Association of holidays and the day of the week with suicide risk: multicounty, two stage, time series study

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ABSTRACT

OBJECTIVES

To assess the short term temporal variations in suicide risk related to the day of the week and national holidays in multiple countries.

DESIGN

Multicountry, two stage, time series design.

SETTING

Data from 740 locations in 26 countries and territories, with overlapping periods between 1971 and 2019, collected from the Multi-city Multi-country Collaborative Research Network database.

PARTICIPANTS

All suicides were registered in these locations during the study period (overall 1 701 286 cases).

MAIN OUTCOME MEASURES

Daily suicide mortality.

RESULTS

Mondays had peak suicide risk during weekdays (Monday-Friday) across all countries, with relative risks (reference: Wednesday) ranging from 1.02 (95% confidence interval (CI) 0.95 to 1.10) in Costa Rica to 1.17 (1.09 to 1.25) in Chile. Suicide risks were lowest on Saturdays or Sundays in many countries in North America, Asia, and Europe. However, the risk increased during weekends in South and Central American countries, Finland, and South Africa. Additionally, evidence suggested strong increases in suicide risk on New Year's Day in most countries with relative risks ranging from 0.93 (95% CI 0.75 to 1.14) in Japan to 1.93 (1.31 to 2.85) in Chile, whereas the evidence on Christmas day was weak. Suicide risk was associated with a weak decrease on other national holidays, except for Central and South American countries, where the risk generally increased one or two days after these holidays.

CONCLUSIONS

Suicide risk was highest on Mondays and increased on New Year's Day in most countries. However, the risk of suicide on weekends and Christmas varied by country and territory. The results of this study can help to better understand the short term variations in suicide risks and define suicide prevention action plans and awareness campaigns.

WHAT IS ALREADY KNOWN ON THIS TOPIC

Previous studies reported that suicide risk differed by the day of the week

However, the generalisability of the previous findings was limited due to the restricted study locations and heterogeneous methodological frameworks

Mixed results have been reported on the association between holidays and suicide risk

WHAT THIS STUDY ADDS

This study presents the association as the relative risk of suicide by days within a week or a ratio of risk for national holidays compared with non-national holidays

Mondays and New Year's Day were both associated with increased suicide risk in most countries; however, suicide risks related to weekends and other national holidays were heterogeneous

The findings provide novel scientific evidence at a global scale, which can help to establish more targeted suicide prevention and response programmes related to holidays and the day of the week

The results provide significant information about associations between suicide and social and environmental factors

Introduction

Suicide is an important global public health concern. According to the World Health Organization, more than 700 000 people died due to suicide in 2019, accounting for approximately 1.3% of deaths, which was higher than the number of deaths by malaria, HIV/AIDS, and breast cancer.[1] Suicide has been shown to be a leading cause of premature deaths and particularly the fourth leading cause of death among young people aged 15-29 years.[1] Studies have attempted to theoretically explain suicidal behaviour in sociology since Durkheim's work,[2] suggesting that suicide may be associated with social factors, as well as individual characteristics.[3 4] These social or individual factors might contribute to developing short or long term suicidal thoughts and behaviours.

Suicide is associated with time varying factors.[5 6] Suicides have historically and consistently peaked in the spring and early summer in multiple countries.[7] Several studies have reported other shorter term variabilities in suicide risk, particularly in reference to the day of the week and holidays.[5 8] The suicide risk peaks on Mondays and decreases during weekends.[5 9] However, previous results for holiday effects regarding suicide were mixed. Multiple studies in European countries and the United States reported that end-of-year holidays such as Thanksgiving, Advent, and

Christmas were associated with lower suicide or suicidal intent, whereas suicidal events seemed to increase on New Year's Day.[5 10 11] Public holidays seem to provide a protective association with suicidal events, however, several studies have reported an increase in risk in the immediately following days.[8 12] However, a few other studies reported no strong linkage between suicide and general holidays.[13 14]

The broken-promise effect theory has been widely adapted to explain short term temporal variations in suicide. It states that individuals may postpone committing suicide due to the hope of a "new beginning" when the cycle ends (eg, weekends and the end of the year),[8 10] while people may be prone to suicidal reactions when they encounter a sense of hopelessness from a new cycle (eg, Monday and New Year).[5 15] In accordance with the broken-promise effect, plausible explanations for the protective effects on suicidal events may also include improved family or social support during weekends and holidays.[9] Previous studies have been conducted on this theory; however, they have several limitations. The existing findings were primarily based on Western cultures, and no multiregional study could provide comparative results across different lifestyles and cultures with unified analytical frameworks. Second, the day of the week and holiday effects on suicide using time series data should be estimated considering the season and ambient temperature,[7 16 17] potentially confounding the results. Previous studies in the UK reported a peak in suicide in January along with a strong New Year's Day effect on suicide,[5 16] which appears contradictory to the peak in spring and early summer in other countries. Applying the unified approach to multiple countries can provide comparable results and clarify the changes in risk at different timescales by adjusting the season and temperatures under the same conditions.

Therefore, to address these limitations, we performed a multicountry time series study that included suicide deaths across 26 countries from 1971 to 2019. We investigated the association of the day of the week and major holidays with suicide risk and differences by culture and country using a cutting-edge standardised two stage time series analysis. Based on the large sample size and geographical scope, this study aimed to provide international results regarding the effects of the day of the week and major holidays on suicide risk.

Methods

Data

We collected suicide data for 740 locations in 26 countries from the database of the Multi-country Multi-city Collaborative Research Network (https://mccstudy.lshtm.ac.uk/). The dataset we used for this study included location specific daily suicide counts and daily mean temperatures (°C) in overlapping periods between 1 January 1971 and 31 December 2019. Detailed information regarding the country name, number of locations, and country specific study period are displayed in table 1. In this study, suicide was defined as intentional self-poisoning and self-harm using the 8th, 9th, and 10th revisions for the International Statistical Classification of Diseases and Related Health Problems (E950.0-E958.9 for ICD-8 and ICD-9, and X60-X84 for ICD-10).[7 17] Details regarding the data collection and data sources are described in the "data collection details" section of the supplementary materials. Table S1 displays the summary of statistics regarding suicides for each location.

The holiday information for each country during the study period was collected from a calendar website (https://www.timeanddate.com/calendar/). We collected data for all the national holidays for each country; however, because this study addressed multicountry data, we were limited in covering the entire holidays that are heterogeneous by country and have different meanings (eg, festivals or memorial days). Additionally, we conjectured that the practical impacts of holidays are substantially heterogeneous; for example, it is difficult to assume that all holidays identically affect the general life. Therefore, we classified the holidays into the following three categories: Christmas (25th December), New Year's Day (1 January), and other national holidays. The other national holidays included all variable holidays, such as temporary holidays (eg, election days) and observed holidays: a list of holidays we collected is displayed in supplementary table S2. Moreover, for comparability, we allocated Christmas and New Year's Day as national holidays for all countries based on the assumption that these holidays have similar implications across culturally diverse countries; although some countries did not designate them as national holidays. For countries with Lunar New Year holidays, we considered them as other holidays for comparability with other countries.

The daily suicide counts from all locations within each country were summed up to create the daily suicide counts by country. To address the conditions in more densely populated areas of each country, we calculated the suicide count-weighted daily mean temperatures by country using the location specific daily mean temperature and suicide count data.

Statistical analysis

We performed a two stage analysis. In the first stage, we fitted a quasi-Poisson regression model to estimate the associations between suicide and the day of the week, as well as three different types of holidays (New Year's Day, Christmas, and other national holidays), with the corresponding 95% confidence intervals. We used an indicator variable for the day of the week and several binary indicators representing the different types of national holidays. We incorporated all those variables into the model to ensure that they were mutually adjusted. We also considered the possible effects before and after the holidays on the risk of suicide that may be attributed to behavioural changes, expectations of the event, or lagged effects observed after the holidays. We used lagged indicator variables for a five day period from two days before until two days after the holidays

Table 1 | Study locations, periods, and information on suicide events and temperature

Region and country	No. of locations	Study period	Suicide count	Suicide count, Men (% of the total suicide count)	Suicide count, aged 0-64 (% of the total suicide count)	Suicide rate per 100 000 (WHO)	Average temperature* (°C)
North America:							
Canada	26	1986-2015	51 867	38 661 (74.5)	45 041 (86.8)	12.0	7.2
United States	134	2001-06	84 684	66 110 (78.1)	70 581 (83.3)	11.8	15.8
Central America:							
Costa Rica	1	2000-17	4345	NA	NA	6.6	22.7
Guatemala	1	2009-18	145	NA	NA	6.2	19.4
Mexico	10	1998-2014	26 329	21 309 (80.9)	24 614 (93.5)	4.4	18.3
South America:							
Brazil	15	2000-19	26 145	19 580 (74.9)	23 828 (91.1)	4.4	22.8
Chile	1	2008-14	4876	3816 (78.3)	4401 (90.3)	11.2	15.4
Ecuador	2	2013-19	1938	1519 (78.4)	1762 (90.9)	8.7	19.8
Paraguay	1	2004-19	549	NA	NA	4.8	23.3
Africa and Oceania:							
Australia	5	2009-18	1811	1324 (73.1)	1582 (87.4)	11.2	19.4
South Africa	52	1997-2013	6104	4721 (77.3)	5716 (93.6)	24.2	18.2
Asia:							
China	1	2015-19	1247	753 (60.4)	826 (66.2)	8.1	17.7
Japan	47	1973-2019	1 130 219	759 676 (67.2)	827 160 (73.2)	24.0	15.2
South Korea	36	1997-2019	154 465	105 500 (68.3)	117 975 (76.4)	26.7	13.6
Philippines	8	2006-19	2672	1773 (66.4)	2596 (97.2)	2.1	28.3
Taiwan	3	1994-2014	23 405	15 495 (66.2)	18 494 (79.0)	NA	23.8
Vietnam	1	2010-13	460	336 (73.0)	432 (93.9)	7.3	28.5
Europe:							
Czech Republic	3	2003-19	4317	3363 (77.9)	2911 (67.4)	15.4	9.5
Estonia	5	2005-15	1096	807 (73.6)	792 (72.3)	22.6	6.4
Finland	310	1971-2018	55 028	42 750 (77.7)	44 670 (84.8)	16.6	4.1
Germany	1	1990-2006	3972	2629 (66.2)	2764 (69.6)	14.0	9.9
Italy	1	2006-15	1606	1149 (71.5)	1075 (66.9)	7.1	16.0
Romania	8	1999-2016	5380	4281 (79.6)	4263 (79.2)	12.3	11.1
Spain	50	1990-2013	21 998	15 650 (71.1)	15 425 (70.1)	7.9	16.4
Switzerland	8	1978-2016	37 313	24 857 (66.6)	24 755 (66.3)	17.8	9.8
United Kingdom	10	2001-14	49 315	38 293 (77.6)	41 413 (84.0)	8.1	10.6

Suicide rate per 100 000: age standardised suicide mortality rate per 100 000 people from 2000 to 2019 (provided by the WHO Global Health Estimates; https://www.who.int/data/global-health-estimates).
NA=not available.
*The average temperature indicates a suicide count-weighted average of daily mean temperature across cities and locations.

for each holiday type, which is statistically equivalent to an unconstrained distributed lag model.[18] Thus, the implicit reference days were the days other than the five day period for each holiday type. Seasonal and long term trends were controlled using a natural cubic spline of time (date) with four degrees of freedom per year. In addition, we adjusted for the weighted daily mean temperature using a cross-basis function with a quadratic B-spline, with three internal knots placed at the 25th, 50th, and 75th percentiles of the country specific temperature distribution. For the association of the lag response for temperature, we used dummy intervals defined by parameters lag 0 and lag 1-2. The modelling choices for temperature were based on the previous Multi-country Multi-city study for the short term temperature and suicide association that used relevant statistical tests.[17] The relative risk estimates of 1 do not indicate that no suicide event occurred, and therefore, should be carefully interpreted.

In the second stage, we conducted a meta-regression model with a random intercept to pool the country specific estimates for the day of the week, Christmas, New Year's Day, and other national holidays from the first stage analysis and obtained the best linear unbiased predictor for each country.[19] To address the heterogeneity across the countries, we incorporated a region indicator, including North America, Central America, South America, Europe, Africa and Oceania, and Asia (table 1) as a meta predictor.

We repeated the same analyses for subpopulations, stratified by sex and age group (aged 0-64 and 65 or older). Limited data were available for the subpopulation analysis: three countries (Costa Rica, Guatemala, and Paraguay) were excluded from the subpopulation analysis. More detailed information on the statistical analysis is reported in the supplementary materials. To examine the potential bias due to misclassification from the mortality registration system during the weekends, we did a simulation study that considers the situations in which the number of suicides would have been over-counted (supplementary materials, in the section: simulation study for the misclassification on Monday). Lastly, to consider the most recently available suicide data for the United States (1999-2019), we did a sensitivity analysis (supplementary materials, in the section: sensitivity analysis using the recent US mortality data).

Patient and public involvement

This study used deidentified suicide mortality data at the aggregated level, and because of the sensitive and emotional nature of this topic we were without the expertise in our team to involve patients or members of the public in this study.

Results

A total of 1 701 286 suicides in 740 locations across 26 countries were included in this study. During the study period, the suicide rate was highest in South Korea and Japan, South Africa, and Estonia, and lowest in the Philippines, Brazil, Mexico, and Paraguay (table 1). Across all countries, higher suicide counts were shown for men (*v* women) and people aged 0-64 years (*v* ≥65 years). Average temperatures were generally higher in low latitude countries (Vietnam, Philippines, Taiwan, and Costa Rica) than in high latitude countries (Finland, Estonia, and Canada). Monday accounted for approximately 15-18% of total suicides (fig 1). Country specific distributions of other national holidays by day of the week are displayed in table S3. Although the distributions were heterogeneous by country, most countries showed the highest proportion of suicides on Monday.

The risks of suicide were higher on Mondays compared with Wednesdays (reference) and other weekdays in the total population, with relative risks ranging from 1.02 (95% CI 0.95 to 1.10) in Costa Rica to 1.17 (1.09 to 1.25) in Chile (fig 2). However, suicide risk on weekends varied by country. Suicide risks for the countries in South and Central America, South Africa, and Finland were generally higher on weekends than on other weekdays. By contrast, suicide risks in most countries in North America, Europe, and Asia were lowest during weekends. These patterns were broadly similar between sexes and age groups in most countries (figures S1-S2). Table S4 shows country specific average suicide counts by the day of the week.

Suicide risk marginally increased on Christmas day and for two days after in the total and male populations, but not in the female group (fig 3). However, this pattern was heterogeneous among the regions: relative risks ranged from 0.54 (95 CI 0.39 to 0.76) in Switzerland to 1.89 (1.01 to 3.56) in South Africa. The suicide risk marginally increased on Christmas day for countries in Central and South America, and South Africa. However, countries in North America and Europe generally showed a decreased suicide risk on Christmas Day. These patterns were more evident in men across the countries (figure S3).

Risk of suicide peaked on New Year's Day across all countries: ranging in relative risk from 0.93 (95% CI 0.75 to 1.14) in Japan to 1.93 (1.31 to 2.85) in Chile. The only exception was in Asian countries, where peak risk remained for one or two days after New Year's Day (fig 4). Furthermore, men generally had a more pronounced increasing pattern of suicide on New Year's Day (fig 4 and figure S4). We also examined the effect of the Lunar New Year's Day for three East Asian countries and regions where people celebrate New Year's Day on the Lunar calendar (China, South Korea, and Taiwan). Only South Korea showed a decreased suicide risk during the Lunar New Year (figure S5).

In many countries, suicide risk decreased on other national holidays (relative risks ranging from 0.80 (95% CI 0.71 to 0.89) in the UK to 1.14 (0.97 to 1.35) in Chile) and one or two days before the holidays. Conversely, risk was reversed and increased one or two days after the holidays (fig 5). This trend was generally more evident in men than in women and was generally observed in European countries and Asian countries (figure S6).

Patterns of suicide risk for individuals aged 0-64 years on Christmas (figure S3), New Year's Day (figure S4), and other national holidays (figure S6) were broadly similar to those in the total population. Numerical data corresponding to figures 2-5 (and figure S1-S4, and S6) can be found in tables S5-S8. We

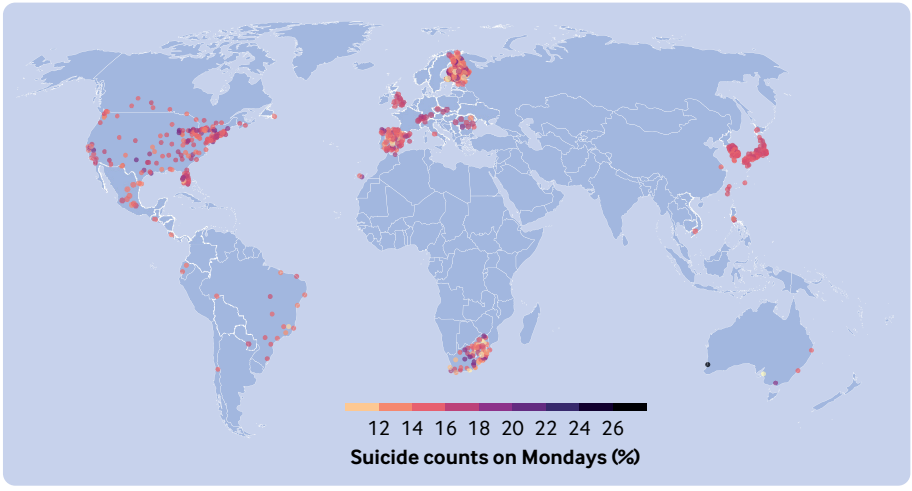

Fig 1 | Geographical locations of the 740 sites in 26 countries included in the study and the corresponding percentage of suicide counts on Monday during the study period

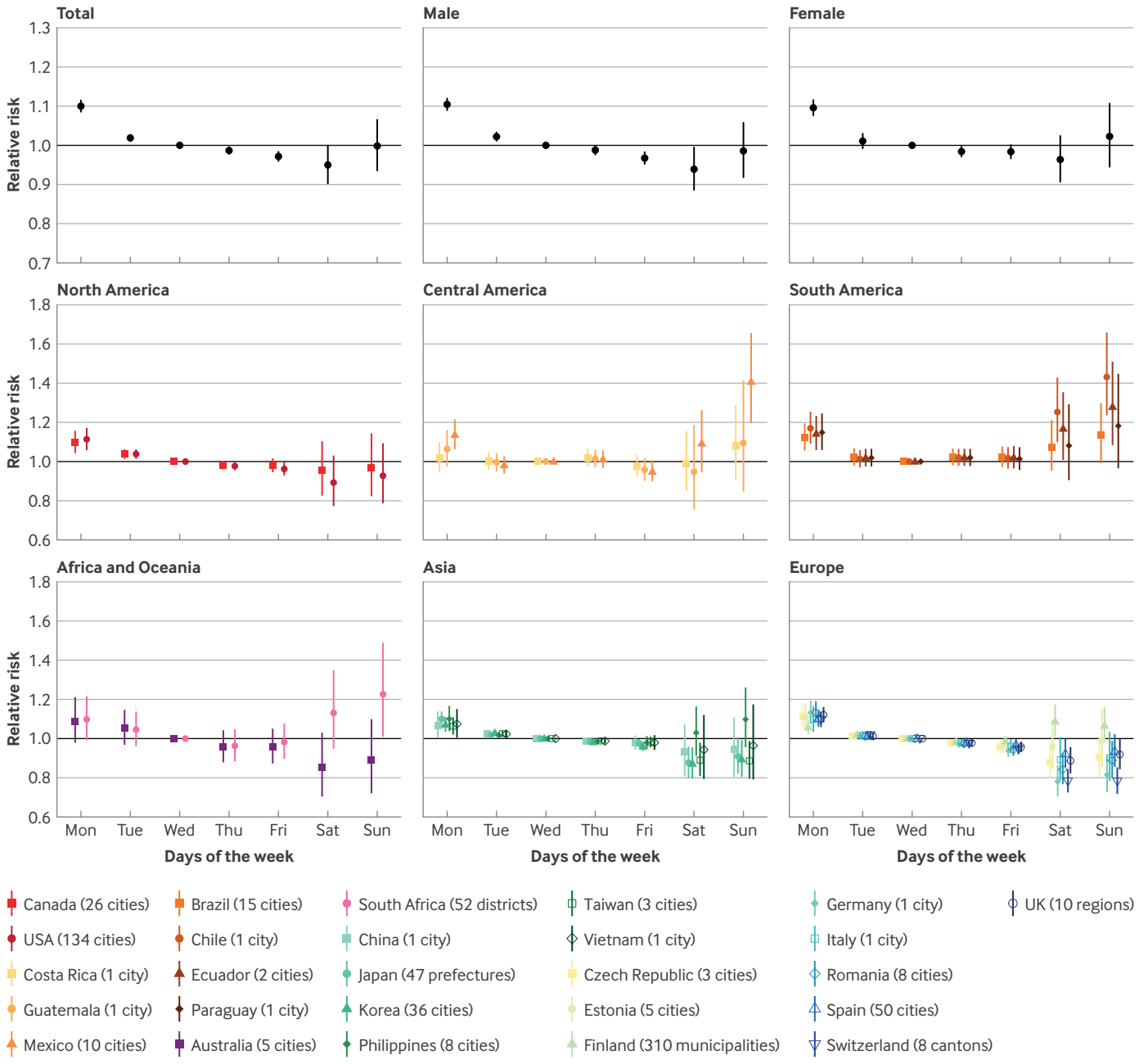

Fig 2 | Risks of suicide by the day of the week with the corresponding 95% confidence intervals (vertical lines). A reference day: Wednesdays

were unable to assess the associations with holidays among older individuals owing to the insufficient number of suicidal events.

The heterogeneity statistics from our meta-regression analyses are reported in tables S9-S13. Although the Cochran Q test provides evidence for residual heterogeneity in all the models, the I^2 statistics substantially decreased after incorporating the region indicator as a meta-predictor, suggesting that the heterogeneity was largely explained by between-region differences (table S9). Another measure of heterogeneity, tau (τ), is reported in supplementary tables S10-S13 with the corresponding correlation matrix of random effects. Consistent with the results on the I^2 statistics, the τ generally decreased when the region indicator was included in the meta-regression model.

Finally, the simulation study examining potential bias due to misclassification arising from the administrative system showed that our main results remained consistent when the misclassification of suicide on Monday was less than 10%. However, when the misclassification on Monday reached 20%, the peak observed on Monday diminished in the total population, and in several countries in Central America and Asia, which showed relatively low Monday risks (relative risks <1.1) (supplementary materials, in the section: Simulation study for the misclassification).

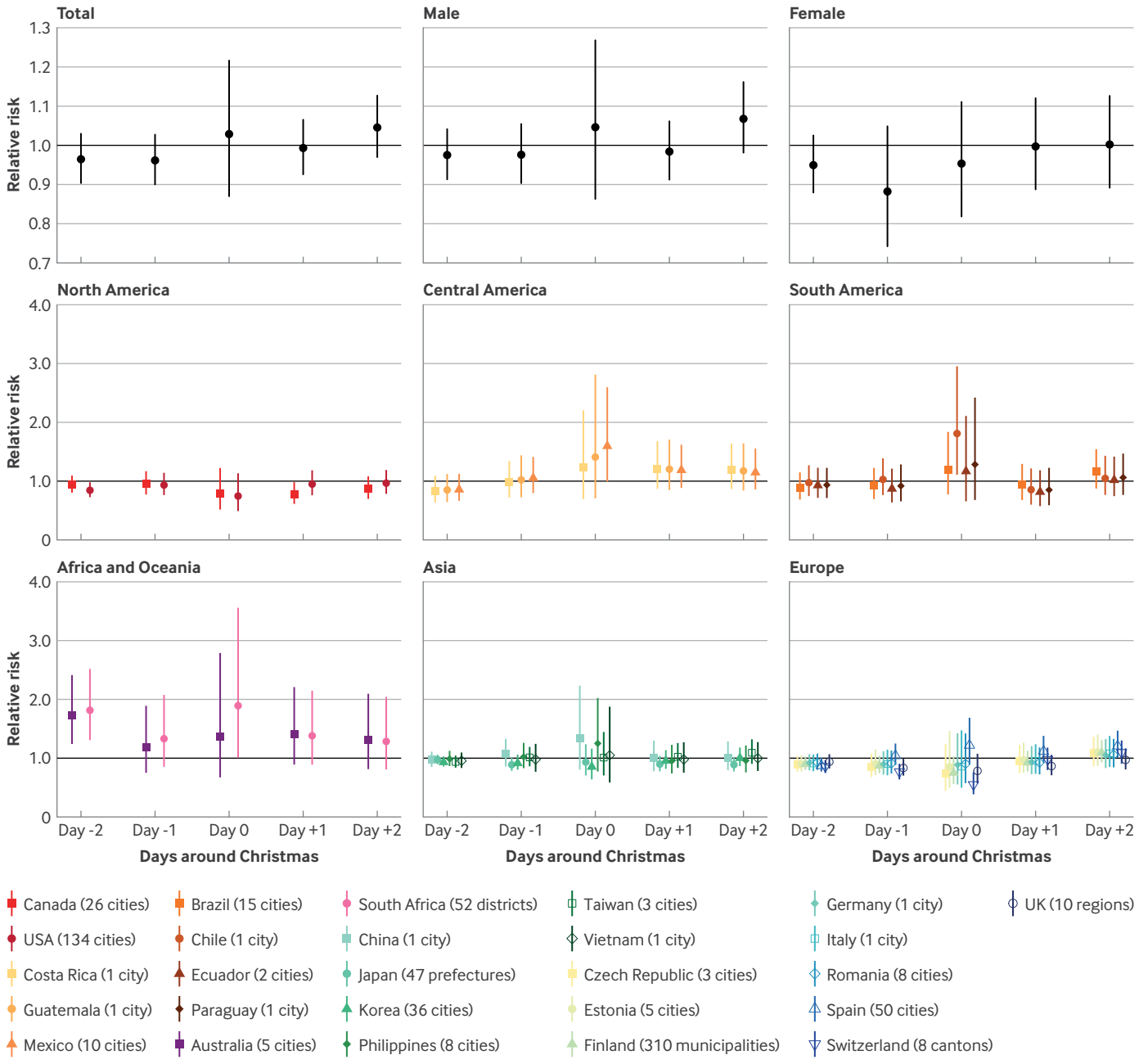

Fig 3 | Risks of suicide around Christmas with the corresponding 95% confidence intervals (vertical lines). Reference days: non-holidays that are not included in New Year's Day, Christmas, and other national holidays that this study addressed.

Discussion

Principal findings

We investigated the short term variation in suicide risk with respect to the day of the week and national holidays, including New Year's Day and Christmas across 26 countries. We found that Monday had the highest suicide risk during weekdays across all countries; however, the effect of the weekend on suicide was mixed. Suicide risk increased on New Year's Day in all countries, whereas the pattern on Christmas was heterogeneous. We also found a decreasing pattern on other national holidays; however, suicide risk increased after other national holidays in most countries.

Our findings provide empirical evidence of the temporal variations in suicide,[20] considering possible interactions between underlying vulnerable states with suicidal thoughts and behaviours as well as short term psychological fluctuations derived from changing environments before, during, and after holidays and weekends. Our results provide epidemiological evidence to establish more effective action plans for suicide prevention and administrative support for enhancing the mental health of workers and

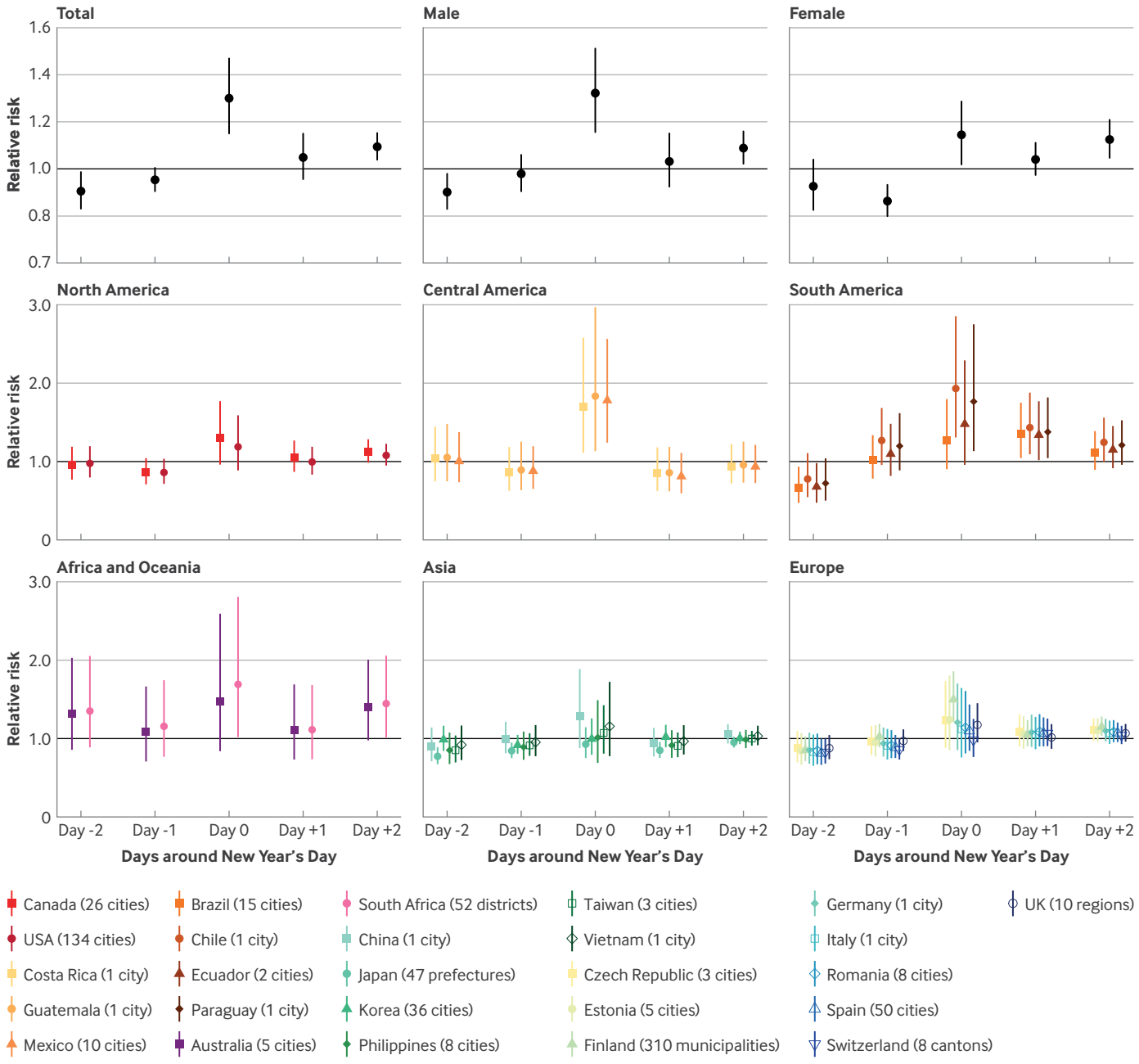

Fig 4 | Risks of suicide around New Year's Day with the corresponding 95% confidence intervals (vertical lines). Reference days: non-holidays that are not included in New Year's Day, Christmas, and other national holidays that this study addressed)

younger generations (eg, pre-emptive screening, and psychological support programmes), which might be important for reducing suicide events related to weekdays and holidays.

Our findings on Mondays and New Year's Day were broadly consistent with previous studies that could be explained by the "broken-promise effect theory".[5 10 11] "Blue Monday" was also used as an explanation, indicating that the beginning of a week makes individuals distressed by pressure from work.[21] In addition, increased alcohol consumption before and on New Year's Day and weekends was considered as one of the major risk factors for higher suicide risk on that day.[22-24] Regardless, we found different patterns of suicide risk by day of the week in several countries, where the risk peaked during the weekends, but not necessarily on Monday. A few previous studies have reported consistent results: studies in Colombia and Brazil showed that the suicide risk increased on the weekends and holidays in relation to alcohol consumption.[25-27] Another previous study in northern Finland reported an increased risk of suicide during the weekends,[28] which might be linked to their drinking culture in which drinking alcohol is concentrated on weekends, as highlighted in the previous review.[29] Higher rates of alcohol consumption on the weekends in comparison to weekdays might be common across various countries,[30] therefore, additional underlying

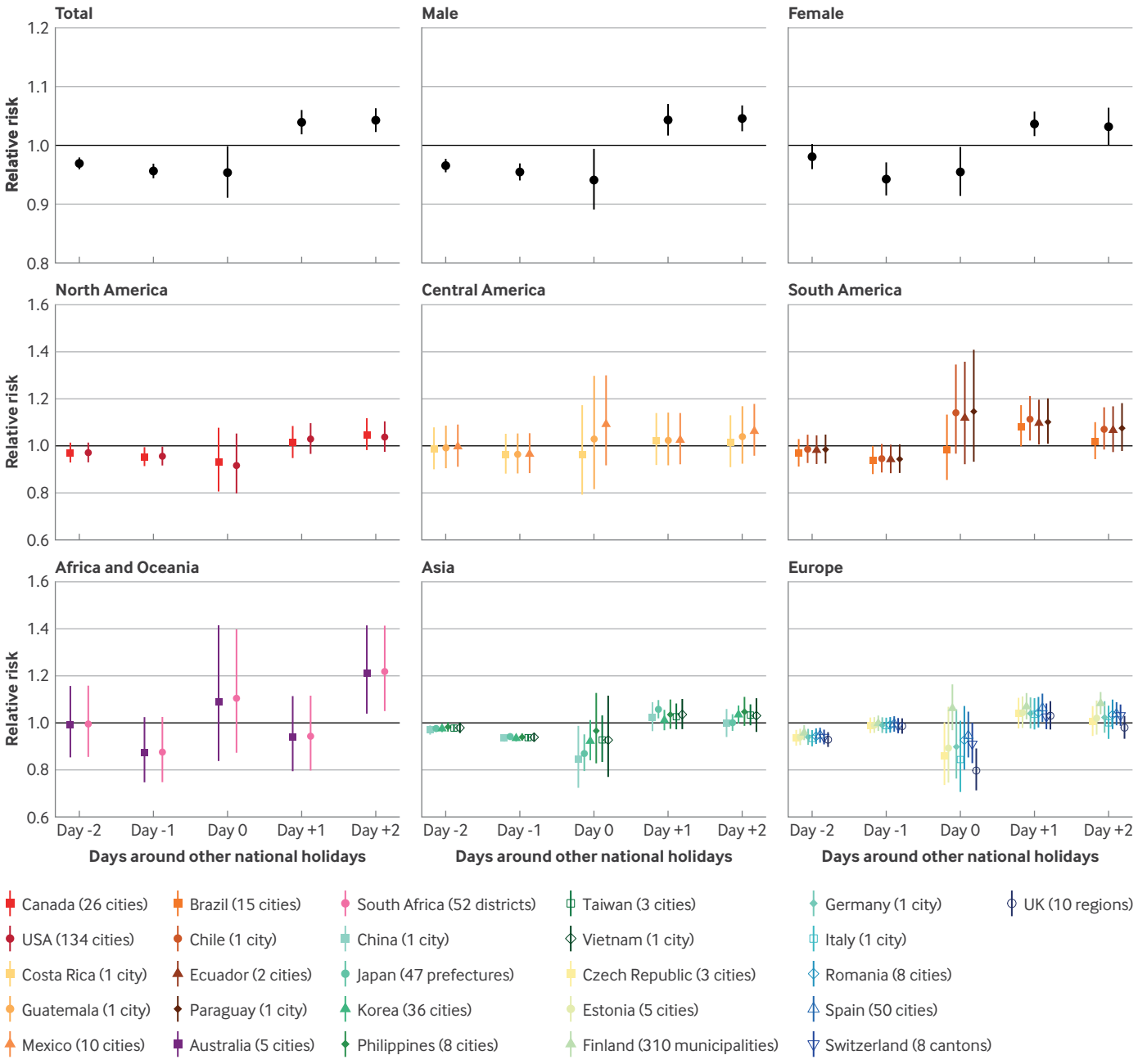

Fig 5 | Risks of suicide around other national holidays (except Christmas and New Year's Day) and neighbouring days with the corresponding 95% confidence intervals (vertical lines). Reference days: non-holidays that are not included in New Year's Day, Christmas, and other national holidays that this study addressed)

factors, such as religion and working conditions might be at play. Our results support the necessity of in-depth studies to investigate these factors.

Notably, our study showed that men who died by suicide were more affected by the day of the week and New Year's Day compared with women. These sex differences may also be associated with disparities in the social capital and susceptibility to isolation by gender. Previous studies have reported that men—particularly male older people—are more susceptible to isolation, stress, and insufficient social capital. Conversely, women derive more health benefits from social capital than men and generally have a bigger and more diverse social support system, actively participating in social networks.[31 32] We also hypothesise that the higher economic activity by men in general globally might be associated with the higher vulnerability on Mondays, New Year's Day, and days after major holidays, which are the beginning of the new economic activity cycle.[23 33 34] Higher labour force participation in younger individuals might also support our findings of the stronger effect by day of the week on suicide in individuals aged 0-64 compared with people aged 65 or older.

We noted that suicide risks decreased on Christmas and other national holidays among men in North American and European countries, although the statistical significance was weak. Better family and social relationships may be associated with a lower suicide risk on holidays.[35 36] However, the results for Christmas were heterogeneous among the countries studied. This suggests that the existing plausible explanations for the results should be addressed with caution, and future research is needed to identify the related factors.

Limitations and strengths

This study has several limitations. Firstly, we were unable to use data at the location level because of a problem with model convergence. Although the location level analysis could provide more information regarding spatial heterogeneity, we believe that our results using a standardised method can provide more valuable information to establish relevant interventions on a national scale. Secondly, our estimates should not be considered generalisable for each country because this study included a sample of locations. Some countries were limited to one or two cities or could not cover recent periods because of the data availability. Due to privacy concerns, the National Center for Health Statistics in the US has discontinued providing the date of death on their mortality files to the public since the 2010s. Thus, we used the US data from 2001 to 2006 in the main analysis. Thirdly, most of the countries analysed in our study were generally based on urban populations, therefore, our results are limited in addressing patterns of suicide in rural areas. Previous studies reported that rural areas showed higher suicide rates than urban areas,[37] thus the underlying differences related to urbanisation should be addressed in future studies. Fourthly, the lower quality of suicide data (under-reported or misclassified) in less industrialised countries may be another limitation.[1 17] Finally, we could not address the potentially heterogeneous impacts of different types of holidays (eg, festivals or memorial days) on suicide risk by country.

Despite these limitations, our results have important implications for suicide studies and relevant public health policies. This study was a large epidemiological investigation into the association of the day of the week and national holidays with suicide. Based on the large sample, we have provided statistically reliable results on the effects of the day of the week and major holidays on suicide with their heterogeneities among the countries. These results can be used to establish more elaborate international and national interventions. In particular, our findings suggest benefits for expediting prioritisation in response to the different suicide risks during a week and national holidays and we provide evidence to establish more effective and targeted action plans for enhancing the mental health of workers and younger generations (eg, pre-emptive screening). Furthermore, our results including multiple countries provide evidence for more targeted suicide preventions to address country specific suicidal patterns. Finally, by applying state-of-the-science analytical frameworks, this study considerably alleviates potential estimation biases for the effects of the day of the week and holidays, which were attributable to the less developed seasonal decomposition methods.[38]

Conclusion

In conclusion, this study provides evidence regarding the association of the day of the week and national holidays with suicide risk using multicountry data with 1.7 million suicide cases. Suicide risk peaked on Mondays during weekdays across all countries, and the effect of weekends was heterogeneous among the countries. New Year's and the consecutive days were universally associated with an increased risk of suicide. Our findings contribute to the implications for national and global suicide prevention strategies in both industrialized and less-industrialized countries considering public health resource allocation and mobilisation.

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Contributors: WL and CK contributed equally to this research as co-first authors. YK is the guarantor; had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. YK was also responsible for the acquisition of data, study concept, design, drafting of the manuscript, statistical analysis, and final approval of the article to be published. WH and CK performed statistical analyses, manuscript draft writing, and draft revision. YK, WL, and CK were responsible for the data analysis and interpretation of data. YK, WL, CK, CP, MLB, MH, AG, FS, YH, and HK contributed to the critical revision of the manuscript for important intellectual content. YK provided administrative, technical, or material support. YK supervised the study. All other co-authors reviewed the manuscript and participated in the revisions. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

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Ethical approval: Not required.

Data sharing: Data have been collected within the Multi-Country Multi-City (MCC) Collaborative Research Network (https://mccstudy.lshtm.ac.uk/) under a data sharing agreement and cannot be made publicly available. Researchers can refer to MCC participants listed as coauthors for information on accessing the data for each country. However, the R code with the sample (mock-up) data is available from the corresponding author.

Transparency: The lead author (the manuscript's guarantor) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Dissemination to participants and related patient and public communities: We will disseminate the results to the public through media outreach, including press releases by the media departments of the co-authors' research institutes and plain language messaging on social media.

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Web appendix: Extra material supplied by authors