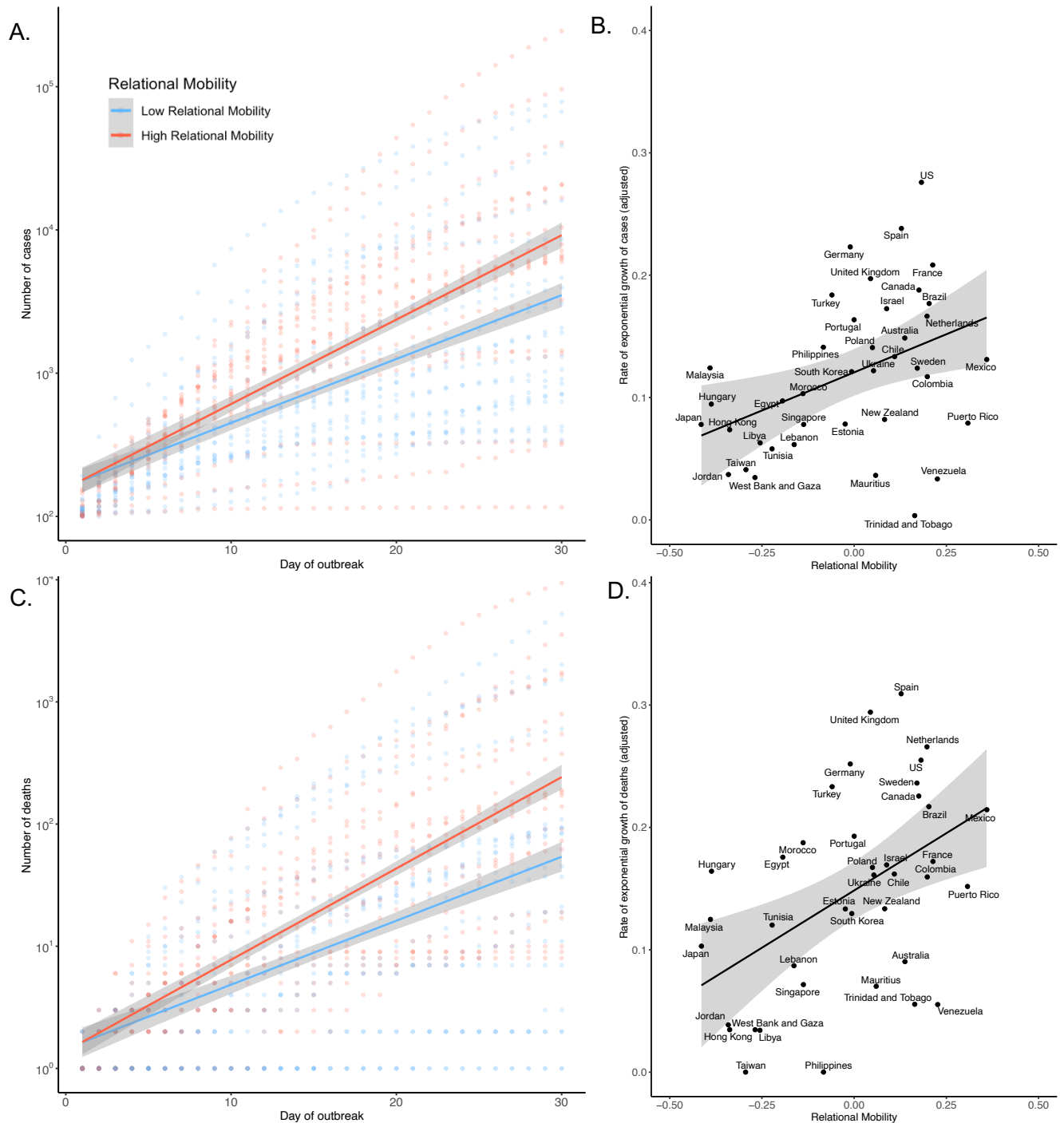
Regression coefficients predicting the number of confirmed cases (A) and deaths (B) over the first 30 days of country-wise outbreaks. Models vary in the covariates included. Model 1 includes only total population (called Population). Model 2 includes all demographic covariates. Model 3 includes only those that prove at least marginally significant in Model 2. The results are based on all 39 countries, except in Model 2, which is based on 38 countries because of a missing value for Tourism in one of the countries (Taiwan).

A. Predictor	Model 1			Model 2			Model 3		
	b	t	p	b	t	p	b	t	p
Intercept	7.023	20.394	<.001	6.924	45.445	0.002	6.916	38.220	<.001
Day	0.131	6.109	0.005	0.120	17.055	0.011	0.121	12.830	0.006
Relational Mobility	2.312	3.268	0.002	1.446	2.095	0.055	1.798	2.791	0.010
Population	0.647	4.777	<.001	0.351	2.493	0.019	0.356	2.744	0.011
Migration				0.263	2.090	0.046	0.248	2.171	0.038
GDP				0.103	0.433	0.668			
Population Density				-0.360	-2.161	0.039	-0.251	-2.139	0.040
Tourism				0.322	2.218	0.035	0.339	2.521	0.017
Percent Urban				0.033	0.231	0.819			
Median Age				0.115	0.658	0.518			
Day x Relational Mobility	0.131	3.610	0.001	0.082	2.514	0.026	0.112	3.513	0.002
Day x Population	0.039	5.411	<.001	0.022	3.233	0.003	0.021	3.333	0.003
Day x Migration				0.013	2.197	0.037	0.014	2.532	0.017
Day x GDP				0.016	1.398	0.173			
Day x Population Density				-0.014	-1.732	0.094	-0.004	-0.726	0.473
Day x Tourism				0.022	3.197	0.003	0.024	3.586	0.001
Day x Percent Urban				-0.003	-0.375	0.710			
Day x Median Age				0.001	0.157	0.877			
R ² fixed effects		0.615			0.767			0.751	
R ² fixed and random effects		0.978			0.973			0.972	

B. Predictor	<u>Model 1</u>			<u>Model 2</u>			<u>Model 3</u>		
	b	t	p	b	t	p	b	t	p
Intercept	2.618	7.230	0.002	2.665	8.513	0.018	2.618	7.230	0.002
Day	0.149	6.743	0.002	0.149	8.592	0.002	0.149	6.743	0.002
Relational Mobility	2.073	1.860	0.073	1.689	1.392	0.189	2.073	1.860	0.073
Population	0.472	2.320	0.027	0.361	1.455	0.158	0.472	2.320	0.027
Migration				0.225	1.037	0.309			
GDP				0.234	0.569	0.574			
Population Density				-0.361	-1.254	0.220			
Tourism				0.119	0.475	0.638			
Percent Urban				0.112	0.459	0.650			
Median Age				0.220	0.721	0.481			
Day x Relational Mobility	0.144	2.727	0.010	0.103	1.889	0.070	0.144	2.727	0.010
Day x Population	0.031	3.172	0.004	0.024	2.223	0.036	0.031	3.172	0.004
Day x Migration				0.013	1.411	0.170			
Day x GDP				0.016	0.933	0.358			
Day x Population Density				-0.020	-1.638	0.113			
Day x Tourism				0.011	1.026	0.314			
Day x Percent Urban				0.001	0.142	0.888			
Day x Median Age				0.018	1.335	0.192			
R ² fixed effects		0.499			0.577			0.499	
R ² fixed and random effects		0.969			0.970			0.969	

Figure 1.

The rate of growth of confirmed cases and deaths of COVID-19 during the first 30 days of country-wise outbreaks. A. Growth curves on a log scale for confirmed cases. The solid red (or blue) line designates the growth estimated for the country one SD above (or below) the grand mean of RM. Blurred red (or blue) lines show individual countries that are higher (or lower) than the RM grand mean. B. Country-wise growth rates of confirmed cases as a function of RM. C. Growth curves on a log scale for deaths. D. Country-wise growth rates of deaths as a function of RM.



Supplementary Tables*Table S1.*

Countries included in the analyses of confirmed cases and deaths. For each country, the date of the first 100 confirmed cases, the date of the first death, and the date of lockdown are noted. NI stands for not implemented.

Country	Date of first 100 cases	Date of first death	Date of lockdown
Australia	3.10.20	3.1.20	3.23.20
Brazil	3.13.20	3.17.20	3.24.20
Canada	3.11.20	3.9.20	NI
Chile	3.16.20	3.22.20	3.19.20
Colombia	3.18.20	3.22.20	3.25.20
Egypt	3.14.20	3.8.20	3.19.20
Estonia	3.14.20	3.25.20	3.27.20
France	2.29.20	2.15.20	3.17.20
Germany	3.1.20	3.9.20	3.23.20
Hong Kong	3.2.20	2.4.20	NI
Hungary	3.21.20	3.15.20	3.28.20
Israel	3.12.20	3.21.20	4.02.20
Japan	2.21.20	2.13.20	4.07.20
Jordan	3.22.20	3.27.20	3.18.20
Lebanon	3.15.20	3.10.20	3.15.20
Libya	5.28.20	4.2.20	3.22.20
Malaysia	3.9.20	3.17.20	3.18.20
Mauritius	3.28.20	3.21.20	3.24.20
Mexico	3.18.20	3.19.20	3.26.20
Morocco	3.22.20	3.10.20	3.19.20

Netherlands	3.6.20	3.6.20	3.16.20
New Zealand	3.22.20	3.29.20	3.26.20
Philippines	3.14.20	2.2.20	3.16.20
Poland	3.14.20	3.12.20	3.13.20
Portugal	3.13.20	3.17.20	3.19.20
Puerto Rico	3.28.20	3.21.20	3.15.20
Singapore	2.29.20	3.21.20	4.07.20
South Korea	2.20.20	2.20.20	NI
Spain	3.2.20	3.3.20	3.14.20
Sweden	3.6.20	3.11.20	NI
Taiwan	3.18.20	2.16.20	NI
Trinidad and Tobago	4.4.20	3.25.20	3.17.20
Tunisia	3.24.20	3.19.20	3.22.20
Turkey	3.19.20	3.17.20	4.11.20
Ukraine	3.25.20	3.13.20	NI
United Kingdom	3.2.20	3.5.20	3.23.20
United States	3.4.20	2.29.20	3.19.20 (CA)
Venezuela	3.26.20	3.27.20	3.17.20
West Bank and Gaza	3.29.20	3.26.20	3.22.20

Table S2.

Regression coefficients predicting the number of confirmed cases (A) and deaths (B) over the first 30 days of country-wise outbreaks. Individualism is added as a covariate. Model 1 includes total population (called Population) and Individualism. Model 2 includes all demographic covariates and Individualism. Model 3 includes only those demographic variables that prove at least marginally significant in Model 2 and Individualism. The results are based on 35 of the 39 countries, except in Model 2, which is based on 34 countries because of a missing value for Tourism in Taiwan.

A. Predictor	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	6.778	24.778	3.282	<.001	6.712	23.311	2.975	<.001	6.731	27.782	3.350	<.001
Day	0.116	9.698	2.473	0.005	0.114	11.987	2.489	0.003	0.115	14.026	2.455	0.002
Relational Mobility	1.815	2.386	29.059	0.024	1.697	2.443	23.913	0.022	1.881	2.751	26.806	0.011
Individualism	0.146	0.973	29.551	0.339	-0.272	-1.608	22.707	0.122	-0.005	-0.036	27.911	0.972
Population	0.891	4.744	28.385	<.001	0.734	3.554	21.286	0.002	0.817	4.155	25.169	<.001
Migration					0.542	3.338	19.854	0.003	0.498	2.982	25.032	0.006
GDP					0.180	0.715	21.298	0.482				
Population Density					-0.420	-2.299	19.954	0.032				
Tourism					0.152	1.078	21.179	0.293	0.140	1.007	26.853	0.323
Percent Urban					0.184	1.419	21.808	0.170				
Median Age					-0.054	-0.304	23.804	0.764				
Day x Relational Mobility	0.088	2.372	25.048	0.026	0.077	2.280	19.874	0.034	0.084	2.869	19.355	0.010
Day x Individualism	0.018	2.405	26.757	0.023	0.005	0.547	23.990	0.589	0.010	1.590	26.220	0.124
Day x Population	0.049	5.271	27.959	<.001	0.040	3.748	23.331	0.001	0.038	4.186	25.770	<.001
Day x Migration					0.022	2.553	20.732	0.019	0.024	3.053	25.370	0.005
Day x GDP					0.010	0.763	23.131	0.453				
Day x Population Density					-0.007	-0.729	20.876	0.474				
Day x Tourism					0.015	2.076	23.200	0.049	0.017	2.757	27.763	0.010
Day x Percent Urban					0.001	0.138	23.138	0.892				
Day x Median Age					-0.001	-0.097	20.786	0.924				

	Model 1				Model 2				Model 3			
B. Predictor	b	t	df	p	b	t	df	p	b	t	df	p
R ² fixed effects	0.671				0.733				0.747			
R ² fixed and random effects	0.973				0.974				0.972			
Intercept	2.519	6.478	4.093	0.003	2.399	5.354	3.757	0.007	2.448	6.049	4.222	0.003
Day	0.140	7.202	4.297	0.001	0.137	6.480	3.943	0.003	0.136	6.728	4.415	0.002
Relational Mobility	1.725	1.378	26.377	0.180	0.578	0.445	23.656	0.660	1.831	1.473	27.078	0.152
Individualism	0.105	0.424	27.829	0.675	-0.579	-1.804	23.628	0.084	-0.014	-0.054	29.092	0.957
Population	0.686	2.137	29.280	0.041	0.810	2.048	22.641	0.052	0.710	2.265	28.244	0.031
Migration					0.381	1.215	21.147	0.238	0.465	1.490	28.057	0.147
GDP					0.874	1.813	22.590	0.083				
Population Density					-0.781	-2.217	21.244	0.038				
Tourism					-0.048	-0.177	22.542	0.861				
Percent Urban					0.295	1.194	22.871	0.245				
Median Age					-0.071	-0.212	23.854	0.834				
Day x Relational Mobility	0.094	1.708	29.271	0.098	0.075	1.312	23.942	0.202	0.101	1.930	29.488	0.063
Day x Individualism	0.024	2.175	29.733	0.038	0.002	0.114	23.450	0.910	0.016	1.533	29.928	0.136
Day x Population	0.043	3.115	29.071	0.004	0.045	2.636	22.429	0.015	0.044	3.457	27.961	0.002
Day x Migration					0.024	1.783	21.116	0.089	0.028	2.210	27.671	0.036
Day x GDP					0.019	0.887	22.405	0.385				
Day x Population Density					-0.017	-1.117	21.204	0.276				
Day x Tourism					0.004	0.315	22.338	0.755				
Day x Percent Urban					0.005	0.509	22.732	0.616				
Day x Median Age					0.011	0.741	23.996	0.466				
R ² fixed effects	0.491				0.535				0.504			

R ² fixed and random effects	0.967	0.970	0.968
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Table S3.

Regression coefficients predicting the number of confirmed cases (A) and deaths (B) over the first 30 days of country-wise outbreaks. Government efficiency is added as a covariate. Model 1 includes total population (called Population) and Government efficiency. Model 2 includes all demographic covariates and Government efficiency. Model 3 includes only those demographic variables that prove at least marginally significant in Model 2 and Government efficiency. The results are based on 34 of the 39 countries.

A. Predictor	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	7.029	21.247	3.053	<.001	6.888	28.652	1.848	0.002	6.886	28.180	2.715	<.001
Day	0.131	6.725	2.854	0.008	0.120	11.164	1.471	0.021	0.121	10.112	2.439	0.005
Relational Mobility	2.279	2.916	29.816	0.007	1.490	1.865	23.974	0.075	1.951	2.791	27.962	0.009
Government Efficiency	0.174	1.125	29.381	0.270	-0.203	-0.841	20.019	0.410	-0.224	-1.200	27.416	0.240
Population	0.663	4.488	21.364	<.001	0.347	2.177	20.784	0.041	0.444	3.045	20.230	0.006
Migration					0.644	2.780	18.436	0.012	0.655	2.939	23.550	0.007
GDP					0.109	0.380	20.521	0.708				
Population Density					-0.313	-1.829	20.292	0.082				
Tourism					0.271	1.830	22.471	0.081	0.247	1.716	27.648	0.097
Percent Urban					0.111	0.784	21.464	0.441				
Median Age					-0.084	-0.412	23.994	0.684				
Day x Relational Mobility	0.133	3.570	28.168	0.001	0.085	2.174	23.775	0.040	0.116	3.529	27.993	0.001
Day x Government Efficiency	0.016	2.131	27.682	0.042	-0.008	-0.662	20.094	0.515	-0.002	-0.267	27.001	0.791
Day x Population	0.041	5.562	22.123	<.001	0.022	2.844	20.869	0.010	0.026	3.721	19.115	0.001
Day x Migration					0.028	2.435	18.106	0.025	0.027	2.620	22.802	0.015
Day x GDP					0.017	1.202	20.394	0.243				
Day x Population Density					-0.012	-1.416	20.306	0.172				
Day x Tourism					0.019	2.623	22.606	0.015	0.019	2.836	27.378	0.008
Day x Percent Urban					0.001	0.078	21.531	0.939				

Day x Median Age		-0.006	-0.567	23.340	0.576
R ² fixed effects	0.634		0.739		0.731
R ² fixed and random effects	0.977		0.974		0.974

B. Predictor	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	2.752	7.174	4.002	0.002	2.687	7.577	2.771	0.006	2.752	7.174	4.002	0.002
Day	0.155	6.542	3.950	0.003	0.151	7.543	3.408	0.003	0.155	6.542	3.950	0.003
Relational Mobility	1.499	1.254	29.001	0.220	0.215	0.152	23.331	0.881	1.499	1.254	29.001	0.220
Government Efficiency	0.224	0.940	29.779	0.355	-0.388	-0.886	22.438	0.385	0.224	0.940	29.779	0.355
Population Migration	0.479	2.231	24.958	0.035	0.170	0.610	22.758	0.548	0.479	2.231	24.958	0.035
GDP					0.543	1.281	21.189	0.214				
Population Density					0.573	1.094	22.432	0.285				
Tourism					-0.509	-1.635	22.488	0.116				
Percent Urban					0.154	0.575	23.559	0.571				
Median Age					0.221	0.862	23.031	0.397				
Day x Relational Mobility	0.115	2.257	29.434	0.032	-0.127	-0.355	22.745	0.726	0.115	2.257	29.434	0.032
Day x Government Efficiency	0.027	2.672	29.037	0.012	0.084	1.402	23.698	0.174	0.027	2.672	29.037	0.012
Day x Population	0.038	3.868	23.240	0.001	0.027	2.221	21.818	0.037	0.038	3.868	23.240	0.001
Day x Migration					0.017	1.004	20.357	0.327				
Day x GDP					0.008	0.384	21.730	0.705				
Day x Population Density					-0.018	-1.424	21.483	0.169				
Day x Tourism					0.011	1.010	22.949	0.323				
Day x Percent Urban					0.002	0.157	22.250	0.876				
Day x Median Age					0.013	0.858	23.824	0.400				

R ² fixed effects	0.507	0.549	0.507
R ² fixed and random effects	0.967	0.968	0.967

Table S4.

Regression coefficients predicting the number of confirmed cases (A) and deaths (B) over the first 30 days of country-wise outbreaks. Tightness of cultural norms is added as a covariate. Model 1 includes total population (called Population) and Tightness. Model 2 includes all demographic covariates and Tightness. Model 3 includes only those demographic variables that prove at least marginally significant in Model 2 and Tightness. The results are based on 23 of the 39 countries.

A. Predictor	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	6.950	14.835	4.208	<.001	7.119	18.453	1.863	0.004	6.961	19.192	3.834	<.001
Day	0.134	4.834	4.062	0.008	0.126	7.494	2.458	0.009	0.135	6.213	3.748	0.004
Relational Mobility	2.271	2.622	16.691	0.018	1.989	2.178	11.419	0.051	2.151	2.696	16.429	0.016
Tightness-Looseness	0.246	1.365	16.744	0.190	0.346	1.589	12.961	0.136	0.219	1.321	16.255	0.205
Population	0.866	3.162	18.003	0.005	0.426	1.230	12.768	0.241	0.793	3.168	17.637	0.005
Migration					0.602	2.667	11.351	0.021	0.483	2.438	17.644	0.026
GDP					-0.145	-0.425	12.843	0.678				
Population Density					-0.263	-1.421	10.956	0.183				
Tourism					0.077	0.439	11.348	0.669				
Percent Urban					0.146	0.397	12.681	0.698				
Median Age					-0.024	-0.099	12.602	0.923				
Day x Relational Mobility	0.108	2.510	16.048	0.023	0.061	1.382	12.200	0.192	0.100	2.786	15.229	0.014
Day x Tightness-Looseness	0.009	1.009	16.115	0.328	-0.000	-0.031	12.884	0.976	0.008	1.076	15.069	0.299
Day x Population	0.046	3.347	17.328	0.004	0.031	1.892	12.956	0.081	0.042	3.613	16.622	0.002
Day x Migration					0.025	2.277	12.137	0.042	0.029	3.169	16.309	0.006
Day x GDP					0.019	1.203	12.834	0.251				
Day x Population Density					-0.012	-1.378	11.909	0.194				
Day x Tourism					0.014	1.702	12.146	0.114				
Day x Percent Urban					-0.004	-0.220	12.583	0.829				
Day x Median Age					-0.006	-0.485	12.942	0.636				

	Model 1				Model 2				Model 3			
B. Predictor	b	t	df	p	b	t	df	p	b	t	df	p
R ² fixed effects	0.603				0.711				0.699			
R ² fixed and random effects	0.977				0.973				0.973			
Intercept	2.822	5.670	3.023	0.011	3.136	4.006	2.813	0.031	3.261	5.893	3.197	0.008
Day	0.146	5.514	4.733	0.003	0.152	4.808	3.512	0.012	0.170	6.909	3.840	0.003
Relational Mobility	1.839	1.226	18.310	0.236	1.069	0.597	11.854	0.562	1.302	0.935	17.320	0.363
Tightness-Looseness	0.391	1.256	18.332	0.225	0.770	1.793	12.994	0.096	0.643	2.410	15.603	0.029
Population	0.676	1.472	18.983	0.157	0.251	0.368	12.796	0.719				
Migration					0.613	1.387	11.812	0.191	0.542	1.555	17.732	0.138
GDP					-0.054	-0.081	12.929	0.937				
Population Density					-0.427	-1.175	11.517	0.264	-0.358	-1.732	15.180	0.104
Tourism					-0.255	-0.745	11.816	0.471				
Percent Urban					0.552	0.762	12.858	0.460				
Median Age					0.005	0.011	12.640	0.991				
Day x Relational Mobility	0.105	1.657	18.007	0.115	0.062	0.949	11.766	0.362	0.096	1.669	17.155	0.113
Day x Tightness-Looseness	0.005	0.348	18.011	0.732	0.018	1.148	12.983	0.272	0.018	1.677	15.741	0.113
Day x Population	0.046	2.346	18.869	0.030	0.013	0.502	12.639	0.624				
Day x Migration					0.039	2.419	11.737	0.033	0.040	2.788	17.549	0.012
Day x GDP					-0.002	-0.064	12.991	0.950				
Day x Population Density					-0.024	-1.810	11.445	0.097	-0.017	-2.000	15.362	0.063
Day x Tourism					0.003	0.236	11.779	0.818				
Day x Percent Urban					0.037	1.375	12.980	0.192				
Day x Median Age					0.004	0.227	12.367	0.824				
R ² fixed effects	0.505				0.443				0.531			

R ² fixed and random effects	0.965	0.974	0.968
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Table S5.

Regression coefficients predicting the number of confirmed cases (A) and deaths (B) over the first 30 days of country-wise outbreaks. BCG policy status is added as a covariate. Model 1 includes total population (called Population) and BCG. Model 2 includes all demographic covariates and BCG. Model 3 includes only those demographic variables that prove at least marginally significant in Model 2 and BCG. The results are based on 37 of the 39 countries, with the exception of Model 2, which is based on 36 countries because of a missing value for Tourism in one of the countries (Taiwan).

A. Predictor	Model 1				Model 2				Model 3			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	7.217	19.589	6.770	<.001	7.019	28.515	26.000	<.001	7.150	28.089	13.746	<.001
Day	0.149	7.045	4.799	0.001	0.137	12.429	26.000	<.001	0.142	14.268	13.883	<.001
Relational Mobility	1.877	2.254	28.768	0.032	1.462	2.602	26.000	0.015	1.721	2.705	15.851	0.016
BCG Current vs. Not Current	-0.297	-0.933	32.878	0.358	-0.105	-0.343	26.000	0.734	-0.338	-1.194	26.555	0.243
Population	0.558	3.996	20.488	0.001	0.327	2.705	26.000	0.012	0.405	3.406	27.323	0.002
Migration					0.493	2.902	26.000	0.007	0.484	3.069	28.243	0.005
GDP					0.082	0.346	26.000	0.732				
Population Density					-0.330	-1.945	26.000	0.063				
Tourism					0.331	2.603	26.000	0.015	0.304	2.498	28.363	0.019
Percent Urban					-0.126	-0.942	26.000	0.355	-0.214	-1.819	28.978	0.079
Median Age					0.117	0.800	26.000	0.431				
Day x Relational Mobility	0.091	2.124	32.359	0.041	0.081	3.213	26.000	0.003	0.088	3.514	11.925	0.004
Day x BCG Current vs. Not Current	-0.028	-1.727	32.821	0.094	-0.022	-1.624	26.000	0.116	-0.030	-2.589	25.999	0.016
Day x Population	0.035	4.678	17.876	<.001	0.021	3.904	26.000	0.001	0.021	4.197	28.532	<.001
Day x Migration					0.021	2.734	26.000	0.011	0.025	3.641	28.763	0.001
Day x GDP					0.010	0.948	26.000	0.352				
Day x Population Density					-0.008	-1.045	26.000	0.305				
Day x Tourism					0.022	3.922	26.000	0.001	0.025	4.926	26.107	<.001

Day x Percent Urban	-0.012	-2.038	26.000	0.052	-0.011	-2.230	28.842	0.034
Day x Median Age	0.002	0.333	26.000	0.742				
R ² fixed effects	0.649		0.830			0.802		
R ² fixed and random effects	0.975		0.972			0.971		

B. Predictor	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	3.224	5.712	8.061	<.001	2.841	4.465	8.936	0.002	3.087	5.339	8.285	0.001
Day	0.185	6.546	7.649	<.001	0.169	6.201	9.633	<.001	0.175	6.306	7.304	<.001
Relational Mobility	0.974	0.727	26.039	0.473	0.674	0.465	17.351	0.647	1.072	0.803	26.588	0.429
BCG Current vs. Not Current	-0.764	-1.476	32.483	0.150	-0.244	-0.366	25.976	0.717	-0.635	-1.216	31.956	0.233
Population	0.443	1.993	22.634	0.058	0.336	1.238	19.198	0.231	0.445	2.013	21.631	0.057
Migration					0.290	0.868	21.511	0.395	0.402	1.367	29.214	0.182
GDP					0.363	0.743	25.125	0.464				
Population Density					-0.375	-1.104	22.888	0.281				
Tourism					0.127	0.484	25.127	0.633				
Percent Urban					-0.010	-0.035	25.628	0.973				
Median Age					0.097	0.288	25.661	0.775				
Day x Relational Mobility	0.075	1.224	31.198	0.230	0.055	0.944	23.809	0.354	0.083	1.440	31.279	0.160
Day x BCG Current vs. Not Current	-0.047	-2.018	32.997	0.052	-0.028	-1.077	25.808	0.291	-0.037	-1.707	31.790	0.098
Day x Population	0.030	2.914	21.713	0.008	0.024	2.193	18.543	0.041	0.031	3.138	20.760	0.005
Day x Migration					0.023	1.813	22.233	0.083	0.030	2.464	28.404	0.020
Day x GDP					0.017	0.899	24.861	0.377				
Day x Population Density					-0.015	-1.122	23.202	0.273				
Day x Tourism					0.011	1.117	25.244	0.275				

Day x Percent Urban		-0.010	-0.886	25.907	0.384	
Day x Median Age		0.014	1.093	25.838	0.285	
R ² fixed effects	0.483		0.528			0.500
R ² fixed and random effects	0.970		0.971			0.971

Table S6-A.

Regression coefficients predicting the number of confirmed cases over the first 30 days of country-wise outbreaks, with the Russell et al. (2020) underreporting index used as a weighting factor. Model 1 includes total population (called Population). Model 2 includes all demographic covariates. Model 3 includes only those demographic variables that prove at least marginally significant in Model 2. The results are based on 29 of the 39 countries.

Predictor	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	7.026	28.270	4.817	<.001	7.342	20.418	20.032	<.001	7.238	60.459	24.059	<.001
Day	0.124	8.003	4.035	0.001	0.138	8.626	19.192	<.001	0.134	23.453	23.411	<.001
Relational Mobility	1.880	2.647	25.590	0.014	1.690	2.309	20.012	0.032	1.550	2.503	24.105	0.019
Population	0.668	3.329	24.852	0.003	0.259	0.972	19.987	0.342				
Migration					0.239	1.556	20.197	0.135	0.255	2.034	24.250	0.053
GDP					0.192	0.756	20.103	0.458	0.149	0.900	24.274	0.377
Population Density					0.723	0.526	20.029	0.605				
Tourism					0.314	1.945	20.490	0.066	0.404	3.275	24.551	0.003
Percent Urban					-0.091	-0.493	20.072	0.627				
Median Age					0.069	0.378	19.901	0.710				
Day x Relational Mobility	0.121	3.130	26.497	0.004	0.099	3.053	19.210	0.006	0.095	3.199	23.664	0.004
Day x Population	0.044	4.078	24.454	<.001	0.017	1.401	19.179	0.177				
Day x Migration					0.012	1.778	20.670	0.090	0.016	2.662	24.868	0.013
Day x GDP					0.025	2.208	19.888	0.039	0.013	1.574	24.689	0.128
Day x Population Density					0.030	0.487	19.207	0.632				
Day x Tourism					0.020	2.705	22.298	0.013	0.026	4.405	26.095	<.001
Day x Percent Urban					-0.009	-1.068	19.790	0.298				
Day x Median Age					-0.005	-0.645	18.673	0.527				
R ² fixed effects		0.721				0.812				0.823		
R ² fixed and random effects		0.991				0.991				0.991		

Table S6-B.

Regression coefficients predicting the number of confirmed cases over the first 30 days of country-wise outbreaks, with the Russell et al. (2020) underreporting index used as a covariate. Model 1 includes total population (called Population) and Underreporting. Model 2 includes all demographic covariates and Underreporting. Model 3 includes only those demographic variables that prove at least marginally significant in Model 2 and Underreporting. The results are based on 29 of the 39 countries.

Predictor	Model 1				Model 2				Model 3			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	6.938	23.570	4.324	<.001	7.317	20.067	19.000	<.001	7.240	56.800	24.000	<.001
Day	0.120	6.645	4.016	0.003	0.138	8.319	19.000	<.001	0.135	20.652	24.001	<.001
Relational Mobility	1.633	2.457	24.999	0.021	1.787	2.360	19.000	0.029	1.418	2.162	24.000	0.041
Reporting Index	0.329	2.480	24.808	0.020	0.099	0.627	19.000	0.538	0.126	0.895	24.000	0.379
Population	0.852	4.382	23.696	<.001	0.274	1.014	19.000	0.323				
Migration					0.211	1.310	19.000	0.206				
GDP					0.146	0.544	19.000	0.593	0.122	0.637	24.000	0.530
Population Density					0.692	0.498	19.000	0.624				
Tourism					0.346	2.021	19.000	0.058	0.488	3.462	24.000	0.002
Percent Urban					-0.122	-0.630	19.000	0.536				
Median Age					0.094	0.494	19.000	0.627				
Day x Relational Mobility	0.107	2.937	24.809	0.007	0.098	2.849	19.000	0.010	0.080	2.389	24.001	0.025
Day x Reporting Index	0.016	2.207	24.307	0.037	0.001	0.116	19.000	0.909	0.004	0.539	24.001	0.595
Day x Population	0.053	5.009	23.047	<.001	0.018	1.455	19.000	0.162				
Day x Migration					0.012	1.661	19.000	0.113				
Day x GDP					0.024	1.954	19.000	0.066	0.013	1.284	24.001	0.211
Day x Population Density					0.032	0.502	19.000	0.621				
Day x Tourism					0.020	2.588	19.000	0.018	0.030	4.182	24.001	<.001
Day x Percent Urban					-0.009	-1.033	19.000	0.315				
Day x Median Age					-0.004	-0.422	19.000	0.678				

R ² fixed effects	0.690	0.788	0.777
R ² fixed and random effects	0.968	0.968	0.967

Table S7-A.

Regression coefficients predicting the number of confirmed cases over the first 30 days of country-wise outbreaks, with testing availability used as a weighting factor. Model 1 includes total population (called Population). Model 2 includes all demographic covariates. Model 3 includes only those demographic variables that prove at least marginally significant in Model 2. The results are based on 29 of the 39 countries, except in Model 2, which is based on 28 countries because of a missing value in Tourism in one of the countries (Taiwan).

Predictor	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	7.008	28.009	4.719	<.001	6.980	31.961	3.829	<.001	7.082	42.099	3.521	<.001
Day	0.124	8.312	3.859	0.001	0.121	11.833	5.025	<.001	0.125	15.176	3.205	<.001
Relational Mobility	1.956	2.795	25.477	0.010	1.254	1.655	17.167	0.116	1.302	1.910	19.419	0.071
Population	0.768	3.670	24.710	0.001	0.445	1.596	18.482	0.127	0.435	1.670	20.138	0.110
Migration					0.364	0.791	18.813	0.439				
GDP					0.212	0.676	15.941	0.509	0.220	1.165	20.755	0.257
Population Density					-0.352	-1.591	19.110	0.128	-0.380	-2.018	22.146	0.056
Tourism					0.262	1.499	19.388	0.150	0.242	1.545	21.470	0.137
Percent Urban					-0.114	-0.494	16.622	0.628				
Median Age					-0.041	-0.197	15.701	0.846				
Day x Relational Mobility	0.126	3.425	23.970	0.002	0.079	2.425	16.666	0.027	0.085	2.651	20.033	0.015
Day x Population	0.046	4.202	24.283	<.001	0.031	2.583	17.435	0.019	0.031	2.484	20.389	0.022
Day x Migration					0.014	0.682	18.770	0.504				
Day x GDP					0.031	2.226	18.243	0.039	0.019	2.111	21.537	0.047
Day x Population Density					-0.019	-1.925	20.749	0.068	-0.016	-1.761	24.882	0.090
Day x Tourism					0.016	2.090	21.920	0.048	0.017	2.158	25.103	0.041
Day x Percent Urban					-0.014	-1.407	16.730	0.178				
Day x Median Age					-0.010	-1.128	16.252	0.276				
R ² fixed effects		0.279				0.310				0.312		

R ² fixed and random effects	0.377	0.381	0.376
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Table S7-B.

Regression coefficients predicting the number of confirmed cases, with testing availability (referred to as Testing) used as a covariate. A. Model 1 includes total population (called Population) and Testing. Model 2 includes all demographic covariates and Testing. Model 3 includes only those demographic variables that prove at least marginally significant in Model 2 and Testing. The results are based on 29 of the 39 countries, except in Model 2, which is based on 28 countries because of a missing value in Tourism in one of the countries (Taiwan).

Predictor	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	7.000	26.609	4.628	<.001	7.012	36.280	1.863	<.001	7.114	48.948	21.001	<.001
Day	0.124	7.977	3.994	0.001	0.120	14.178	2.458	<.001	0.125	18.349	21.000	<.001
Relational Mobility	1.901	2.626	24.861	0.015	1.242	1.634	11.419	0.120	1.228	1.806	21.001	0.085
Testing	0.040	0.255	24.911	0.801	-0.119	-0.726	12.961	0.477	-0.112	-0.734	21.001	0.471
Population	0.790	3.425	24.063	0.002	0.321	1.118	12.768	0.278	0.317	1.206	21.001	0.241
Migration					0.382	0.810	11.351	0.429				
GDP					0.261	0.815	12.843	0.426	0.268	1.347	21.001	0.192
Population Density					-0.436	-1.782	10.956	0.092	-0.469	-2.277	21.001	0.033
Tourism					0.275	1.525	11.348	0.145	0.256	1.593	21.001	0.126
Percent Urban					-0.166	-0.720	12.681	0.481				
Median Age					-0.007	-0.036	12.602	0.971				
Day x Relational Mobility	0.125	3.237	24.997	0.003	0.077	2.310	12.200	0.033	0.076	2.388	21.000	0.026
Day x Testing	-0.004	-0.537	24.947	0.596	-0.011	-1.497	12.884	0.152	-0.009	-1.310	21.000	0.204
Day x Population	0.044	3.583	23.358	0.002	0.023	1.832	12.956	0.083	0.024	1.920	21.000	0.069
Day x Migration					0.018	0.875	12.137	0.393				
Day x GDP					0.033	2.327	12.834	0.032	0.024	2.526	21.000	0.020
Day x Population Density					-0.025	-2.372	11.909	0.029	-0.024	-2.433	21.000	0.024
Day x Tourism					0.016	1.986	12.146	0.062	0.015	2.050	21.000	0.053
Day x Percent Urban					-0.016	-1.567	12.583	0.135				
Day x Median Age					-0.008	-0.830	12.942	0.417				

R ² fixed effects	0.698	0.787	0.797
R ² fixed and random effects	0.968	0.967	0.966

Table S8.

Regression coefficients predicting the number of confirmed cases over the first 30 days of country-wise outbreaks. Day 1 is defined as the date when 20 cases (rather than 100 cases as in the main analysis) were confirmed in each country. The Models vary in the covariates included. Model 1 includes only total population (called Population). Model 2 includes all demographic covariates. Model 3 includes only those that prove at least marginally significant in Model 2. The results are based on 39 countries, except in Model 2, which is based on 38 countries because of a missing value in Tourism in one of the countries (Taiwan).

Predictor	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	5.900	16.756	3.668	<.001	5.785	23.964	3.934	<.001	5.805	25.019	4.228	<.001
Day	0.157	7.883	2.818	0.005	0.154	16.072	0.948	0.045	0.152	17.168	0.832	0.058
Relational Mobility	3.216	4.138	35.741	<.001	2.724	3.246	24.259	0.003	2.605	3.494	29.370	0.002
Population	0.458	3.112	28.178	0.004	0.155	0.923	26.715	0.364	0.181	1.194	26.541	0.243
Migration					0.245	1.711	27.427	0.098	0.232	1.789	31.223	0.083
GDP					-0.139	-0.504	29.174	0.618				
Population Density					-0.116	-0.606	28.236	0.549	-0.196	-1.464	31.655	0.153
Tourism					0.366	2.191	28.880	0.037	0.340	2.203	31.933	0.035
Percent Urban					-0.020	-0.124	28.062	0.902				
Median Age					-0.010	-0.049	26.866	0.961				
Day x Relational Mobility	0.182	4.061	34.214	<.001	0.126	2.900	10.012	0.016	0.131	3.350	8.017	0.010
Day x Population	0.039	4.559	26.498	<.001	0.024	2.691	24.750	0.013	0.021	2.547	23.703	0.018
Day x Migration					0.014	1.794	26.526	0.084	0.015	1.953	31.897	0.060
Day x GDP					-0.000	-0.029	28.531	0.977				
Day x Population Density					-0.019	-1.792	28.444	0.084	-0.015	-2.003	26.563	0.055
Day x Tourism					0.017	1.856	28.964	0.074	0.022	2.558	19.679	0.019
Day x Percent Urban					-0.001	-0.067	27.547	0.947				
Day x Median Age					0.017	1.517	14.847	0.150				
R ² fixed effects		0.648				0.724				0.733		

R ² fixed and random effects	0.974	0.970	0.969
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Table S9.

Regression coefficients predicting the number of confirmed cases (A) and deaths (B) over the first 15 (rather than 30 as in the main analysis) days of country-wise outbreaks. Models vary in the covariates included. Model 1 includes only total population (called Population). Model 2 includes all demographic covariates. Model 3 includes only those that prove at least marginally significant in Model 2. The results are based on 39 countries, except in Model 2, which is based on 38 countries because of a missing value in Tourism in one of the countries (Taiwan).

A. Predictor	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	6.034	32.669	3.822	<.001	6.044	71.522	29.000	<.001	6.018	57.589	2.819	<.001
Day	0.174	7.265	3.374	0.004	0.169	19.410	29.000	<.001	0.169	18.360	1.169	0.022
Relational Mobility	1.282	2.508	33.123	0.017	0.685	1.433	29.000	0.163	0.826	1.750	19.416	0.096
Population	0.334	3.566	29.136	0.001	0.173	1.656	29.000	0.109				
Migration					0.181	1.879	29.000	0.070	0.167	1.861	32.910	0.072
GDP					-0.022	-0.127	29.000	0.900				
Population Density					-0.277	-2.194	29.000	0.036	-0.265	-2.971	32.619	0.006
Tourism					0.179	1.636	29.000	0.113	0.276	3.003	31.126	0.005
Percent Urban					0.042	0.392	29.000	0.698				
Median Age					0.147	1.188	29.000	0.245				
Day x Relational Mobility	0.197	3.433	35.408	0.002	0.092	1.872	29.000	0.071	0.118	2.505	10.264	0.031
Day x Population	0.042	3.914	27.003	0.001	0.018	1.693	29.000	0.101				
Day x Migration					0.021	2.100	29.000	0.045	0.023	2.499	32.988	0.018
Day x GDP					0.013	0.717	29.000	0.479				
Day x Population Density					-0.036	-2.778	29.000	0.009	-0.028	-2.994	27.271	0.006
Day x Tourism					0.027	2.358	29.000	0.025	0.041	4.319	23.151	<.001
Day x Percent Urban					0.004	0.338	29.000	0.738				
Day x Median Age					0.007	0.547	29.000	0.588				
R ² fixed effects		0.615				0.733				0.706		

	0.986				0.985				0.985			
	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
B. Predictor	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	1.509	6.723	3.487	0.004	1.536	6.314	1.840	0.030	1.486	7.051	3.642	0.003
Day	0.187	6.110	4.310	0.003	0.190	6.450	2.728	0.010	0.183	6.294	4.441	0.002
Relational Mobility	1.152	1.424	22.833	0.168	0.508	0.513	17.816	0.614	1.194	1.441	22.494	0.163
Population	0.240	1.596	33.211	0.120	0.151	0.765	25.318	0.452				
Migration					0.132	0.764	26.946	0.451				
GDP					0.183	0.554	28.965	0.584				
Population Density					-0.275	-1.195	28.168	0.242	-0.125	-0.795	35.868	0.432
Tourism					0.057	0.284	28.784	0.778				
Percent Urban					0.096	0.495	27.807	0.624				
Median Age					0.016	0.066	23.132	0.948				
Day x Relational Mobility	0.140	1.469	30.256	0.152	0.046	0.419	23.024	0.679	0.135	1.386	29.928	0.176
Day x Population	0.026	1.469	31.464	0.152	0.020	0.928	25.526	0.362				
Day x Migration					0.014	0.729	27.207	0.472				
Day x GDP					0.041	1.128	28.996	0.269				
Day x Population Density					-0.046	-1.832	28.083	0.078	-0.019	-1.070	34.900	0.292
Day x Tourism					0.000	0.003	28.714	0.998				
Day x Percent Urban					0.001	0.031	27.943	0.976				
Day x Median Age					0.009	0.345	26.771	0.733				
R ² fixed effects		0.398				0.414				0.375		
R ² fixed and random effects		0.963				0.966				0.962		

Table S10.

Regression coefficients predicting the number of confirmed cases (A) and deaths (B) over the first 60 (rather than 30 as in the main analysis) days of country-wise outbreaks. Models vary in the covariates included. Model 1 includes only total population (called Population). Model 2 includes all demographic covariates. Model 3 includes only those that prove at least marginally significant in Model 2. The results are based on 39 countries, except in Model 2, which is based on 38 countries because of a missing value in Tourism in one of the countries (Taiwan).

A. Predictor	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	8.133	15.441	3.056	0.001	7.925	37.700	0.909	0.023	7.987	22.898	2.450	0.001
Day	0.071	7.174	2.501	0.010	0.068	12.734	0.515	0.172	0.067	18.581	1.394	0.012
Relational Mobility	2.925	3.430	34.282	0.002	1.904	2.273	15.212	0.038	2.571	3.134	33.910	0.004
Population	1.054	6.152	29.318	<.001	0.649	3.848	21.946	0.001	0.770	4.516	22.343	<.001
Migration					0.333	2.259	25.596	0.033				
GDP					0.244	0.867	28.890	0.393				
Population Density					-0.313	-1.597	27.360	0.122				
Tourism					0.446	2.605	28.579	0.014	0.409	2.449	33.441	0.020
Percent Urban					-0.002	-0.015	26.959	0.988				
Median Age					0.125	0.593	21.076	0.560				
Day x Relational Mobility	0.048	2.261	35.989	0.030	0.037	1.969	15.291	0.067	0.039	2.437	8.816	0.038
Day x Population	0.023	5.777	24.539	<.001	0.019	5.031	14.283	<.001	0.014	4.134	31.570	<.001
Day x Migration					0.005	1.650	19.752	0.115				
Day x GDP					0.009	1.503	28.588	0.144				
Day x Population Density					0.001	0.349	22.865	0.731				
Day x Tourism					0.009	2.524	26.678	0.018	0.016	4.312	20.585	<.001
Day x Percent Urban					-0.002	-0.627	22.710	0.537				
Day x Median Age					0.001	0.131	24.000	0.897				
R ² fixed effects		0.561				0.752				0.666		

B. Predictor	0.953				0.938				0.938			
	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	4.045	7.181	3.422	0.004	3.982	9.089	2.189	0.009	3.939	9.486	3.587	0.001
Day	0.098	5.515	3.360	0.009	0.088	12.220	2.207	0.005	0.090	9.412	2.400	0.006
Relational Mobility	3.061	2.431	35.927	0.020	1.849	1.400	27.793	0.173	3.039	2.536	31.271	0.016
Population	0.956	4.027	26.933	<.001	0.704	2.671	21.456	0.014	0.657	2.722	26.061	0.011
Migration					0.337	1.578	25.317	0.127	0.349	1.676	31.555	0.104
GDP					0.497	1.186	28.443	0.245				
Population Density					-0.524	-1.827	26.327	0.079				
Tourism					0.341	1.348	28.085	0.188	0.447	1.814	32.973	0.079
Percent Urban					0.031	0.130	26.567	0.898				
Median Age					0.226	0.698	28.991	0.491				
Day x Relational Mobility	0.087	3.543	33.170	0.001	0.073	2.955	24.899	0.007	0.086	3.719	32.924	0.001
Day x Population	0.032	6.388	32.557	<.001	0.021	4.271	23.304	<.001	0.020	4.251	21.573	<.001
Day x Migration					0.007	1.731	26.158	0.095	0.007	1.712	29.372	0.097
Day x GDP					0.006	0.809	28.868	0.425				
Day x Population Density					-0.007	-1.337	27.237	0.192				
Day x Tourism					0.015	3.045	28.409	0.005	0.015	3.203	32.336	0.003
Day x Percent Urban					-0.005	-1.167	27.238	0.253				
Day x Median Age					0.009	1.435	28.074	0.162				
R ² fixed effects		0.540				0.652				0.620		
R ² fixed and random effects		0.948				0.940				0.936		

Table S11-A.

Regression coefficients predicting the number of confirmed cases for the 39 countries with RM scores and an additional 46 countries with interpolated scores. Models vary in the covariates included. Model 1 includes only total population (called Population). Model 2 includes all demographic covariates. Model 3 includes only those that prove at least marginally significant in Model 2. The results are based on 83 countries in Model 1 due to missing COVID-19 data for a country and a missing value for population size for another. Model 2 included 78 countries due to missing data on a few demographic variables. Model 3 included 82 countries.

Predictor	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	6.721	30.909	4.412	<.001	6.741	43.771	3.139	<.001	6.706	51.693	4.327	<.001
Day	0.111	7.779	3.888	0.002	0.110	11.604	3.240	0.001	0.107	14.956	2.836	0.001
Relational Mobility	2.686	3.433	72.040	0.001	1.471	2.368	60.695	0.021	1.634	2.497	51.225	0.016
Population	0.140	1.433	76.410	0.156	0.028	0.369	63.475	0.713				
Migration					0.183	1.873	66.853	0.065	0.131	1.535	76.975	0.129
GDP					-0.052	-0.424	68.143	0.673				
Population Density					-0.260	-3.064	67.814	0.003				
Tourism					0.489	6.040	68.073	<.001	0.530	5.952	75.465	<.001
Percent Urban					0.198	1.639	57.414	0.107				
Median Age					-0.089	-0.736	54.844	0.465				
Day x Relational Mobility	0.148	3.623	78.916	0.001	0.095	2.856	66.739	0.006	0.090	2.793	53.620	0.007
Day x Population	0.007	1.495	74.122	0.139	0.002	0.459	62.386	0.648				
Day x Migration					0.011	2.045	65.553	0.045	0.008	1.994	75.605	0.050
Day x GDP					-0.002	-0.307	66.768	0.760				
Day x Population Density					-0.006	-1.231	66.178	0.223				
Day x Tourism					0.029	6.692	67.263	<.001	0.030	6.967	76.513	<.001
Day x Percent Urban					0.008	1.247	64.708	0.217				
Day x Median Age					-0.009	-1.361	64.406	0.178				
R ² fixed effects		0.472				0.696				0.645		

R ² fixed and random effects	0.972	0.970	0.969
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Table S11-B.

Regression coefficients predicting the number of confirmed deaths for the 39 countries with RM scores and an additional 46 countries with interpolated scores. Models vary in the covariates included. Model 1 includes only total population (called Population). Model 2 includes all demographic covariates. Model 3 includes only those that prove at least marginally significant in Model 2. The results are based on 82 countries in Model 1, due to missing COVID-19 data for two countries and a missing value for population size in one. Model 2 included 77 countries due to missing data on a few demographic variables. Model 3 included 81 countries.

Predictor	<u>Model 1</u>				<u>Model 2</u>				<u>Model 3</u>			
	b	t	df	p	b	t	df	p	b	t	df	p
Intercept	2.370	11.322	5.162	<.001	2.432	14.744	2.690	0.001	2.405	14.423	3.714	<.001
Day	0.131	9.307	4.786	<.001	0.136	12.366	3.891	<.001	0.132	12.309	4.628	<.001
Relational Mobility	3.261	3.257	54.647	0.002	1.942	1.957	33.045	0.059	1.816	1.877	44.769	0.067
Population	0.144	1.084	77.767	0.282	0.016	0.117	66.628	0.907				
Migration					0.268	1.580	67.993	0.119	0.262	1.994	75.561	0.050
GDP					-0.131	-0.627	66.920	0.533				
Population Density					-0.242	-1.657	63.520	0.102	-0.258	-1.945	75.639	0.056
Tourism					0.375	2.673	67.993	0.009	0.444	3.394	71.026	0.001
Percent Urban					0.130	0.671	27.260	0.508				
Median Age					0.165	0.873	18.115	0.394				
Day x Relational Mobility	0.202	3.831	69.512	<.001	0.122	2.538	56.348	0.014	0.113	2.341	64.576	0.022
Day x Population	0.009	1.362	75.839	0.177	0.002	0.295	64.305	0.769				
Day x Migration					0.014	1.836	66.937	0.071	0.014	2.230	74.573	0.029
Day x GDP					-0.005	-0.499	67.785	0.619				
Day x Population Density					-0.012	-1.774	67.737	0.081	-0.012	-1.962	75.377	0.053
Day x Tourism					0.026	4.054	67.602	<.001	0.031	4.872	75.325	<.001
Day x Percent Urban					0.005	0.544	52.400	0.589				
Day x Median Age					0.011	1.153	49.958	0.255				
R ² fixed effects		0.449				0.578				0.547		

R ² fixed and random effects	0.966	0.967	0.966
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Figure S1.

A correlation matrix of the demographic and cultural variables included in the present analysis. Only countries with RM scores are included to compute each correlation. Some covariates, particularly, cultural covariates, were not available for some countries. Each coefficient is based on the maximal number of countries that is possible given the data. Significant correlations are outlined with a square.

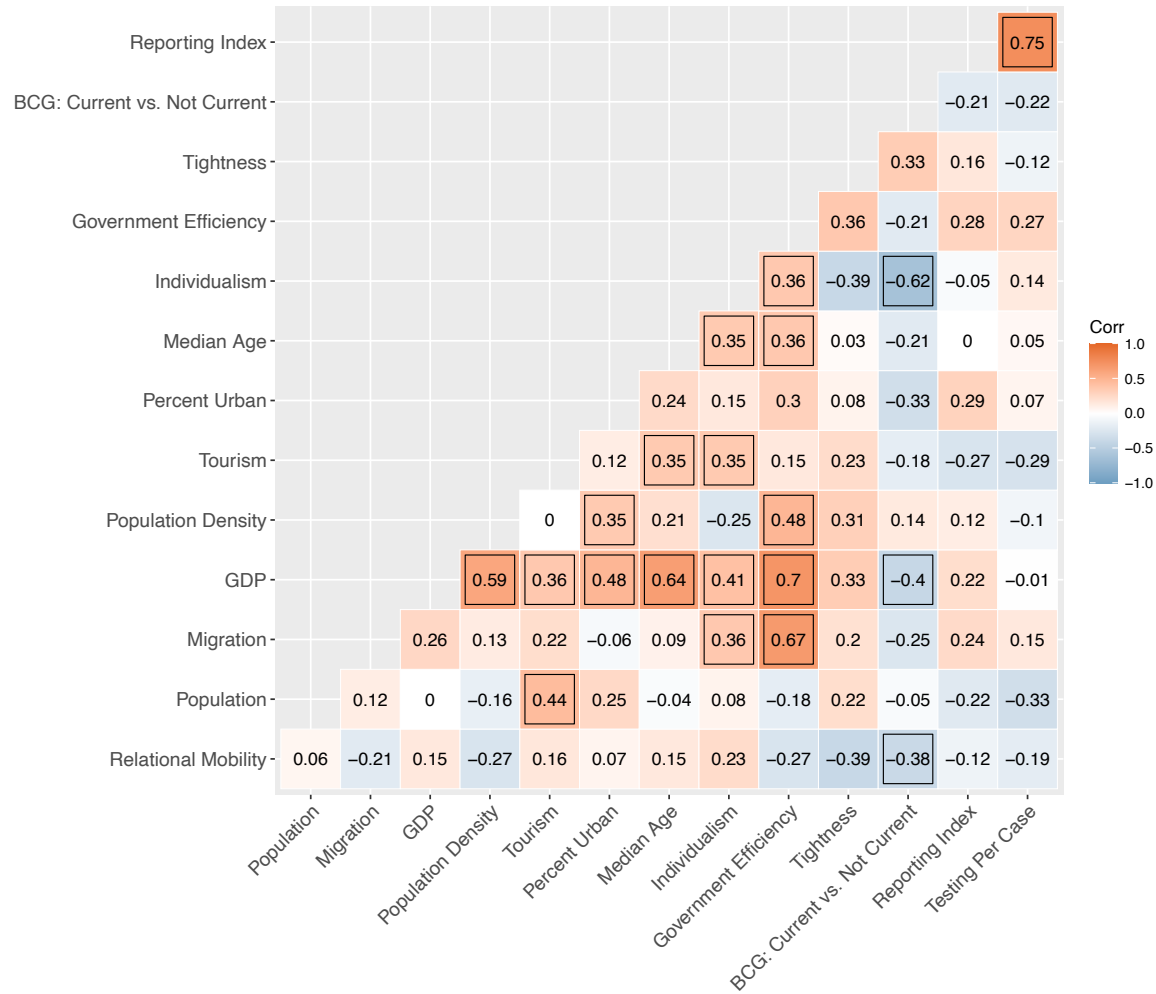


Figure S2.

The rate of growth of confirmed cases and deaths of COVID-19 during the first 30 days of country-wise outbreaks after interpolation. A. Country-wise growth rates of confirmed cases as a function of RM for 83 countries. B. Country-wise growth rates of deaths as a function of RM for 82 countries.

