Suicide trends in the early months of the COVID-19 pandemic

TITLE

Suicide trends in the early months of the COVID-19 pandemic: Interrupted time series analysis of preliminary data from 21 countries

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SUMMARY

Background

The COVID-19 pandemic is having profound mental health consequences for many people. Concerns have been expressed that at its most extreme, this may manifest itself in increased suicide rates.

Methods

We sourced real-time suicide data from around the world via a systematic internet search and recourse to our networks and the published literature. We used interrupted time series analysis to model the trend in monthly suicides prior to COVID-19 in each country/area-within-country, comparing the expected number of suicides derived from the model with the observed number of suicides in the early months of the pandemic. Countries/areas-within countries contributed data from at least 1 January 2019 to 31 July 2020 and potentially from as far back as 1 January 2016 until as recently as 31 October 2020. We conducted a primary analysis in which we treated 1 April to 31 July 2020 as the COVID-19 period, and two sensitivity analyses in which we varied its start and end dates (for those countries/areas-within-countries with data beyond July 2020).

Outcomes

We sourced data from 21 countries (high income [n=16], upper-middle income [n=5]; whole country [n=10], area(s)-within-the-country [n=11]). In general, there does not appear to have been a significant increase in suicides since the pandemic began in the countries for which we had data. In fact, in a number of countries/areas-within-countries there appears to have been a decrease.

Interpretation

This is the first study to examine suicides occurring in the context of the COVID-19 pandemic in multiple countries. It offers a consistent picture, albeit from high- and upper-middle income countries, of suicide numbers largely remaining unchanged or declining in the early months of the pandemic. We need to remain vigilant and be poised to respond if the situation changes as the longer-term mental health and economic impacts of the pandemic unfold.

Funding

None.

RESEARCH IN CONTEXT

Evidence before this study

Evidence on the relationship between the COVID-19 pandemic and suicide before this study predominantly came from studies that relied on unofficial data sources and/or did not account for pre-existing trends. We have been conducting a living systematic review since the onset of the pandemic, searching the literature (including pre-prints) on a daily basis via PubMed, Scopus, medRxiv, bioRxiv, the COVID-19 Open Research Dataset (CORD-19) by Semantic Scholar and the Allen Institute for AI, and the WHO COVID-19 database. As at 8 December we had identified 21 reports but only five of these accounted for temporal trends in suicides (e.g., by using time series analyses). Three of these studies found no change in suicide numbers in Greece, Australia (Queensland) and the United States (Massachusetts), and the fourth identified a decrease in Peru. The fifth highlighted a decrease followed by an increase in Japan, which appeared to be related to pandemic induced 'employment shocks'.

Added value of this study

This study drew on data from 21 countries and used an analytical approach that controlled for pre-existing trends to determine whether patterns of suicide have changed since the COVID-19 pandemic was declared. It is the first study to explore the potential suicide-related impacts of COVID-19 at this scale. It shows that, in general, there does not appear to have been a significant increase in suicides since the pandemic began, at least in high- and upper middle-income countries.

Implications of all the available evidence

The consistency of these findings is noteworthy, and it is worth considering how they may have arisen. Many countries put in place additional mental health supports and financial safety nets, both of which may have buffered any early adverse impact of the pandemic. There is a need to ensure that efforts that may have kept suicide rates down until now are continued, and to remain vigilant as the longer term mental health and economic consequences of the pandemic unfold. There are some concerning signals that the pandemic may be adversely affecting suicide rates in low- and lower middle-income countries, although data are only available in a small minority of these countries and tend to be of sub-optimal quality. Even in high- and upper

middle-income countries, the impact of the pandemic on suicide may vary over time and be different for different sub-groups in the population.

INTRODUCTION

The COVID-19 pandemic is having profound mental health consequences,[1] and there are concerns that it may lead to increases in suicide rates.[2] We established the International COVID-19 Suicide Prevention Research Collaboration (ICSPRC) to monitor the global impact of COVID-19 on suicide.

Relatively few studies have examined the impact of previous widespread disease outbreaks on suicide. Two systematic reviews have been conducted which collectively identified 10 studies, most of which were conducted in the United States and Hong Kong.[3,4] These reviews suggest that although suicide rates may sometimes increase following these sorts of public health emergencies, this may not necessarily occur immediately, and in fact the risk may be reduced initially.

We have tracked studies specific to COVID-19 and suicide through a living systematic review,[5] and found that most have methodological limitations. Some have relied on data from unconfirmed sources, including reports from Nepal and Thailand based on newspaper articles citing data from police[6,7] and a "secondary source",[8] respectively. These indicated increases in suicides after the pandemic began.

Other studies have used official suicide statistics for the months since the pandemic began, but have made comparisons to equivalent periods without accounting for underlying trends. Studies of this kind in Norway,[9] Sweden,[10] South Korea,[11] Tyrol (Austria),[12] Leipzig (Germany)[13] and Connecticut (United States)[14] showed decreases in suicides, and one in Evros (Greece) found no change.[15] Three separate studies used a similar approach to analysing Japanese suicide statistics. One considered children and adolescents only and found no evidence of an increase.[16] The other two considered all age groups, and identified a decrease in the pandemic's early stages,[17] but highlighted an upswing in July 2020.[17,18]

Only five studies – from Greece,[19] Queensland (Australia),[20] Massachusetts (United States),[21] Peru[22] and Japan[23] – have used official data and accounted for temporal trends. The studies in Greece, Queensland and Massachusetts found that the observed and expected numbers of suicides did not differ after pandemic responses were introduced.[19-21] The Peruvian study reported a decrease in suicides following stay-at-home orders.[22] The Japanese study confirmed fluctuations in suicides and identified a positive association between pandemic-induced "employment shocks" and suicides.[23]

In sum, the evidence to date is insufficient to indicate what the impact of COVID-19 on suicides has been or will be. It is likely that any impact will vary between and within countries, and over time, depending on

factors like the extent of the pandemic, the public health measures instituted to control it, the capacity of existing mental health services and suicide prevention programmes, and the strength of the economy and relief measures to support those whose livelihoods are impacted by the pandemic. There are also multiple other population-level influences on suicide (e.g., political unrest, economic challenges, availability of lethal means) that may operate independently of the pandemic or be exacerbated by it, and these may differ across countries. We conducted this ICSPRC study because we felt that a broader understanding of suicide patterns was crucial for mitigating the risk of any pandemic-related increases. We used real-time suicide data from multiple countries/areas-within-countries to determine whether trends in monthly suicide counts changed after the pandemic began.

METHODS

Our approach followed the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER; see Appendix, pages 1-2).[24] We received approval from the Swansea University Medical School Research Ethics Sub-Committee (2020-0054).

Data inputs

Real-time suicide data

In many countries, there is a time-lag in official suicide data being released because of the way in which suicide deaths are identified and recorded in vital statistics collections. In these countries, suspected suicides are investigated by a coroner, medical examiner or other official to confirm the cause and manner of death, with or without an autopsy. The investigation process can be lengthy, resulting in data that are not sufficiently timely to guide suicide prevention actions. Consequently, some countries/areas-within-countries have developed methods for initial death classification while the investigation is ongoing, to produce real-time suicide data. Typically, although not always, these approaches rely on police reports or death certificates as their primary source of evidence for the preliminary classification. These alternative or preliminary data sources are crucial for identifying and responding to any changes in patterns of suicide that may be associated with external events. Given the importance of questions about COVID-19 and suicide, we felt that it was critical to provide evidence from the best available real-time data sources.

We sought real-time data on suicides from countries and areas-within-countries. We included the latter in order to maximise the number of places that could contribute to the overall picture. Establishing real-time suicide data collection systems is no trivial undertaking, particularly on a national level, so restricting our efforts to whole countries would have limited the conclusions we could draw.

We used three methods to identify real-time suicide data: (a) internet searches; (b) recourse to the scientific literature; and (c) contact with our networks (detail below).

Inclusion and exclusion criteria

To be included, data from a given country/area-within-country had to come from an official government source (e.g., government department, agency responsible for collating national statistics, coroners court,

medical examiners office, police department, university), and be available at a monthly level from at least 1 April 2019 to 31 July 2020 (and potentially from as far back as 1 January 2016 until as recently as 31 October 2020). Our internet searches were restricted to countries with >3 million residents for pragmatic reasons, but we relaxed this rule for countries identified through the literature and our networks. Areas-within-countries could also be included with populations of ≤3 million.

Identifying and accessing suicide data

We conducted internet searches between 1 September and 1 November 2020 to identify relevant data in World Bank countries/economies with >3 million residents (n=135).[25] We searched the official websites of these countries' ministries of health, police agencies, and government-run statistics agencies or equivalents. We used the translated search terms "*suicide"* and *"cause of death*". If this did not yield results, we then searched for publicly reported information (e.g., in news reports, on suicide prevention organisations' websites) that might provide clues as to whether relevant data existed and, if so, how they might be traced. This involved a more general internet search using the following translated search terms: *"suicide"*, *"[name of country]"*, *"pandemic", "COVID"* and *"Corona"*.

We also searched the academic literature for studies reporting on suicides before and after the pandemic began via our living review.[5] We extracted data from the publications or their cited sources, and contacted the authors. We also drew on the knowledge of ICSPRC members (representing 39 countries) and our World Health Organization (WHO) and International Association for Suicide Prevention (IASP) contacts.

Publicly available data were accessed online and data that were not publicly available were provided by data custodians.

Data storage and management

We aggregated all data to the monthly level. Data were housed in a safe, secure, password-protected database held at Swansea University using Secure eResearch Platform technology (Adolescent Mental Health Data Platform [ADP]). As per the platform's data protection protocols, access to the data was limited and only made available to JP, AJ, SS, MDPB, VA, DGu and MJS.

Data analysis

We used interrupted time series analysis to model the trends in monthly suicides prior to COVID-19 in each country/area-within-country, accounting for time trends and seasonality wherever possible. Models were fitted using Poisson regression and accounted for possible over-dispersion using a scale parameter set to the model's chi-square value divided by the residual degrees of freedom. We modelled the effect of time as a non-linear predictor, unless this offered no improvement beyond a linear model, in which case we used this instead. Non-linear time trends were estimated by selecting the best fitting model from a series of fractional polynomial models. Seasonality was accounted for with Fourier terms (i.e., pairs of sine and cosine functions). We then used each country's model to forecast what the trend in suicides from the beginning of the COVID-19 period would have been had COVID-19 not occurred, calculating the expected number of suicides which represented the counterfactual. We compared this with the observed number of suicides in the same period by calculating rate ratios (and 95% confidence intervals [CIs]). In a small number of countries/areas-within-countries, it was not possible to account for seasonality in the model because we only had pre-COVID-19 data for a single year (1 January 2019 onwards). For these countries, we fitted a model with a linear predictor for time only. For further details of the modelling strategy, see Appendix, pages 3-17.

We conducted a primary analysis and two sensitivity analyses (see Figure 1). In each analysis, we included data from all available months in each country/area-within-country in the pre-COVID-19 period. In the primary analysis, we treated 1 April 2020 as the start of the COVID-19 period and censored the data beyond 31 July 2020. We did this to maximise data quality, recognising that there may have been under-enumeration of suicides in the later months with figures being subsequently updated. In sensitivity analysis 1, we retained 1 April 2020 as the start of the COVID-19 period but relaxed the end date to include all data available in the COVID-19 period for each country/area-within-country up to 31 October 2020. In sensitivity analysis 2, we brought the start of the COVID-19 period forward to 1 March 2020 and used the original censoring date of 31 July 2020 as the end of the COVID-19 period, recognising that the onset of COVID-19 and associated public health measures varied.

All analyses were conducted on the Swansea University ADP Secure eResearch Platform, using Stata 16.1. The Stata code is available at Appendix, pages 18-24.

RESULTS

We sourced data from 21 countries (high income [n=16], upper-middle income [n=5]; whole country [n=10], area(s)-within-the-country [n=11]). Table 1 shows the countries'/areas-within-countries' populations and the date that the first stay-at-home orders were implemented in each country.[26] For full details of the source and nature of the data for each country and area-within-country, see Appendix, pages 25-33, and for the raw data see Appendix, page 34.

Figure 2 shows the observed and expected number of suicides for April to July 2020 and presents rate ratios based on these numbers (see Appendix, pages 5-18 for the coefficients and standard errors of the models underlying the expected number of suicides). The confidence intervals surrounding the rate ratio for each country/area-within-country either include the null value of 1.00 or fall below the null value, indicating that there was no evidence of an increase in suicides during the COVID-19 period. In fact, there was statistical evidence of a decrease in suicides in 12 countries/areas-within-countries: New South Wales (RR 0·81, 95% CI 0·72–0·91), Alberta (RR 0·80, 95% CI 0·68–0·93), British Columbia (RR 0·76, 95% CI 0·66–0·87), Chile (RR 0·85, 95% CI 0·78–0·94), Leipzig (RR 0·49, 95% CI 0·32–0·74), Japan (RR 0·94, 95% CI 0·91–0·96), New Zealand (RR 0·79, 95% CI 0·68–0·91), South Korea (RR 0·94, 95% CI 0·92–0·97), California (RR 0·90, 95% CI 0·85–0·95), Illinois (RR 0·79, 95% CI 0·67–0·93), Texas (RR 0·82, 95% CI 0·68–0·98) and Ecuador (RR 0·74, 95% CI 0·67–0·82).

Figure 3 shows the results of sensitivity analysis 1. Incorporating data up until the latest month available (October 2020) made little difference to the results from most countries/areas-within-countries. Again, the confidence intervals surrounding the rate ratio estimates are below 1.00 or include 1.00 in all cases, with three exceptions. Vienna showed a significant increase in suicides with the additional months (RR 1·31, 95% CI 1·08–1·59), as did Japan (RR 1.05, 95% CI 1·04–1·07) and Puerto Rico (RR 1·29, 95% CI 1·05–1·58). In each case, the latest month for which data were available was October.

Figure 4 presents the findings from sensitivity analysis 2. Again, the picture is similar to that from our primary analysis. When the pandemic's first month was considered to be March rather than April, there was no evidence of any increase in suicides during this redefined COVID-19 period for any country/area-within-country, except Puerto Rico (RR 1·36, 95% CI 1·07–1·72).

DISCUSSION

Our findings are relatively consistent, at least for high- and upper middle-income countries. In general, there does not appear to have been a significant increase in suicides during the pandemic's early months in these countries. In fact, in a number of countries/areas-within-countries there seems to have been a decrease.

Our findings align with the published studies from high- and upper middle-income countries that have either found no change in suicide rates as a function of the pandemic, or have identified decreases.[9-15,19-22] Our findings are also consistent with emerging reports in the "grey" literature from various countries (e.g., England[27]). In some cases, this consistency is not surprising because we used the same data sources but the fact that we found similar patterns in many other countries is encouraging.

Interpreting the findings

There may be various reasons for the lack of increase in suicides since the pandemic began. Firstly, there was an early emphasis on the potential adverse impacts of stay-at-home orders, school closures and business shut-downs. Empirical evidence began to emerge from some countries that self-reported levels of depression, anxiety and suicidal thinking were heightened during the initial stay-at-home periods,[1] but this does not appear to have translated into increases in suicides, at least in the countries in our study. In some countries, governments responded rapidly to the threat to people's mental health, implementing recommended approaches like bolstering mental health services.[28] Maintaining this emphasis on accessible, high-quality mental health care is critical.

Secondly, certain protective factors may have been operating in the pandemic's early months. Communities may have "rallied around" vulnerable individuals, people may have connected in new ways, and some relationships may have been strengthened by households spending more time with each other.[28] For some people, everyday stresses may have been reduced during stay-at-home periods, and for others the collective feeling that "we're all in this together" may have been beneficial.

Finally, many countries rapidly enacted fiscal support initiatives to buffer the pandemic's economic consequences. In many cases, these are now being wound back. As they lapse, previously protected populations may face increasing stress. Suicide rates can rise during times of economic recession,[29] so it is possible that the pandemic's potential suicide-related impacts are yet to occur.

A comment on outliers

Vienna, Japan and Puerto Rico were outliers. We found no evidence of an increase in suicides in our primary analysis in any of these places, but we observed an increase in all three when we extended the observation period to 31 October and in Puerto Rico we noted an increase when we brought forward the pandemic's start date from 1 April to 1 March. Additional contextual factors may have operated in these countries (e.g., in Japan several widely reported celebrity suicides that occurred during the pandemic may have exerted an influence; Puerto Rico has been in a deep recession since 2006 so pre-existing high levels of poverty may have exacerbated the pandemic's economic impacts).

Strengths and limitations

Our study is the first to combine data from multiple countries to examine the early impact of COVID-19 on suicide, taking account of underlying trends. It involved a systematic search process and overcame the delays inherent in vital statistics collections by using real-time data from numerous official sources.

However, it lacked representation from low- and lower middle-income countries, which account for 46% of the world's suicides and may be particularly hard hit by the pandemic. Very few of these countries have good quality vital registrations systems and still fewer collect real-time suicide data.[30] In our search, we identified unofficial real-time data from two lower middle-income countries (Myanmar and Tunisia) and one low-income country (Malawi) that could not be disaggregated to the monthly level. We were unable to verify or use these data in our analyses, but they paint a concerning picture for two of these countries. In Malawi there was a 57% increase "since January" and in Tunisia there was a 5% increase in March-May. By contrast, in Myanmar there was a 2% decrease in January-August.

Data quality may have been an issue in the countries/areas-within-countries in our study. Data from the most recent months in any given country/area-within-country may have been the least reliable and the most likely to represent undercounts, particularly if COVID-19 disrupted data collection processes. We attempted to overcome this by using 31 July 2020 as the end date in our primary analysis, and only using more recent months (to 31 October 2020) in sensitivity analysis 1. If the data in the later months were artificially low, we might have expected to see countries/areas-within-countries that recorded no difference in suicides in the primary analysis recording a decrease in sensitivity analysis 1, but this only occurred in Victoria, Thames Valley and Mexico City. We also conducted a post-hoc analysis in which we repeated the primary analysis but inflated the number of suicides in each month of the COVID period by 5% on the grounds that where

numbers in the latter period were likely to be updated, this might be the typical magnitude of any increase (see above and Appendix, page 35). This made little difference; only two areas-within-countries demonstrated statistical evidence of an increase in suicides where this had not been the case previously (New Jersey [RR 1·18, 95% CI 1·05–1·34] and Puerto Rico [RR 1·34, 95% CI 1·03–1·74]).

In addition, various factors may have influenced the power and precision of our models. In particular, low numbers of time points and low numbers of monthly suicides in given countries or areas-within-countries may have resulted in models with relatively poorer power and precision. This would have had the effect of biasing the findings to the null and suggesting that there was no change in the number of monthly suicides from the pre-COVID-19 period to the COVID-19 period when in fact there may have been an increase or a decrease. Only five areas-within-countries had both the minimum number of pre-COVID-19 time points (January 2019 to March 2020) and low numbers of monthly suicides and demonstrated no change in our primary analysis: Vienna, Cologne and Leverkusen, Frankfort, Botucatu and Maceio. The findings from these areas-within-countries should be interpreted with caution.

We were unable to stratify the data by age, sex or ethnicity, and the pandemic may have a differential impact on suicides in certain demographic groups (e.g., females,[17,18] children and adolescents,[17] and ethnic minorities[14]). We were also unable to explore any temporal changes in suicide methods. Additionally, we could not consider external factors that may have influenced suicide patterns in different countries/areas-within-countries, including varying public health measures or economic support packages. We are planning future studies to address these questions.

We relied on area-within-country data for 11 countries. We included these data in order to ensure representation from as many countries as possible and to avoid generating a picture that was biased towards better-resourced countries. We deliberately did not extrapolate from areas-within-countries to whole countries because we were aware that they were sometimes small and may have had unique suicide profiles. Having said this, some accounted for a large proportion of the suicides in the given country (e.g., New South Wales, Queensland and Victoria represent 75% of all Australian suicides) and others had larger populations than some of our included countries (e.g., California: 39.7 million). Additionally, data from the areas-within-countries yielded pictures that were similar to evidence from other relevant areas. For example, the studies in Massachusetts and Connecticut showed no increase in suicide numbers after the pandemic began,[14,21] which is in line with our findings from United States' jurisdictions for which we had data. Similarly, we had data from Tasmania (Australia) which did not meet our inclusion criteria because they were presented at the

3-monthly level, but when we analysed these data separately the results were consistent with those from the included Australian states (RR 0·74, 95% CI 0·53–1·02).

We used the same date in a given analysis to distinguish the pre-COVID-19 period from the COVID-19 period for all countries (1 April or 1 March 2020), potentially underestimating any effect of COVID-19 in countries/areas-within-countries with an earlier onset of the pandemic or public health protection measures. We considered using the date of the initial stay-at-home order to distinguish the pre-COVID-19 and COVID-19 periods, but areas within a given country may have introduced stay-at-home orders at different times. Additionally, because we had monthly suicide counts we would have had to convert the date of initial stay-at-home order to the beginning of the month in question or the next month. The dates fell between 23 February and 7 April, so between them the analyses covered all periods.

Conclusions

Our study is the first to examine suicides occurring in the COVID-19 context in multiple countries. It offers a consistent picture, albeit from high- and upper middle-income countries, of suicide numbers remaining unchanged or declining in the pandemic's early months. This picture is neither complete nor final but it serves as the best available evidence about the pandemic's effects on suicide to date.

We need to continue to monitor real-time data and be alert to any increases in suicide, particularly as the pandemic's full economic consequences emerge. We need to understand what has kept suicide numbers down during the pandemic's early months, and what drives any increases if they do occur. We also need to recognise that suicide is not the only indicator of negative mental health impacts of the pandemic; levels of community distress are high and we need to make sure that people are supported. We need to redouble our efforts to understand the pandemic's impact on suicides in low- and lower middle-income countries. And we need to make sure that we communicate our findings to governments and communities in safe, non-sensationalist ways.[31]

Policy-makers should heed the value of high quality, timely suicide data in suicide prevention efforts. They should prioritise mitigating the suicide risk factors associated with COVID-19 and take decisive action (e.g., resourcing mental health services, providing financial safety nets) to prevent possible longer-term detrimental impacts of the pandemic on suicide.

ROLE OF FUNDER

This study was unfunded.

CONTRIBUTORS

JP, AJ and DGu conceptualised, designed and led the study, with assistance from MJS. SS, MDPB, VA conducted the internet searches for data and JP, AJ and DGu followed up leads through the ICSPRC and IASP networks, assisted by MJS and TN. Additional data were sourced or provided by the following authors: PAA, AB, JMB, PB, GC, MC, DCo, DCr, CD, ED, GD, JD, MDPB, JSF, SF, AG, DGe, RGe, RGi, DGu, KH, AJ, JK, KK, SL, EM-R, NN, HO, GP, PLP, PQ, AR, CR, DR, CR-L, VR, BS, CS, MS, NS, MU and RW. JP, SS, MDPB and VA were responsible for data verification, management and storage. MJS conducted the analysis. JP prepared the first draft of the manuscript with input from AJ, DGu and MJS. All authors interpreted data and made critical intellectual revisions to the manuscript. Access to the data was limited for data protection reasons and only made available to JP, AJ, SS, MDPB, VA, DGu and MJS.

DECLARATION OF INTERESTS

We declare no competing interests.

DATA SHARING

The statistical code and raw data are available in the Appendix (page 18-24 and page 25, respectively).

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Table 1: Country/area-within-country details

Country	Country's population 2020	Area-within-country	Area-within-country's population	Beginning of initial stay-at-home period in country[c]
High-income countries[a]				
Australia	25,500,000	New South Wales	8,157,700	24 Mar 2020
		Queensland	6,689,400	
		Victoria	5,160,000	
Austria	8,900,000	Carinthia	560,900	16 Mar 2020
		Tyrol	757,600	
		Vienna	1,911,200	
Canada	37,700,000	Alberta	4,421,900	14 Mar 2020
		British Columbia	5,147,700	
		Manitoba	1,380,000	
Chile	19,100,000	Whole country	Not applicable	25 Mar 2020
Croatia	4,100,000	Whole country	4,100,000	23 Mar 2020
England	56,300,000	Thames Valley	2,400,000	14 Mar 2020
Estonia	1,300,000	Whole country	Not applicable	9 Mar 2020
Germany	83,800,000	Cologne and Leverkusen	1,285,500	9 Mar 2020
		Frankfurt	753,000	
		Leipzig	591,000	
Italy	60,500,000	Udine and Pordenone	841,300	5 Mar 2020*
Japan	126,500,000	Whole country	Not applicable	7 Apr 2020
Netherlands	17,100,000	Whole country	Not applicable	6 Mar 2020
New Zealand	4,800,000	Whole country	Not applicable	21 Mar 2020
Poland	37,800,000	Whole country	Not applicable	31 Mar 2020
South Korea	51,200,000	Whole country	Not applicable	23 Feb 2020
Spain	46,800,000	Las Palmas	1,109,000	14 Mar 2020
United States	331,000,000	California	39,747,300	15 Mar 2020
		Illinois (Cook County)	17,000	
		Louisiana	4,649,000	
		New Jersey	8,936,600	
		Texas (Denton, Johnson, Parker, Tarrant Counties)	3,374,000	
		Puerto Rico[b]	3,032,200	
Upper middle-income countries[a]				
Brazil	212,600,000	Botucatu	140,000	14 Mar 2020
		Maceió	1,020,000	
Ecuador	17,600,000	Whole country	Not applicable	17 Mar 2020
Mexico	128,900,000	Mexico City	9,000,000	30 Mar 2020
Peru	33,000,000	Whole country	Not applicable	15 Mar 2020
Russian Federation	146,000,000	Saint Petersburg	5,468,000	5 Mar 2020

a. Source: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups
b. Unincorporated territory of the United States
c. Source: https://ourworldindata.org/grapher/stay-at-home-covid?tab=table&stackMode=absolute&time=2020-03-05..latest&region=World, with amendments from local authors (indicated by *). Note that dates refer to the date when stay-at-home orders were first applied anywhere in the given country and that the date for areas-within-countries may differ from this.

Figure 1: Pre-COVID-19 and COVID-19 periods in the primary analysis and the two sensitivity analyses

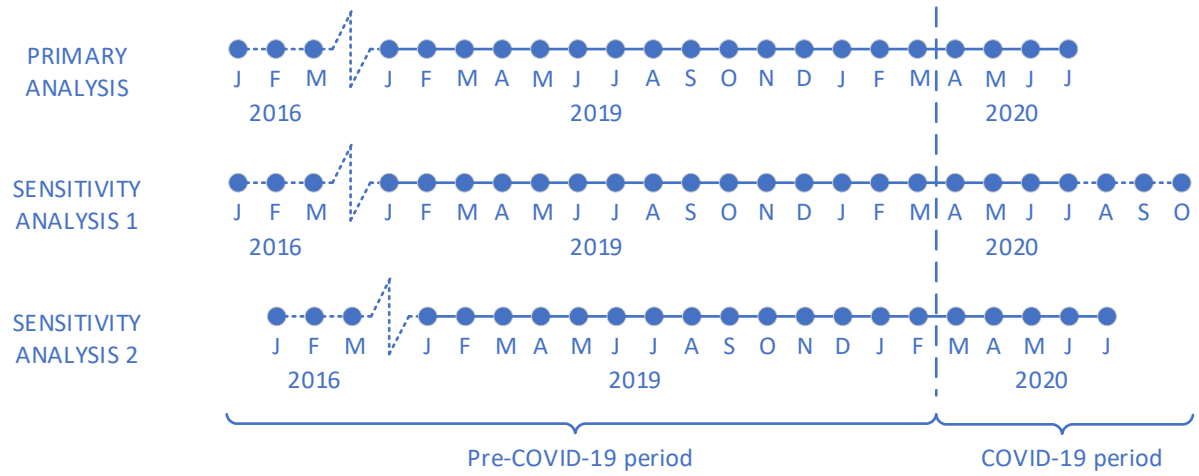
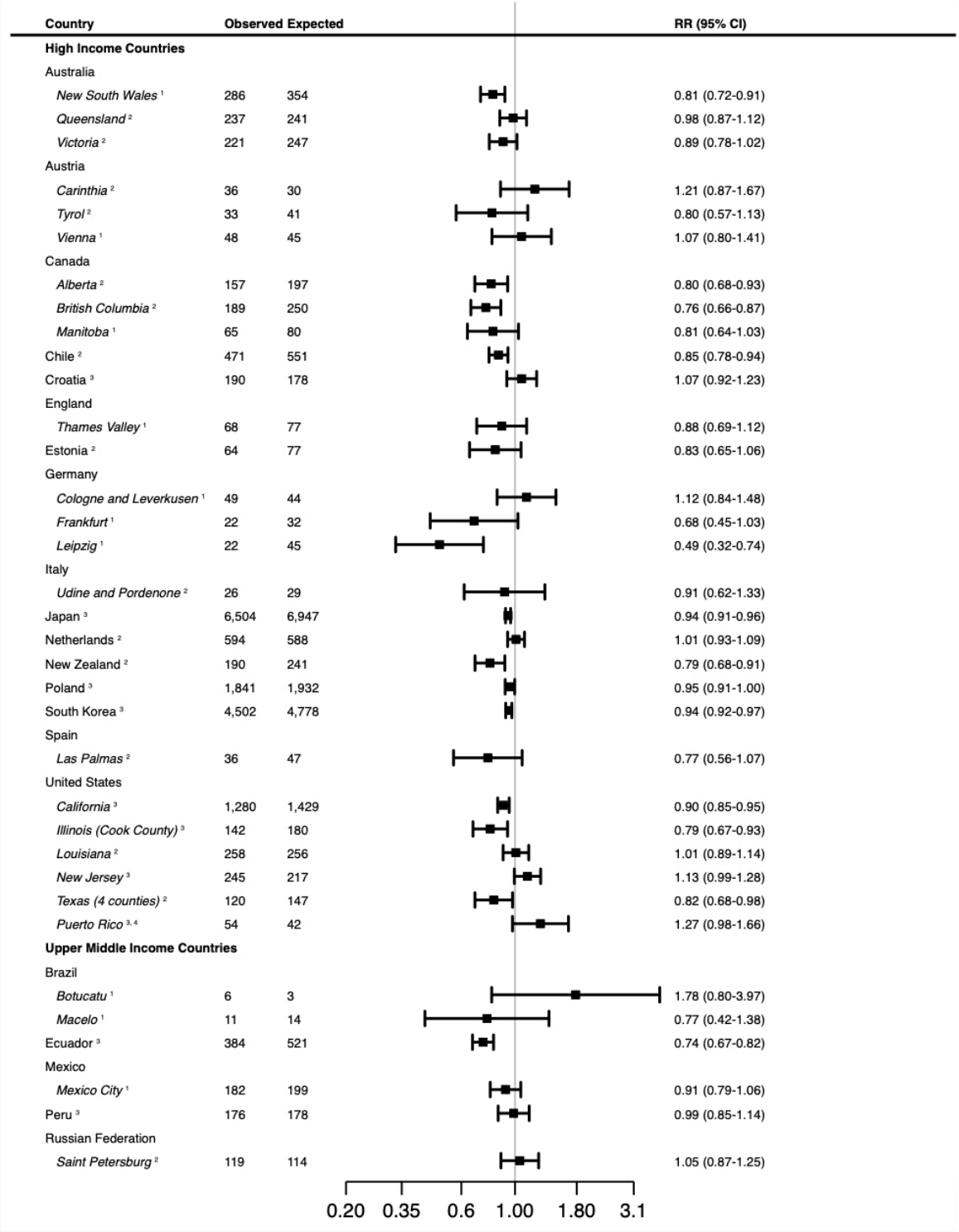
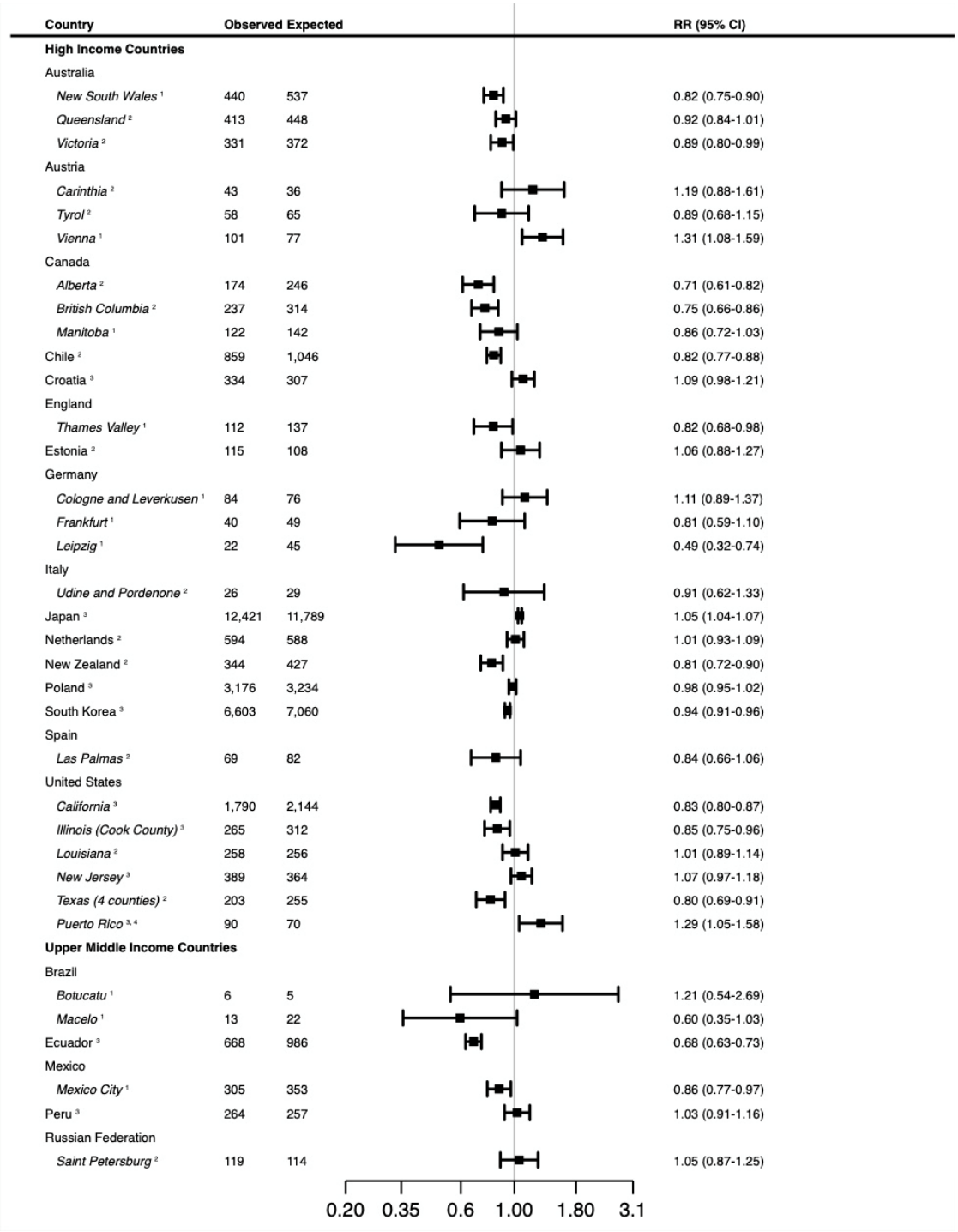


Figure 2: Primary analysis: Observed and expected numbers of suicides in COVID-19 period (1 April 2020 to 31 July 2020) based on trends in pre-COVID-19 period (at least 1 January 2019 to 31 March 2020), by country/area-within-country



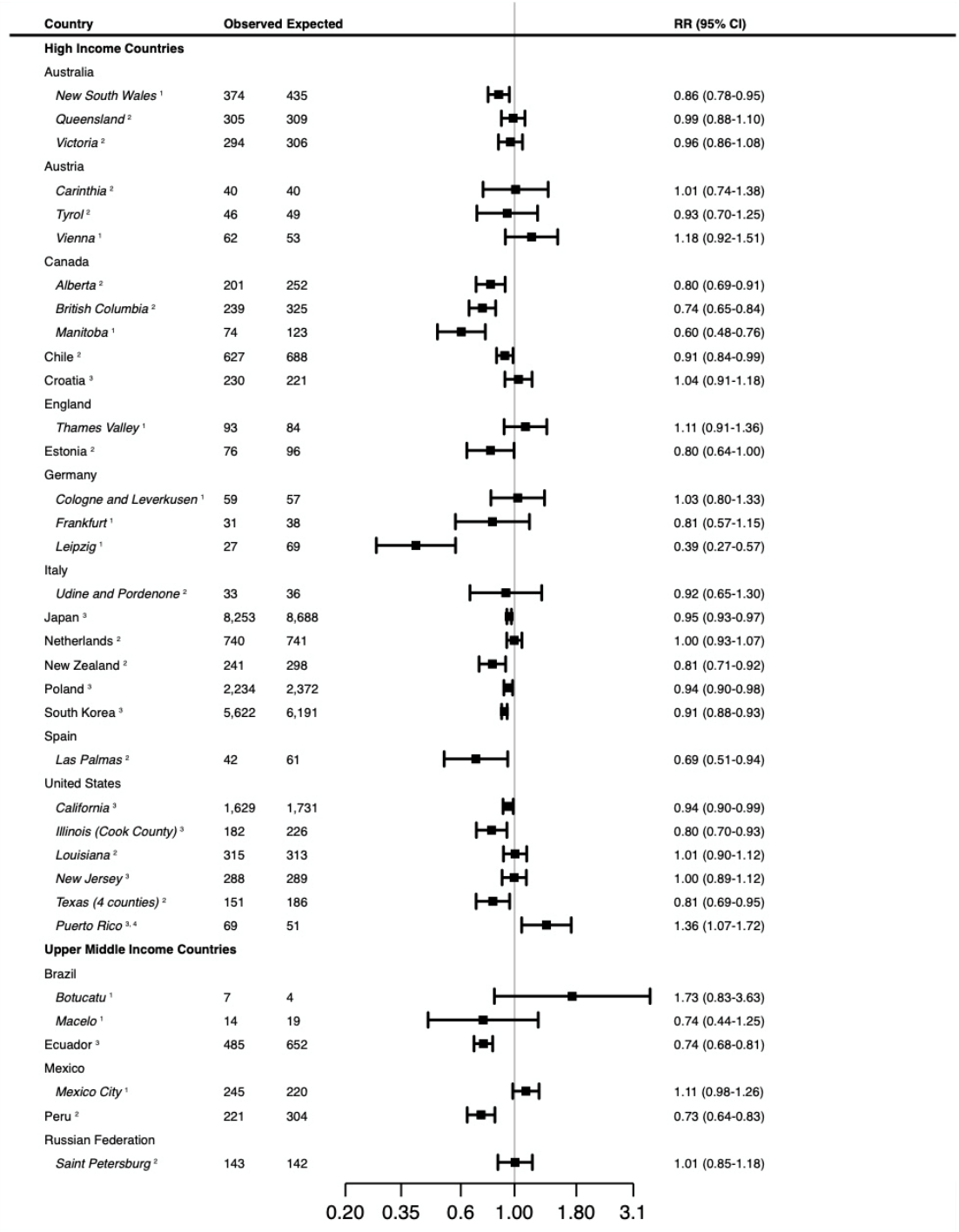
(1) Predictors for non-linear time trends and seasonality; (2) Predictors for linear time trends and seasonality; (3) Predictor for linear time trend only; (4) Unincorporated territory of the United States.

Figure 3: Sensitivity analysis 1: Observed and expected numbers of suicides in COVID-19 period (1 April 2020 latest available month until 31 October 2020) based on trends in pre-COVID-19 period (at least 1 January 2019 to 31 March 2020), by country/area-within-country



(1) Predictors for non-linear time trends and seasonality; (2) Predictors for linear time trends and seasonality; (3) Predictor for linear time trend only; (4) Unincorporated territory of the United States.

Figure 4: Sensitivity analysis 2: Observed and expected numbers of suicides in COVID-19 period (1 March 2020 to 31 July 2020) based on trends in pre-COVID-19 period (at least 1 January 2019 to 31 March 2020), by country/area-within-country



(1) Predictors for non-linear time trends and seasonality; (2) Predictors for linear time trends and seasonality; (3) Predictor for linear time trend only; (4) Unincorporated territory of the United States.