Suicide numbers during the first 9-15 months of the COVID-19 pandemic compared with pre-existing trends: An interrupted time series analysis in 33 countries

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Summary

Background Predicted increases in suicide were not generally observed in the early months of the COVID-19 pandemic. However, the picture may be changing and patterns might vary across demographic groups. We aimed to provide a timely, granular picture of the pandemic's impact on suicides globally.

Methods We identified suicide data from official public-sector sources for countries/areas-within-countries, searching websites and academic literature and contacting data custodians and authors as necessary. We sent our first data request on 22nd June 2021 and stopped collecting data on 31st October 2021. We used interrupted time series (ITS) analyses to model the association between the pandemic's emergence and total suicides and suicides by sex-, age- and sex-by-age in each country/area-within-country. We compared the observed and expected numbers of suicides in the pandemic's first nine and first 10-15 months and used meta-regression to explore sources of variation.

Findings We sourced data from 33 countries (24 high-income, six upper-middle-income, three lower-middle-income; 25 with whole-country data, 12 with data for area(s)-within-the-country, four with both). There was no evidence of greater-than-expected numbers of suicides in the majority of countries/areas-within-countries in any analysis; more commonly, there was evidence of lower-than-expected numbers. Certain sex, age and sex-by-age groups stood out as potentially concerning, but these were not consistent across countries/areas-within-countries. In the meta-regression, different patterns were not explained by countries' COVID-19 mortality rate, stringency of public health response, economic support level, or presence of a national suicide prevention strategy. Nor were they explained by countries' income level, although the meta-regression only included data from high-income and upper-middle-income countries, and there were suggestions from the ITS analyses that lower-middle-income countries fared less well.

Interpretation Although there are some countries/areas-within-countries where overall suicide numbers and numbers for certain sex- and age-based groups are greater-than-expected, these countries/areas-within-countries are in the minority. Any upward movement in suicide numbers in any place or group is concerning, and we need to remain alert to and respond to changes as the pandemic and its mental health and economic consequences continue.

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Research in context

Evidence before this study

We searched PubMed, Scopus, medRxiv, bioRxiv, the COVID-19 Open Research Dataset, and the WHO COVID-19 database using terms for suicide and suicidal behaviour (e.g., "suicid*") and COVID-19 (e.g., "coronavirus" OR "COVID*" or "SARS-CoV-2") from 1st January 2020 to 17th February 2022 and identified 86 studies investigating COVID-related suicide trends from 32 countries/areas-within-countries, many of which did not use appropriate time series approaches. No change (and sometimes declines) in suicide frequencies/rates during the COVID-period were reported in most countries/areas-within-countries, with the exceptions of rises (or slowing of declines) in Hungary, India, Japan, Nepal and Spain and in Vienna and Puerto Rico. There was no consistent evidence of disproportionate effects on suicide by specific groups based on sex or age.

Added value of this study

We synthesised sex- and age-specific suicide trend data from 33 countries over the first 9-15 months of the pandemic and used time-series models to account for pre-pandemic trends in suicide. There was no evidence of a change to pre-pandemic suicide trends in most countries/areas-within-countries, and no consistent evidence that any age/sex group was differentially affected by the pandemic. There were suggestions that proportionally more countries/areas-within-countries had greater-than-expected numbers of suicide in analyses with longer follow-up periods, and that areas within lower- middle-income countries were faring less well than other settings.

Implications of all the available evidence

In most countries/areas-within-countries we studied, suicide frequencies were no higher than expected based on previous trends during the first 9-15 months of the pandemic. We need to understand the underlying drivers of this stability, particularly in the context of rises in population mental distress reported in many settings, to inform future suicide prevention efforts more generally. We urgently need timely suicide surveillance data from low-income countries.

Introduction

When the COVID-19 pandemic began there was widespread concern that suicide rates might increase. Media outlets published largely unfounded and inaccurate reports of spikes in suicide.[1] Suicide prevention researchers were more measured but noted that certain risk factors for suicide (e.g., isolation, stress, mental disorders such as depression and anxiety, substance use, sub-optimal access to healthcare, economic hardship) were likely to be exacerbated by the pandemic.[2,3] They also emphasised, however, that some protective factors (e.g., community togetherness, resilience) might be heightened.[2,3]

We studied 21 high- and upper-middle-income countries (population ≈435M) and found that total suicide frequencies remained largely unchanged or declined during the pandemic's first four months.[4] We were unable to examine whether the pandemic was differentially affecting certain demographic groups; total numbers may have masked increases for some groups (particularly if these were offset by decreases for others). Single-country studies suggest that this may be the case, although the evidence is mixed. For example, a Japanese study found evidence of increases in suicides for women,[5] whereas studies from China, India and Sweden either found no sex differences or greater reductions for women.[6–8] Similarly, an English study found no increases in suicides among children/adolescents,[9] whereas studies from Japan and China identified increases for young people.[8,10]

The picture may also be changing.[4] In most high-income countries the economic consequences of the pandemic were buffered initially by financial support schemes, but these have been progressively withdrawn. There may also be long-term impacts of COVID-19 on people with pre-existing mental disorders.[11] Studies of other pandemics/epidemics suggest that if increases in suicide do occur, they may be delayed.[12]

The aim of this study was to provide an updated, more granular picture of the impact of COVID-19 on suicides globally to inform pandemic-related suicide prevention activities. We used data from a larger number of countries than previously, extended our observation period to include the first 9-15 months of the pandemic, and examined patterns by sex, age and sex-by-age.

Methods

We followed the Guidelines for Accurate and Transparent Health Estimates Reporting (appendix 1 pp2-3).[13] The Swansea University Medical School Research Ethics Sub-Committee approved the study (2020-0054). Informed consent was not relevant; all data pertained to suicides and were provided in an aggregate form (as monthly counts).

Data inputs

Suicide data sources. We sought suicide data from vital statistics systems and real-time suicide surveillance systems. The former are usually regarded as the official source of suicide statistics because they record deaths deemed to be suicides following investigations by coroners, medical examiners or other authorities. Because these investigations are often lengthy, however, real-time surveillance systems have been established to capture data in a timelier fashion. These use sources such as police reports and death certificates to classify deaths as suspected suicides.[14] They yield estimates that correspond closely with those from vital statistics systems.[14]

Inclusion criteria. We sought data from countries and areas-within-countries, including the latter to generate as global a synthesis of the evidence as possible. To be included, data had to:

(1) come from a vital statistics or real-time surveillance system from an official public-sector source (e.g., government department, national statistics agency, coroners court, medical examiners office, police department, university or other research setting);
(2) cover a minimum period from 1st January 2019 to 31st December 2020 (and potentially a maximum period from 1st January 2016 to 30th June 2021); and
(3) include total monthly counts of suicide (and ideally monthly counts by sex, age, and sex-by-age).

Identifying and accessing suicide data. We searched health ministries', police agencies', and statistics agencies' websites using the (translated) terms "*suicide*" and "*cause of death*". We searched the academic literature, via our living systematic review.[15] We extracted data from websites and publications, contacting data custodians and authors as necessary. We also drew on the International COVID-19 Suicide Prevention Research Collaboration (https://www.iasp.info/research-collaboration-icsprc/) network.

We sent our first data request on 22nd June 2021 and stopped collecting data on 31st October 2021.

Data storage and management

Data were provided on Excel spreadsheets and housed on Swansea University's Adolescent Mental Health Data Platform (ADP), which uses Secure eResearch Platform technology. Only JP, DG, SS, MDP-B, VA, AJ and MJS had access to the data.

Data analysis and presentation

We conducted interrupted time series (ITS) analyses to model the association between the pandemic's emergence and total monthly suicide counts (and suicide counts by sex, age and sex-by-age) in each country/area-within-country. We modelled the underlying suicide trend in each time series prior to COVID-19, accounting for temporal trends and seasonality wherever possible, and then used this model to forecast what the expected trend from the beginning of the COVID-19 period would have been had the pandemic not occurred. We compared the observed number of suicides in the COVID-19 period to the expected number (the counterfactual) by calculating rate ratios (RRs), 95% confidence intervals (CIs) and p values. We considered the p value as a measure of the strength of the evidence against the null hypothesis as follows[16]: $p > 0.05$ — no evidence of a change in the ratio of observed to expected suicides; $0.01 < p \leq 0.05$ — weak evidence; $0.001 < p \leq 0.01$ — moderate evidence; and $p \leq 0.001$ — strong evidence.

All models were fitted using Poisson regression and accounted for over-dispersion using a scale parameter set to the model's chi-square value divided by the residual degrees of freedom. For each time series, we fitted four models to the data and selected the best fitting model using the AIC statistic:

(1) fitting a non-linear time trend (entered as time and time squared) as well as seasonality trends using Fourier terms (entered as sine and cosine pairs);
(2) with a linear time trend (time) and Fourier terms;
(3) with non-linear time trends only; and
(4) with linear time trends only.

If the mean number of suicides per month was ≤1 then we automatically chose model 4. We treated 1st April 2020 as the start of the COVID-19 period because April was the first full month after the World Health Organization's pandemic declaration (11th March 2020). We considered using different start-months for different countries, based on the first date of stay-at-home orders, but this would have presented problems because there was often considerable within-country variability. Our primary analysis considered the pandemic's first nine months (1st April to 31st December 2020), and our secondary analysis considered its first 10-15 months (1st April 2020 through to the latest month for which data were available, from at least 31st January 2021 and potentially up until 30th June 2021; Figure 1). Each analysis examined total suicides and suicides by sex, age and sex-by-age.

We conducted separate analyses for countries and areas-within-countries to avoid duplication in any one analysis and because the numbers of suicides in areas-within-countries were generally smaller, creating more uncertainty around the RR estimates.

We conducted a meta-regression to explore sources of variation in observed changes in suicide numbers against background trends, fitting a random effects model and using whole countries only because relevant covariates weren't available for areas-within-countries. We used (log) RRs from the primary analysis as our outcome variable because this allowed us to include the maximum number of countries. Our covariates were:

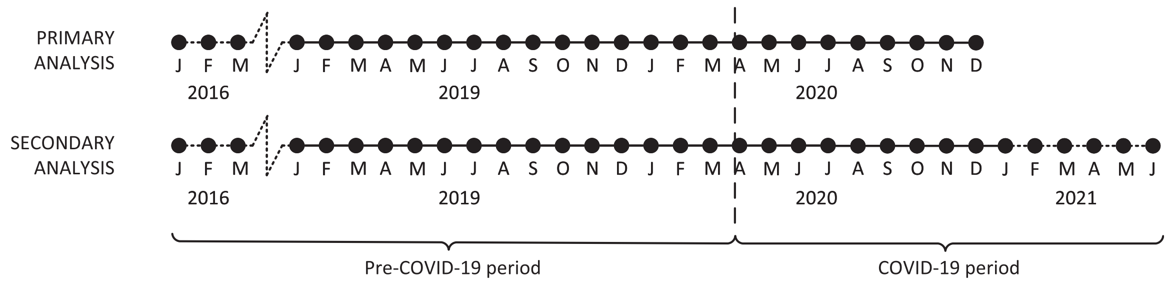

Figure 1. Time series in primary and secondary analyses.

(1) income level (https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups);
(2) COVID-19 mortality rate per 100,000 at 31st December 2020 (https://ourworldindata.org/covid-deaths);
(3) stringency of public health response (composite measure based on indicators such as school/workplace closures and travel bans; scored from 0-100 [100 = strictest]; average of the daily index between 1st April 2020 and 31st December 2020) (https://ourworldindata.org/grapher/covid-stringency-index);
(4) level of economic support (composite measure based on indicators such as income support and debt relief; scored from 0-100 [100 = strong government support]; average of the daily index between 1st April 2020 and 31st December 2020) (https://ourworldindata.org/covid-income-support-debt-relief);
(5) interaction between (3) and (4); and
(6) presence of a national suicide prevention strategy (https://www.mindbank.info/collection/topic/suicide_prevention_).

In presenting the data in tables, we have used red and green cells to indicate the direction and strength of the evidence based on RRs and 95%CIs. Red and green cells indicate that there was statistical evidence of suicide numbers being greater- or lower-than-expected in the COVID-19 period, respectively. The red and green cells are graduated (pale red/green = weak evidence, mid red/green = moderate evidence, dark red/green = strong evidence). White cells indicate no evidence of observed suicide numbers diverging from expected values. Grey cells indicate that data were unavailable, and *np* indicates that data were suppressed because there were ≤5 suicides in the pandemic period. In each table, the findings are clustered so that patterns with respect to observed versus expected suicides in the COVID-19 period are easily discernible. We did this using hierarchical agglomerative clustering[17] to group countries/areas-within-countries into clusters, based on similarities across rows of red, green and white cells.

All analyses were conducted on the ADP, using Stata (version 16.1). Visual representations of results were generated in R (version 4.1.1). See appendix 1 (p4-8) for further details of the modelling strategy and Stata code.

Role of the funding source

There was no funding source for this study. JP, DG, SS, MDP-B, VA, AJ, and MJS had access to the data. JP, DG, AJ and MJS had final responsibility for the decision to submit for publication, but all authors approved the final version for submission.

Results

We sourced data from 33 countries (24 high-income, six upper-middle-income, three lower-middle-income; 25 with whole-country data, 12 with data for area(s)-within-the-country, four with both). In total, we had 59 individual datasets (25 countries, 34 areas-within-countries; Figure 2, Table 1, appendix 1 [pp9-28]), with a total of 852,150 suicides. Data from England/Wales were provided to us in a combined form so we treated them as one country. See appendix 2 for raw data and appendix 3 for code that reads the data into Stata, labels the variables and performs an example analysis.

Tables 2−5 present the findings from the primary and secondary analyses, for countries (Tables 2 and 3) and areas-within-countries (Tables 4 and 5); also see appendix 1 (pp 29-32 and pp33-50). Each cell shows the RR for the given country/area-within-country for total suicides and suicides by sex, age and sex-by-age groupings.

There was no evidence of greater-than-expected numbers of suicides in the majority of countries/areas-within-countries in any analysis (i.e., green and white cells combined outnumber red cells in all columns in Tables 2−5). In fact, it was more common to see evidence of numbers being lower-than-expected (i.e., green cells outnumber red cells in most columns in all tables). Even where there was evidence of greater-than-expected numbers of suicides, this sometimes represented a slowing of a decline in numbers, rather than an active increase.

There were some signals that patterns may be changing as the pandemic continues, with relatively

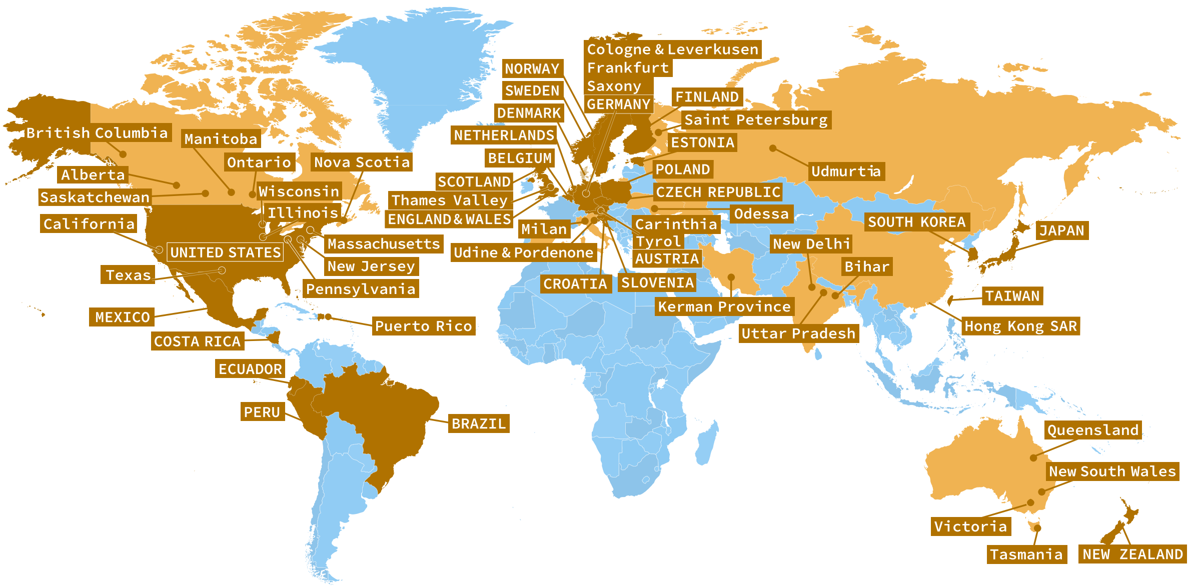

Figure 2. Countries and areas-within-countries included in the analyses.

1. Countries with data available for the whole country are shaded in dark brown. The names of these countries are written in upper case.
2. Countries with data available for one or more areas within the country are shaded in light brown.
3. Areas-within-countries with available data are indicated by dark brown dots. The names of these areas-within-countries are written in lower case.
4. Countries with no data available are shaded in blue.
5. The boundaries and names shown and the designations used on this map do not imply endorsement by all authors.

more instances of greater-than-expected numbers of suicides over 10-15 months than nine months (i.e., proportionally more red cells in some equivalent columns in Table 3 versus Table 2, and Table 5 versus Table 4), although this may reflect the different sample of countries/areas-within-countries in the latter analyses. Certain sex, age and sex-by-age groups stood out as potentially concerning, but these were not consistent across countries/areas-within-countries. For example, Tables 3 and 5 show different results for males and females at 10-15 months. Table 3 indicates that suicide risk may be heightened for females (three dark red cells representing 30% of countries with available data; none for males), whereas Table 5 suggests that the problem may disproportionately worse for males (six dark red cells representing 29% of areas-within-countries with available data; two for females [10%]).

Only a few countries/areas-within-countries showed patterns that were consistent across total suicides and suicides by sex-, age- and sex-by-age strata (e.g., Japan and New Delhi had greater-than-expected numbers of suicides in most analyses, with red cells in most columns in Tables 2 and 3 and Tables 4 and 5, respectively; conversely, Brazil and England/Wales had lower-than-expected numbers of suicide in all or almost all analyses, with the majority of cells being green). The more common scenario was instances of greater-than-anticipated suicides for single sex, age or sex-by-age groups (red or green cells in some columns and not others, with no common patterns).

In Tables 4 and 5, it is noticeable that the areas from lower-middle-income countries feature prominently among those showing evidence of a greater-than-expected number of suicides (e.g., Uttar Pradesh and New Delhi [India] and Kerman Province [Iran] account for half of the areas-within-countries with strong evidence of greater-than-expected numbers of total suicides at nine months [three dark red cells, column 1, Table 4]).

Where data were available from more than one area within a country, patterns were often different. For example, total suicide numbers in the Australian state of Queensland at 10-15 months were greater-than-expected (dark red cell, column 1, Table 5), whereas the numbers for New South Wales, Victoria and Tasmania showed a relative decline (dark green cells, column 1, Table 5).

Table 6 shows the meta-regression results. None of the variables explained the different patterns of suicide seen in the 25 countries nine months into the pandemic.

Discussion

Our results suggest that there has not been the sharp increase in suicides that some commentators forecast when the pandemic began.[1] This does not mean that

Country	Area-within-country	Population (2020)	Source of suicide data	Availability of suicide data for observation period	Total number of suicides in observation period
High-income countries[a]					
Australia	New South Wales	8,164,128	New South Wales Ministry Health	Jan-19 to Jun-21	2285
	Queensland	5,174,437	Australian Institute for Suicide Research and Prevention	Jan-16 to Jun-21	4387
	Tasmania	540,569	Tasmanian Magistrates Court (Coronial Division)	Jan-16 to Jun-21	474
	Victoria	6,694,884	Coroners Court of Victoria	Jan-16 to Jun-21	3911
Austria	Whole country	9,043,072	Statistics Austria	Jan-16 to Dec-20	5822
	Carinthia	562,506	Kärntner Suiziddatenbank, Amt der Kärntner Landesregierung	Jan-18 to Jun-21	403
	Tyrol	759,652	Tyrol Suicide Register	Jan-16 to Jun-21	627
Belgium	Whole country	11,632,334	Federal Police	Jan-17 to Dec-20	5526
Canada	Alberta	4,420,029	Office of the Chief Medical Examiner	Jan-16 to Jun-21	3441
	British Columbia	5,158,728	British Columbia Coroners Service	Jan-16 to Dec-20	2930
	Manitoba	1,380,648	Office of the Chief Medical Examiner	Jan-16 to Dec-20	1099
	Nova Scotia	981,889	Nova Scotia Medical Examiner Service	Jan-16 to Jun-21	762
	Ontario	14,745,712	Office of the Chief Coroner of Ontario	Jan-19 to Dec-20	2995
	Saskatchewan	1,179,300	Saskatchewan Coroners Service	Jan-16 to Jun-21	1096
China[b]	Hong Kong Special Administrative Regions (SAR)	7,552,800	Coroner's Court of Hong Kong SAR Government	Jan-16 to Dec-20	4629
Croatia	Whole country	4,081,657	Ministry of the Interior Affairs	Jan-16 to Jun-21	3461
Czech Republic	Whole country	10,724,553	Czech Statistical Office	Jan-16 to Dec-20	6482
Denmark	Whole country	5,813,302	Danish Health Data Authority	Jan-16 to Dec-20	2922
England/Wales[c]	Whole country	59,720,000	Office for National Statistics	Jan-16 to Dec-20	25,871
	Thames Valley (England)	2,431,905	Thames Valley Police	Jan-17 to Jun-21	847
Estonia	Whole country	1,325,188	National Institute for Health Development	Jan-16 to Jun-21	1116
Finland	Whole country	5,548,361	Forensic Medicine Unit, Finnish Institute for Health and Welfare	Jan-16 to Dec-20	3854
Germany	Whole country	83,900,471	Statistisches Bundesamt	Jan-16 to Dec-20	46,747
	Cologne and Leverkusen	1,247,403	Police Headquarters Cologne	Jan-19 to Jun-21	329
	Frankfurt	764,104	Research Project FraPPE/Frankfurt Municipal Health Authority/University Hospital Frankfurt	Jul-18 to Dec-20	230
	Saxony	4,056,941	Saxon State Office of Criminal Investigation	Jan-17 to Jun-21	3116
Italy	Milan	3,265,327	Institute of Forensic Medicine, University of Milan	Jan-16 to Jun-21	792
	Udine and Pordenone	836,976	Regional Social and Health Information System (SISSR) of the Friuli Venezia Guilia (FVG) Region	Jan-16 to Jun-21	517

***Table 1** (Continued)*

Country	Area-within-country	Population (2020)	Source of suicide data	Availability of suicide data for observation period	Total number of suicides in observation period
Japan	Whole country	126,050,796	National Police Agency	Jan-16 to Jun-21	111,012
Netherlands	Whole country	17,173,094	Statistics Netherlands	Jan-16 to Mar-21	9748
New Zealand	Whole country	5,126,300	Coronial Services of New Zealand	Jan-16 to Jun-21	3411
Norway	Whole country	5,465,629	National Institute of Public Health	Jan-16 to Dec-20	3177
Poland	Whole country	37,797,000	Working Group on Prevention of Suicide and Depression at Public Health Council Ministry of Health	Jan-16 to Jun-21	28,954
Scotland	Whole country	5,466,000	National Records of Scotland	Jan-16 to Dec-20	3197
Slovenia	Whole country	2,078,723	National Institute of Public Health	Jan-16 to Dec-20	1898
South Korea	Whole country	51,305,184	Statistics Korea	Jan-16 to Jun-21	73,833
Sweden	Whole country	10,160,159	National Board of Health and Welfare	Jan-16 to Dec-20	5939
Taiwan	Whole country	23,855,008	Ministry of Health and Welfare	Jan-16 to Dec-20	19,021
United States	Whole country	332,915,074	Centers for Disease Control and Prevention (CDC) Wide-ranging Online Data for Epidemiologic Research (WONDER) and CDC	Jan-16 to Jan-21	237,891
	California	39,368,078	California Department of Public Health	Jan-16 to Jun-21	24,181
	Illinois (Cook County)	5,108,284	Cook County Medical Examiner Case Archive	Jan-16 to Jun-21	2663
	Massachusetts	6,893,674	Massachusetts Department of Health	Jan-16 to Dec-20	3319
	New Jersey	8,882,371	New Jersey Department of Health	Jan-16 to Jun-21	4095
	Pennsylvania	12,783,254	CDC WONDER and Pennsylvania Department of Health	Jan-16 to Jun-21	10,432
	Puerto Rico[d]	3,285,874	Forensic Sciences Institute – Puerto Rico	Jan-16 to Jun-21	1359
	Texas (Denton, Johnson, Parker, Tarrant Counties)	3,370,444	Medical Examiners Case Records	Jan-16 to Jun-21	2265
	Wisconsin (Milwaukee, Jefferson, Kenosha, Racine and Ozaukee Counties)	1,485,570	Milwaukee County Medical Examiner Public Access	Jan-16 to Jun-21	708
Upper-middle-income countries[a]					
Brazil	Whole country	213,993,441	Department of Health Analysis and Surveillance of Noncommunicable Diseases (DASNT), Health Surveillance Secretariat	Jan-16 to May-21	66,143
Costa Rica	Whole country	5,139,053	Instituto Nacional De Estadística Y Censos	Jan-16 to Dec-20	1793

Table 1 *(Continued)*

Country	Area-within-country	Population (2020)	Source of suicide data	Availability of suicide data for observation period	Total number of suicides in observation period
Ecuador	Whole country	17,888,474	Government Ministry (Police Reports)	Jan-16 to Jun-21	6451
Mexico	Whole country	130,262,220	Mexican National Statistical Bureau (INEGI)	Jan-16 to Dec-20	34,856
Peru	Whole country	33,359,415	National Death Registry Information System	Jan-17 to Jun-21	2637
Russia	Saint Petersburg	5,391,203	Saint Petersburg City Bureau of Forensic Medical Examinations	Jan-16 to Dec-20	1777
	Udmurtia	1,497,155	Regional mortality database	Jan-16 to Jun-21	2515
Lower-middle-income countries[a]					
India	Bihar (rural sample)[e]	283,758	Public Health Foundation of India	Jan-18 to Jan-21	18
	New Delhi (2 districts)	≈3,000,000	Department of Forensic Medicine, All India Institute of Medical Sciences (AIIMS)	Jan-16 to Jun-21	2856
	Uttar Pradesh (sample from 5 districts)[e]	196,235	Public Health Foundation of India	Jan-18 to Dec-20	38
Iran	Kerman Province	3,164,718	Iranian Forensic Medicine Organization (IFMO), Kerman Branch	Jan-17 to Mar-21	650
Ukraine	Odessa	2,362,108	Odessa Regional Bureau of Forensic Medical Examination	Jan-16 to Dec-20	2282

***Table 1*: Countries and areas-within-countries' suicide data.**

[a] Income level based on World Bank Classification: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.
[b] China is an upper-middle-income-country but Hong Kong SAR is listed as a high-income economy by the World Bank.
[c] Data from England/Wales were provided to us in a combined form, so for the purposes of the analyses they were treated as one country.
[d] Unincorporated territory of the United States.
[e] Data for Bihar and Uttar Pradesh came from a population-based representative household survey (conducted in rural Bihar and in 5 districts in Uttar Pradesh).

suicides are no longer of concern; those that have occurred have had major impacts for families and communities, and the pandemic is still causing unprecedented levels of stress for many. However, in most of the 25 countries and 34 areas-within-countries in our study there was no divergence from existing trends in overall suicide numbers and in some the numbers were lower-than-expected. There were exceptions, with observed numbers of suicides being greater-than-expected in certain countries/areas-within-countries. We noted more of these exceptions at nine months than we did in our previous study at four months,[4] and there were suggestions that they might be becoming more common at 10-15 months, although the countries/areas-within-countries where this occurred were still in the minority. However, these findings may partly reflect increased statistical power afforded by the longer time series.

We identified differences between countries and between areas-within-countries. Contextual information is important here. Our meta-regression investigated the factors that might explain between-country variability but none of the covariates accounted for the patterns, possibly because they were not sensitive/comprehensive enough or they differentially affected different population groups. For example, the economic support index is influenced by whether countries' governments provided payments to people whose employment was affected by the pandemic. This support may not have covered workers in all sectors/locations. We know from single-country studies that have captured more granular data on economic impacts that these have been related to suicide patterns.[18]

The extent to which the pandemic is impacting on suicides in low- and lower-middle-income countries warrants further exploration. We had data from only three lower-middle-income countries and no low-income countries, and all of our lower-middle-income countries were represented by areas-within-countries and could therefore not be included in the meta-

	All suicides	Males	Females	<20 yrs	20-39 yrs	40-59 yrs	≥60 yrs	Males <20 yrs	Males 20-39 yrs	Males 40-59 yrs	Males ≥60 yrs	Females <20 yrs	Females 20-39 yrs	Females 40-59 yrs	Females ≥60 yrs
USA	0.96														
South Korea	0.91	0.91	0.86												
Brazil	0.88	0.88	0.87	0.75	0.83	0.94	0.91	0.72	0.86	0.93	0.93	0.79	0.74	0.93	1.16
England and Wales	0.77	0.76	0.77	0.77	0.68	0.76	0.87	0.47	0.70	0.77	0.84	1.42	0.60	0.76	0.97
Mexico	0.93	0.93	0.95	0.91	0.90	0.91	1.27	0.97	0.89	0.98	1.11	0.93	0.93	0.78	1.51
Sweden	0.84	0.97	0.77	1.28	0.76	0.84	1.11	0.75	0.81	0.90	1.12	1.82	0.61	0.71	1.00
New Zealand	0.82	0.87	0.71	0.73	0.92	0.77	0.74	0.86	0.86	0.87	0.87	0.52	1.12	0.51	0.43
Norway	0.91														
Peru	0.90	0.98	0.67	0.95	0.91	0.79	1.01	1.07	0.88	0.73	1.09	0.52	1.01	0.55	0.59
Scotland	1.01	0.98	0.75	0.90	0.96	1.08	0.97	1.18	1.04	1.05	0.79	np	0.45	1.17	1.75
Ecuador	0.91	0.87	0.98	1.05	0.88	0.94	1.22	1.08	0.91	0.77	0.96	1.02	0.75	1.12	1.46
Costa Rica	0.83	0.75	1.22	0.88	0.86	0.82	0.69	0.42	0.81	0.74	0.69	1.35	1.06	3.89	np
Finland	0.93	0.95	0.87	0.84	0.86	1.05	0.85	0.76	0.80	1.15	1.14	1.13	1.56	0.81	0.66
Taiwan	1.03	0.97	1.05												
Netherlands	1.02	1.06	0.99												
Estonia	1.08	1.09	1.13	1.27	1.03	1.19	1.09	np	1.09	1.09	1.27	4.24	np	1.77	0.75
Slovenia	0.90	0.90	0.92	1.07	1.13	0.81	0.90	np	1.42	0.81	0.82	np	np	0.53	1.31
Poland	1.01	1.00	1.11	0.99	1.03	1.00	0.99	0.89	1.03	0.97	0.98	1.31	0.82	1.21	1.08
Germany	0.99														
Denmark	0.95														
Belgium	1.03														
Croatia	1.01	1.04	1.31	1.46	1.02	0.96	1.03	0.97	1.15	0.94	1.31	np	0.44	2.02	1.00
Czech Republic	1.09	1.11	0.95	1.40	0.96	1.21	0.95	1.41	0.93	1.33	0.96	0.90	1.20	0.86	0.92
Austria	1.10	1.16	1.00	1.10	1.20	0.95	1.32	1.52	1.14	0.99	1.35	2.60	1.27	0.60	1.02
Japan	1.05	0.98	1.24	1.21	1.17	1.00	1.06	1.18	1.09	0.91	1.00	1.24	1.40	1.22	1.17

Strength of evidence
- Strong ($p \le 0.001$)
- Moderate ($0.001 < p \le 0.01$)
- Weak ($0.01 < p \le 0.05$)
- No evidence ($p > 0.05$)
- Weak ($0.01 < p \le 0.05$)
- Moderate ($0.001 < p \le 0.01$)
- Strong ($p \le 0.001$)

***Table 2*: Rate ratios (RRs) for observed versus expected suicides in the first nine months of the pandemic, by country (*n*=25).**

1. The COVID-19 period was defined as 1st April to 31st December 2020, and the pre-COVID-19 period as at least 1st January 2019 to 31st March 2020 (with data included from as early as 1st January 2016, if available).
2. Red and green cells indicate that there was statistical evidence of suicide numbers being greater- or lower-than-expected in the COVID-19 period, respectively. As noted in the legend, the red and green cells are graduated, with pale red/green indicating weak evidence, mid red/green indicating moderate evidence, and dark red/green indicating strong evidence. Note that greater-than-expected numbers of suicides sometimes represent a slowing of a decline in numbers, rather than an active increase (e.g., Austria, all suicides [column 1]; England/Wales, females <20 yrs [column 12]; Scotland, females ≥60 yrs [column 15]; and Croatia, males ≥60 yrs [column 11]). Similarly, lower-than-expected numbers of suicides sometimes represent a slowing of an increase, rather than an active decrease (e.g., Brazil, all suicides [column 1]; Costa Rica, males [column 2]; and New Zealand, females [column 3]).
3. Cells with the notation "np" (not presented) have been suppressed because the observed number of suicides in the given country or area-within-country was ≤5. Grey cells indicate that the data were unavailable.
4. Countries are grouped based on hierarchical agglomerative clustering, based on similarities across rows of red, green and white cells.
5. The age categories for Poland were provided in a slightly different format to those for the other countries. We classified 7–18 yrs as <20 yrs, and 19–39 yrs as 20–39 yrs.

	All suicides	Males	Females	<20 yrs	20-39 yrs	40-59 yrs	≥60 yrs	Males <20 yrs	Males 20-39 yrs	Males 40-59 yrs	Males ≥60 yrs	Females <20 yrs	Females 20-39 yrs	Females 40-59 yrs	Females ≥60 yrs
USA	0.97														
South Korea	0.90	0.90	0.82												
Brazil	0.80	0.80	0.80	0.68	0.77	0.86	0.80	0.62	0.80	0.85	0.82	0.77	0.66	0.89	1.03
Ecuador	0.89	0.85	0.99	1.11	0.91	1.00	1.06	1.08	0.94	0.80	0.79	1.14	0.79	1.03	1.18
New Zealand	0.85	0.91	0.70	0.73	0.96	0.82	0.77	0.82	0.93	0.91	0.88	0.53	1.02	0.57	0.50
Peru	0.97	1.02	0.73	0.93	1.19	0.73	0.95	0.96	1.04	0.70	1.01	0.46	1.74	0.32	0.66
Estonia	0.99	1.01	0.97	1.03	0.98	1.13	1.00	0.44	0.98	1.09	1.19	3.73	0.95	1.38	0.63
Netherlands	1.03	1.09	0.98												
Poland	1.02	1.01	1.12	1.07	1.03	1.04	0.98	0.97	1.02	1.01	0.96	1.31	0.80	1.24	1.04
Croatia	1.04	1.05	1.50	1.31	0.98	1.02	1.06	0.84	1.03	1.03	1.38	8.60	0.75	2.19	1.09
Japan	1.05	0.98	1.24	1.17	1.18	1.00	1.05	1.13	1.11	0.92	0.99	1.21	1.40	1.24	1.17

Strength of evidence
- Strong (p ≤ 0.001)
- Moderate (0.001 < p ≤ 0.01)
- Weak (0.01 < p ≤ 0.05)
- No evidence (p > 0.05)
- Weak (0.01 < p ≤ 0.05)
- Moderate (0.001 < p ≤ 0.01)
- Strong (p ≤ 0.001)

***Table 3*: Rate ratios (RRs) for observed versus expected suicides in the first 10-15 months of the pandemic, by country (*n*=11).**

1. The COVID-19 period was defined as 1st April to the latest date for which data were available (up to 30th June 2021), and the pre-COVID-19 period as at least 1st January 2019 to 31st March 2020 (with data included from as early as 1st January 2016, if available).
2. Countries with a latest-available date of 31st December 2020 were excluded from the analysis because their RRs were the same as those in Table 2.
3. Red and green cells indicate that there was statistical evidence of suicide numbers being greater- or lower-than-expected in the COVID-19 period, respectively. As noted in the legend, the red and green cells are graduated, with pale red/green indicating weak evidence, mid red/green indicating moderate evidence, and dark red/green indicating strong evidence. Note that greater-than-expected numbers of suicides sometimes represent a slowing of a decline in numbers, rather than an active increase (e.g., Croatia, females [column 3]; Japan, <20 yrs [column 4]; the Netherlands, males [column 2]; and Peru, 20-39 yrs [column 5]). Similarly, lower-than-expected numbers of suicides sometimes represent a slowing of an increase, rather than an active decrease (e.g., South Korea, females [column 3]; Ecuador, all suicides [column 1]; and Peru, females [column 3]).
4. Grey cells indicate that the data were unavailable.
5. Countries are grouped based on hierarchical agglomerative clustering, based on similarities across rows of red, green and white cells.
6. The age categories for Poland were provided in a slightly different format to those for the other countries. We classified 7–18 yrs as <20 yrs, and 19–39 yrs as 20–39 yrs.

	All suicides	Males	Females	<20 yrs	20-39 yrs	40-59 yrs	≥60 yrs	Males <20 yrs	Males 20-39 yrs	Males 40-59 yrs	Males ≥60 yrs	Females <20 yrs	Females 20-39 yrs	Females 40-59 yrs	Females ≥60 yrs
USA, Pennsylvania	0.89														
Canada, British Columbia	0.76														
Australia, Tasmania	0.64	1.04	0.20	np	0.95	0.45	1.20	np	1.02	0.63	1.44	np	np	np	np
Italy, Milan	0.56	0.62	0.44	np	0.62	0.57	1.45	np	0.59	0.66	1.37	np	np	np	np
Australia, New South Wales	0.89														
Australia, Victoria	0.88	0.86	1.05	0.81	1.00	0.72	0.74	0.53	0.88	0.68	0.77	0.55	1.41	1.03	0.77
USA, California	0.88	0.86	0.96												
Germany, Frankfurt	0.43	0.42	0.64	np	0.65	0.20	1.89	np	0.58	0.71	3.18	np	np	0.82	0.43
Australia, Queensland	1.08	1.13	0.88	1.17	1.03	0.70	1.06	1.36	1.37	0.76	0.97	2.63	0.48	0.98	1.36
Canada, Alberta	1.01														
USA, Texas (4 counties)	0.86	0.92	0.68	0.83	0.93	0.70	1.03	1.03	1.01	0.68	1.11	np	0.68	0.78	0.68
Germany, Saxony	0.98	1.07	0.74	1.81	0.81	0.94	1.03	2.46	0.88	0.76	1.12	np	0.56	0.65	0.83
Russia, Saint Petersburg	1.01	1.02	0.70	0.64	1.07	1.13	0.93	np	0.76	1.20	1.32	np	1.11	0.49	1.06
USA, Illinois (Cook County)	0.88	0.91	0.76	1.50	0.93	0.80	0.88	0.84	1.03	0.82	0.89	1.13	0.66	0.73	0.86
England, Thames Valley	0.84														
Austria, Tyrol	0.79	0.81	0.74	np	0.34	0.84	1.11	np	np	0.79	1.26	np	np	0.93	0.77
China, Hong Kong	1.00	1.00	0.94	1.29	1.06	0.80	0.95	1.64	0.88	1.00	0.87	0.89	0.93	0.77	1.11
Canada, Nova Scotia	0.84	0.85	0.87												
USA, Wisconsin (5 counties)	1.03	1.08	0.84	np	0.99	1.00	1.23	np	1.10	1.18	1.11	np	np	np	1.72
India, Bihar	np	np	np	np	np	np	np	np	np	np	np	np	np	np	np
Italy, Udine and Pordenone	0.97	0.95	1.24	np	0.85	0.76	1.20	np	0.78	0.65	1.18	np	np	1.04	1.25
Canada, Saskatchewan	1.15	0.79	1.16	1.52	0.91	0.86	0.70	3.90	0.83	0.79	0.64	0.78	1.19	1.16	np
Ukraine, Odessa	1.03	1.00	1.14	2.07	0.89	1.17	0.98	2.34	0.96	1.16	0.83	np	np	1.25	1.73
USA, Massachusetts	1.01	1.04	1.03	1.07	0.82	1.02	1.31	0.88	0.87	0.93	1.17	1.32	0.66	0.64	2.06
USA, Puerto Rico	1.11	1.15	0.78	np	0.93	1.02	1.52								
India, Uttar Pradesh	6.06	0.94	np	np	np	np	np	np	np	np	np	np	np	np	np
Canada, Manitoba	0.88	0.83	0.98	0.63	1.06	0.81	0.67	0.62	0.96	0.74	0.65	np	1.10	3.01	np
USA, New Jersey	1.07	1.03	1.20	0.62	1.09	1.18	1.06								
Germany, Cologne and Leverkusen	1.17	0.96	2.06	np	1.45	1.26	0.97	np	1.29	0.94	0.82	np	np	2.55	1.57
India, New Delhi	1.40	1.40	1.55	0.19	2.78	6.93	2.97	0.17	2.24	7.83	2.56	0.28	5.19	1.31	np
Iran, Kerman Province	2.05	2.35	1.21	5.14	1.87	0.74	0.51	23.00	1.88	0.87	0.78	2.41	1.08	np	np
Russia, Udmurtia	1.26	1.33	0.93	1.27	1.09	1.00	1.53	np	1.54	0.96	1.81	2.10	np	1.32	0.53
Austria, Carinthia	2.54	2.65	0.60	np	1.02	3.12	2.07	np	0.94	1.18	2.51	np	np	0.41	np
Canada, Ontario	1.51														

Strength of evidence
- Strong (p ≤ 0.001)
- Moderate (0.001 < p ≤ 0.01)
- Weak (0.01 < p ≤ 0.05)
- No evidence (p > 0.05)
- Weak (0.01 < p ≤ 0.05)
- Moderate (0.001 < p ≤ 0.01)
- Strong (p ≤ 0.001)

***Table 4*: Rate ratios (RRs) for observed versus expected suicides in the first nine months of the pandemic, by area-within-country (*n*=34).**

1. The COVID-19 period was defined as 1st April to 31st December 2020, and the pre-COVID-19 period as at least 1st January 2019 to 31st March 2020 (with data included from as early as 1st January 2016, if available).

2. Red and green cells indicate that there was statistical evidence of suicide numbers being greater- or lower-than-expected in the COVID-19 period, respectively. As noted in the legend, the red and green cells are graduated, with pale red/green indicating weak evidence, mid red/green indicating moderate evidence, and dark red/green indicating strong evidence. Note that greater-than-expected numbers of suicides sometimes represent a slowing of a decline in numbers, rather than an active increase (e.g., Massachusetts [US], ≥ 60 yrs [column 5]; Kerman Province [Iran], all suicides [column 1; and Carinthia [Austria], all suicides [column 1]). Similarly, lower-than-expected numbers of suicides sometimes represent a slowing of an increase, rather than an active decrease (e.g., Pennsylvania [US], all suicides [column 1]; Tasmania [Australia], all suicides [column 1]; and Sain Petersburg [Russia], females 40-59 [column 14]).

3. Cells with the notation "np" (not presented) have been suppressed because the observed number of suicides in the given country or area-within-country was ≤5. Grey cells indicate that the data were unavailable.

4. Areas-within-countries are grouped based on hierarchical agglomerative clustering, based on similarities across rows of red, green and white cells.

	All suicides	Males	Females	<20 yrs	20-39 yrs	40-59 yrs	≥60 yrs	Males <20 yrs	Males 20-39 yrs	Males 40-59 yrs	Males ≥60 yrs	Females <20 yrs	Females 20-39 yrs	Females 40-59 yrs	Females ≥60 yrs
USA, California	0.86	0.85	0.93												
Australia, Victoria	0.86	0.85	0.97	0.87	0.96	0.72	0.65	0.40	0.89	0.67	0.69	0.85	1.22	0.99	0.63
USA, Pennsylvania	0.88														
England, Thames Valley	0.76														
Australia, Tasmania	0.59	1.03	0.19	np	0.91	0.59	1.15	np	1.01	0.77	1.33	np	0.64	np	0.70
Australia, New South Wales	0.91														
Austria, Tyrol	0.76	0.78	0.71	np	0.45	0.82	0.97	np	0.46	0.76	1.09	np	np	0.98	0.67
Italy, Milan	0.65	0.65	0.72	np	0.62	0.71	1.97	np	0.66	0.71	1.42	np	0.51	0.30	2.97
Canada, Saskatchewan	1.11	0.72	1.03	1.70	0.79	0.86	0.62	5.30	0.73	0.78	0.57	0.69	0.99	1.22	0.87
USA, Texas (4 counties)	0.93	0.95	0.86	0.87	1.00	0.75	1.14	1.02	1.04	0.73	1.15	0.47	0.86	0.81	1.11
USA, Illinois (Cook County)	0.90	0.93	0.82	1.54	1.05	0.81	0.80	0.66	1.13	0.84	0.84	1.27	0.81	0.69	0.88
India, Bihar	np	np	np	np	np	np	np	np	np	np	np	np	np	np	np
Italy, Udine and Pordenone	0.84	0.89	0.88	np	0.73	0.70	1.05	np	0.72	0.69	1.02	np	np	0.74	1.16
USA, Wisconsin (5 counties)	1.07	1.08	1.03	0.81	0.95	1.15	1.22	np	1.06	1.30	1.01	np	0.58	0.75	2.07
Canada, Alberta	0.97														
Canada, Nova Scotia	0.89	0.87	1.06												
Germany, Saxony	0.99	1.03	0.90	2.26	0.80	0.99	1.04	2.75	0.84	0.71	1.05	1.52	0.65	0.72	1.04
Australia, Queensland	1.13	1.17	0.93	1.08	1.04	0.75	1.06	1.20	1.43	0.78	1.00	3.28	0.43	1.27	1.28
Iran, Kerman Province	2.03	2.33	1.14	5.26	1.84	0.66	0.55	28.00	1.78	0.68	0.84	1.93	1.09	np	np
Germany, Cologne and Leverkusen	1.10	0.90	1.97	np	1.51	1.27	0.82	np	1.32	0.97	0.69	np	2.58	2.52	1.34
USA, New Jersey	1.09	1.06	1.22	0.56	1.17	1.29	0.96								
Russia, Udmurtia	1.16	1.24	0.82	0.99	0.88	0.97	1.46	0.81	1.32	0.98	1.68	1.29	0.38	1.04	0.49
USA, Puerto Rico	1.21	1.31	0.65	1.44	1.04	1.12	1.57								
Austria, Carinthia	3.59	3.48	0.84	np	1.17	4.11	2.69	np	0.98	1.04	3.10	np	np	0.36	1.23
India, New Delhi	1.47	1.41	1.75	0.12	3.32	9.36	2.77	0.10	2.54	10.00	2.66	0.24	6.97	1.99	3.00

Strength of evidence
- Strong ($p \le 0.001$)
- Moderate ($0.001 < p \le 0.01$)
- Weak ($0.01 < p \le 0.05$)
- No evidence ($p > 0.05$)
- Weak ($0.01 < p \le 0.05$)
- Moderate ($0.001 < p \le 0.01$)
- Strong ($p \le 0.001$)

***Table 5*: Rate ratios (RRs) for observed versus expected suicides in the first 10-15 months of the pandemic, by area-within-country (*n*=25).**

1. The COVID-19 period was defined as 1st April to the latest date for which data were available (up to 30th June 2021), and the pre-COVID-19 period as at least 1st January 2019 to 31st March 2020 (with data included from as early as 1st January 2016, if available).

2. Areas-within-countries with a latest-available date of 31st December 2020 were excluded from the analysis because their RRs were the same as those in Table 4.

3. Red and green cells indicate that there was statistical evidence of suicide numbers being greater- or lower-than-expected in the COVID-19 period, respectively. As noted in the legend, the red and green cells are graduated, with pale red/green indicating weak evidence, mid red/green indicating moderate evidence, and dark red/green indicating strong evidence. Note that greater-than-expected numbers of suicides sometimes represent a slowing of a decline in numbers, rather than an active increase (e.g., Saxony [Germany], <20 years [column 4]; Queensland [Australia], females 40-59 years [column 14]; and Puerto Rico [US], all suicides [column 1]). Similarly, lower-than-expected numbers of suicides sometimes represent a slowing of an increase, rather than an active decrease (e.g., California [US], females [column 3]; Thames Valley [England], all suicides [column 1]; and Tyrol [Austria], 20-39 yrs [column 5]).

4. Cells with the notation "np" (not presented) have been suppressed because the observed number of suicides in the given country or area-within-country was ≤5. Grey cells indicate that the data were unavailable.

5. Countries are grouped based on hierarchical agglomerative clustering, based on similarities across rows of red, green and white cells.

	Unadjusted RR (95% CI)	*p* value	Adjusted RR (95% CI)	*p* value
Income level[a]				
• High	1.00		1.00	
• Upper middle	0.91 (0.83 to 1.00)	0.05	0.90 (0.80 to 1.05)	0.15
COVID-19 mortality per 100,000[b]	1.00 (1.00 to 1.00)	0.70	1.00 (1.00 to 1.00)	0.50
Stringency index[c]	1.00 (0.99 to 1.01)	0.82	1.00 (0.99 to 1.01)	0.77
Economic support index[d]	1.00 (0.99 to 1.01)	0.56	1.00 (0.99 to 1.01)	0.36
Stringency index * Economic support index	1.00 (1.00 to 1.00)	0.66	1.00 (1.00 to 1.00)	0.38
National suicide prevention strategy[e]				
• No	1.00		1.00	
• Yes	0.98 (0.90 to 1.06)	0.55	0.94 (0.89 to 1.07)	0.23

***Table 6*: Unadjusted and adjusted meta-regression analyses investigating the relationship between changes in suicide numbers and income level, COVID-19 mortality, public health stringency measures, economic support and the presence of a national suicide prevention strategy, by country (*n*=25).**

[a] Based on World Bank Classification: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups (accessed 5th February 2022).

[b] Taken from Our World in Data: https://ourworldindata.org/covid-deaths (accessed 9th February 2022); Chosen in preference to COVID-19 case numbers because these would have been influenced by testing levels.

[c] Taken from Our World in Data: https://ourworldindata.org/grapher/covid-stringency-index (accessed 9th February 2022).

[d] Taken from Our World in Data: https://ourworldindata.org/covid-income-support-debt-relief (accessed 9th February 2022).

[e] Taken from World Health Organization's MindBank: https://www.mindbank.info/collection/topic/suicide_prevention_ (accessed 9th February 2022).

regression. This is important because there appeared to be concerning uplifts in suicides in the areas of India and Iran for which we had data. Many low- and middle-income countries have been hit hard by the pandemic and struggle to provide economic and mental health supports.

Certain groups had greater-than-expected numbers of suicides in some countries/areas-within-countries, although again these were the exception. The patterns were nuanced and again require an understanding of context. For example, we observed more instances of greater-than-expected numbers of suicides for females than males in our country analysis and the reverse in our area-within-country analysis. There may be plausible reasons for both scenarios. Males may have been particularly affected by the economic sequelae of the pandemic, especially if they were primary breadwinners rather than caregivers,[19] and may have been less likely to seek help from services designed to combat the mental health impacts of the pandemic.[20] However, females may have suffered disproportionately where their employment circumstances were already precarious or where they shouldered heavy responsibilities for home-schooling children while working from home,[21] where underlying gender inequalities were high,[22] or where they experienced elevated domestic violence risk.[23]

Our finding that greater-than-expected numbers of suicides were not the norm is somewhat at odds with documented pandemic-related rises in mental disorders.[24] This may be because there is not a simple relationship between mental disorders and suicide. There may also be longer lag times for suicide-related outcomes than mental health-related outcomes following public health emergencies,[25] and responses to increases in mental disorders (e.g., funding to bolster mental health and crisis services) may have mitigated against increases in suicide risk.[26] The fact that communities appear to have gained a greater collective understanding of distress and rallied around those who are struggling – including those with emerging mental disorders – may have been protective.[3,27] Spending more time with families, working more flexibly, and leading calmer lives may have also had mental health benefits for some.[3,27]

Ongoing monitoring of suicides during the pandemic is critical. Large-scale international efforts such as ours should be complemented by local ones that can be timelier and more detailed and take account of contextual issues. Monitoring should not only track total suicides, but also suicides for different groups because impacts may vary by sex, age and other demographic factors (e.g., race/ethnicity[28]). Real-time surveillance systems are important here. These tend to cover areas-within-countries, which means that they can quickly reveal nuanced pictures in areas where targeted, localised responses may be deployed. Whole countries tend to rely more on vital statistics collections, which are the gold standard but do not afford the same opportunities for timely, tailored responses. In our study, data were available beyond 31st December 2020 in 74% of areas-within-countries but only 44% of whole countries.

There is a need to maintain and strengthen suicide prevention activities. The way that the pandemic confers risk for suicide may be changing. Initially, much of the concern related to potential consequences of lockdowns (e.g., feelings of isolation/entrapment). Many countries have now moved to "living with COVID-19", but the pandemic is still having far-reaching impacts. Many individuals have suffered financially, experienced high levels of stress, and been bereaved through COVID-19 deaths, and many still fear the future. Ongoing suicide prevention activities will need to respond to the major impact that COVID-19 has had and will continue to have on people's lives; continued economic and mental health supports will be key.

Our study had many strengths. It included data from 33 different countries. It used a sophisticated analytical strategy that accounted for pre-pandemic suicide trends, modelling these using data from as far back as 1st January 2016. It provided an extended, in-depth picture of suicides during the pandemic, capturing data on those that occurred as recently as 30th June 2021 and doing so for different sex, age and sex-by-age groups.

Nonetheless, the study had limitations. We became aware of additional data after our data collection cut-off, including some from whole countries. In one of these (Chile[29]), there was no evidence of changes in suicide patterns, but in others (e.g., Hungary,[30] Spain,[31] Nepal,[32,33] India[34]) there were increases or reversals of previously declines. Nepal and India are particularly important because of our lack of representation from low- and lower-middle-income countries.

Our areas-within-countries included whole states/provinces, cities and smaller localities. Data were usually available for the entire area, but sometimes only for selected districts/counties. Even when the unit of aggregation was large and comprehensive, contextual issues (e.g., level of development, average income) may have been masked. For example, we listed Puerto Rico as an area-within-the-US, but it is an unincorporated territory with greater levels of poverty than the remainder of the country.

Our descriptive analysis of suicides was based only on sex and age. Ideally, we would have considered factors such as race/ethnicity, income level and mental health status but these were not consistently available. Similarly, our meta-regression used relatively blunt indicators and did not consider other factors that may have explained between-country differences (e.g., gender equality, access to healthcare, rurality).

Data quality may have varied across countries/areas-within-countries. Data from more recent months may represent an undercount in suicides, although we cross-checked current and previous counts for the four months from 1st April 2020 for countries/areas-within countries that were in our earlier study[4] and found an average increase of <5%. Suicides may not have been as well captured as usual during the pandemic because of parallel events and/or resourcing issues (e.g., there are concerns that some US suicides are now being recorded as drug overdoses because they are occurring alongside the opioid crisis and medical examiners and coroners have been overwhelmed with COVID-19 deaths[35]).

Aggregating monthly data to the pre-COVID-19 and COVID-19 periods may have meant that we missed small, short term rises (or falls) in suicides. We used suicide numbers, not rates, which may have implications in countries/areas-within-countries where the population changed during the pandemic (e.g., the differential Australian state results may be partially explained by 2021 population increases in Queensland not seen elsewhere).

Although we considered the findings in the context of the COVID-19 pandemic and accounted for underlying trends, we cannot attribute causality; some of the observed changes may have happened anyway, for unrelated reasons (e.g., economic/political changes, highly-publicised celebrity suicides).

Although there are some countries/areas-within-countries where overall suicide numbers and numbers for certain sex- and age-based groups are greater than would have expected had the pandemic not occurred, these countries/areas-within-countries are in the minority. Any upward movement in suicide numbers in any place or group is concerning, and we need to remain alert to and respond to changes as the pandemic and its mental health and economic consequences continue to evolve. International efforts should be complemented by local ones that allow for closer consideration of context.

Contributors

JP, DG, AJ and MJS conceptualised, designed and led the study. SS, MDP-B, and VA conducted the internet searches for data and JP, DG and AJ followed up leads through the ICSPRC network. Additional data were sourced or provided by the following authors: PAA, AB, CB, GB, PB, RC, VC, GC, S-SC, DCo, MC-G, MC, RD, EDJ, EAD, JD, AE, JF, MF, SF, AG, GG, RGe, SKG, FH, IK, AK, KK, SCK, HK, SL, FM, AMa, EM-R, PN, NN, TN, MN, HO, RP, TP, GPo, GPs, PQ, DR, AR, CR-L, MR, NR-V, SR, VR, GS, KS, BS, NS, MS, ST, MU, DW, RTW, PW, SFPY, and RZ. MJS, JP, SS, MDP-B and VA were responsible for data verification, management and storage. MJS did the analysis. JP prepared the first draft of the manuscript with input from DG, AJ and MJS. JP, DG, AJ, MJS, SS, MDP-B, VA, PAA, LA, SMYA, EA, JLA-M, YPSB, JBa, AB, CB, JBe, GB, MB, PB, EC, RC, VC, GC, LFC, S-SC, DCo, MC-G, DCr, MC, RD, EDJ, DDL, EAD, JD, AE, JSF, MF, SF, AG, GG, RGe, RGi, MG, SKG, KH, FH, IK, NK, AK, MK, OJK, DK, KK, SCK, HK, SL, FM, AMa, AMe, EM-R, PN, NN, TN, EN, MN, HO, RCOC, RP, TP, MRP, SP, GPo, GPs, PQ, DR, AR, CR-L, MR, NR-V, SR, VR, GS, KS, BS, NS, MS, ST, ET, MU, DW, RTW, PW, SFPY, GZ and RZ interpreted data and made critical intellectual revisions to the manuscript. Access to the data were limited for data protection reasons and only made available to JP, DG, SS, MDP-B, VA, AJ, and MJS. All authors approved the final version for submission.

Data sharing statement

A version of the dataset with sensitive data redacted is provided at appendix 2. Code that reads the data into Stata, labels the variables and performs an example analysis is provided at appendix 3.

Editor note

The Lancet Group takes a neutral position with respect to territorial claims in published maps and institutional affiliations.

Declaration of interests

JP is funded by a National Health and Medical Research Council Investigator Grant (GNT1173126). DG receives funding support from the NIHR Biomedical Research Centre at University Hospitals Bristol and Weston NHS Foundation Trust. He is an unpaid member of the UK Government's Department of Health and Social Care National Suicide Prevention Strategy Advisory Group, England and the COVID-19 response sub-group, an unpaid member of the Samaritan's Policy, Partnerships and Research Committee, and an unpaid member of the Movember Global Advisory Committee. LA has a research grant to Manchester University from Health Quality Improvement Partnership, on behalf of NHS England and devolved UK governments. He is also Chair, National Suicide Prevention Strategy Advisory Group, Department of Health and Social Care. SF was Special Advisor to a Coroner for a specific investigation and is Chairperson, New Zealand Mortality Review Committee. AB is supported by the EU Erasmus+ Strategic Partnership Programme (2019-1-SE01-KA203-060571). LFC is Primary Investigator for pesticide suicide research in Malaysia funded by the Centre of Pesticide Suicide Prevention Malaysia, University of Edinburgh (Oct 2020-31 March 2022). NK is Member, National Suicide Prevention Strategy Advisory Group (England) and Topic Advisor for NICE self-harm guidelines. NK also declares research grants paid to his institution by NIHR, HQIP and DHSC for work related to the treatment and prevention of suicidal behaviour (but not directly related to the current work). OJK is supported by a Senior Postdoctoral Fellowship from Research Foundation Flanders (FWO 1257821N); payment made to institution (KU Leuven). OJK reports grants from UCB Community Health Fund, outside the submitted work. The UCB Community Health funds in this case are managed and disbursed by the King Baudouin Foundation (Belgium). Selection is by an independent jury and UCB is not involved. Payment is to the institution (KU Leuven). OJK received a waived registration fee for the 2021 International Academy of Suicide Research (IASR) Summit in Barcelona (held online), as an invited speaker (unrelated to the current work). No payment was received directly. Fee was automatically waived at registration. OJK is a member of the Samaritans Research Ethics Board (SREB); this is an unpaid role. OJK is co-chair of the Early Career Group of the International Association for Suicide Prevention (IASP). This role is unpaid, but yearly IASP membership fee is covered in return for this service role. No funds are exchanged, but membership fee is covered directly by IASP. DK reports that the Wellcome Trust has supported the Elizabeth Blackwell Institute with a ISSF grant. DK also declares a grant from the Centre for Pesticide Suicide Prevention to conduct COVID-19 related work on self-harm in Sri Lanka, and panel fees from the Department of Health and Social Care for assessing grants. 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It is not a paid position; she attends meetings as part of her responsibilities at the Puerto Rico Department of Health and is the Coordinator of the Public Policy Committee within this advisory council. The aforementioned council is a requisite with which the Puerto Rico Administration of Mental Health and Anti-Addiction Services must comply with because this Administration receives federal funding from the Substance Abuse and Mental Health Services Administration of the United States of America.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.eclinm.2022.101573.

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