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Suicide behaviors during the COVID-19 pandemic: A meta-analysis of 54 studies

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ABSTRACT

COVID-19, and efforts to mitigate its spread, are creating extensive mental health problems. Experts have speculated the mental, economic, behavioral, and psychosocial problems linked to the COVID-19 pandemic may lead to a rise in suicide behavior. However, a quantitative synthesis is needed to reach an overall conclusion regarding the pandemic-suicide link. In the most comprehensive test of the COVID-19—suicidality link to date, we meta-analyzed data from 308,596 participants across 54 studies. Our results suggested increased event rates for suicide ideation (10.81%), suicide attempts (4.68%), and self-harm (9.63%) during the COVID-19 pandemic when considered against event rates from pre-pandemic studies. Moderation analysis indicated younger people, women, and individuals from democratic countries are most susceptible to suicide ideation during the COVID-19 pandemic. Policymakers and helping professionals are advised that suicide behaviors are alarmingly common during the COVID-19 pandemic and vary based upon age, gender, and geopolitics. Strong protections from governments (e.g., implementing best practices in suicide prevention) are urgently needed to reduce suicide behaviors during the COVID-19 pandemic.

1. Introduction

The COVID-19 virus, and efforts to mitigate its spread, are creating serious mental health problems around the world. The COVID-19 pandemic is linked to alarming increases in depression and anxiety, isolation and loneliness, alcohol and cannabis misuse, and unemployment and other economic problems (e.g., Killgore et al., 2020b; Luo et al., 2020).

Negative sequelae of the pandemic are also not equally or randomly distributed across people or places. Disadvantaged and marginalized people, such as those who are Black (e.g., Bray et al., 2020) or people with pre-existing mental health problems (e.g., Taylor and Asmundson, 2020), appear especially vulnerable to the pandemic's negative psychosocial impacts.

Many experts have voiced concerns that mental, economic, behavioral, and psychosocial problems linked to the COVID-19 pandemic may contribute to a rise in suicide behaviors (e.g., McIntyre and Lee, 2020; Samson and Sherry, 2020). These include suggested increases in suicide ideation (thoughts about killing oneself), suicide attempts (non-fatal, potentially self-injurious behavior with intent to die), and self-harm

(non-fatal, deliberate, self-injurious behavior without intent to die).

1.1. Advancing research on COVID-19 and suicide

Understanding of the pandemic-suicide link is limited at present. First, non-empirical narrative reviews on COVID-19 and suicide are abundant (e.g., Gunnell et al., 2020), but these reviews do not clarify, quantitatively, how strong an impact the COVID-19 pandemic has had on suicide behaviors. Second, among empirical studies, there are notable inconsistencies in findings between studies, with some studies reporting suicide behaviors are higher (e.g., Zhang et al., 2020), and other studies reporting suicide behaviors are largely unchanged (e.g., Isumi et al., 2020). A rigorous quantitative synthesis is needed to resolve these inconsistencies and reach an overall conclusion. Third, numerous studies on COVID-19 and suicide involve smaller samples ($N = < 250$; e.g., Benatti et al., 2020), which suggests research on COVID-19 and suicide might be underpowered (see Button et al. (2013) and Ioannidis (2005) for overviews of how sample size affects power). Larger samples are needed to provide more stable estimates of the underlying population (e.g., Schönbrodt and Perugini, 2013). Fourth, moderation analyses will

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allow for greater precision in understanding the pandemic-suicide relationship. Age, sex, ethnicity, country of residence, and geopolitics (e.g., living under a democratic government or an authoritarian government) may potentially moderate the relationship between COVID-19 and suicide, clarifying who is more or less vulnerable to suicide behaviors during the COVID-19 pandemic and allowing for more targeted interventions.

1.2. Present study: objectives and hypotheses

Our objective was to conduct the most comprehensive test of the pandemic-suicidality link to date. We addressed the above-mentioned limitations by conducting a meta-analysis that comprehensively and quantitatively synthesized extant research on COVID-19 and suicide behaviors. Such a rigorous synthesis will help to resolve inconsistencies observed between studies by correcting for distorting artifacts (e.g., small samples). Moreover, meta-analytic moderation will identify potential groups differentially susceptible to suicide behaviors during the COVID-19 pandemic.

Some authors have acknowledged the possibility suicide rates may decrease during the COVID-19 pandemic, with suicide behaviors decreasing as people pull together amid shared pandemic-related adversities (Reger et al., 2020). In contrast, experts have cautioned that mental health and behavioral problems, economic stressors, and psychosocial upheaval linked to the pandemic may lead to a rise in suicide behavior (e.g., Gunnell et al., 2020). Consistent with the latter perspective, we hypothesized a serious increase in suicide behaviors has occurred during the pandemic, including increases in rates of suicide ideation, attempts, and self-harm (relative to event rates available from pre-pandemic studies). Our moderation analyses were exploratory, as there are insufficient data and theory to inform specific hypotheses.

2. Method

2.1. Selection of studies

We developed our search strategy in consultation with a Research Data Management Librarian and conducted our search in eight databases: PsycINFO, PubMed, Cumulative Index of Nursing and Allied Health Literature, Scopus, Web of Science, ERIC, Embase, and ProQuest Dissertations and Theses. We used the following search terms: (TITLE (suicid*) OR ABS (suicid*)) AND (TITLE (COVID-19 OR "2019 novel coronavirus disease" OR "COVID19" OR "SARS-CoV-2 infection" OR "2019 novel coronavirus infection" OR "2019-nCoV infection" OR "coronavirus disease 2019" OR "coronavirus disease-19" OR "2019-nCoV disease") OR ABS ((COVID-19) OR "2019 novel coronavirus disease" OR "COVID19" OR "SARS-CoV-2 infection" OR "2019 novel coronavirus infection" OR "2019-nCoV infection" OR "coronavirus disease 2019" OR "coronavirus disease-19" OR "2019-nCoV disease")). We identified 1010 studies via this search. Two additional studies were identified from the reference sections of articles identified by our initial search. We terminated our literature search and began our study screening and data extraction on November 6, 2020. The first author and a trained research assistant used the following pre-determined criteria to identify studies eligible for inclusion in the current meta-analysis: (a) contained data on suicidal behavior (i.e., ideation, attempts, self-harm) that was collected during the COVID-19 pandemic; (b) reported information to calculate the proportion of participants that endorsed suicide behavior during COVID-19; (c) written in English. We did not restrict studies for inclusion based on sample characteristics (e.g., age) or publication type. Agreement between coders on inclusion was 92.36%. We resolved discrepancies in agreement through discussion among the research team until a consensus of 100% was reached. The final dataset was comprised of 54 studies with 62 samples (see Table 1 and Fig. 1).

2.2. Coding of studies

Studies were coded on the following variables: sample size, sample type, mean age, percentage female participants, percentage White participants, study design, publication status, country, political regime and democracy index score (as per the Economist Intelligence Unit, 2020), and suicide behaviors (see Table 1). Suicide behavior included ideation, attempts, and self-harm. To calculate event rates of suicide behaviors, behaviors that were assessed on continuous scales were converted to dichotomous values (i.e., to indicate the presence or absence of a given suicide behavior). Dichotomization of continuous variables was completed because many studies included in our analyses had assessed suicide behaviors on a binary scale (e.g., Ammerman et al., 2020; Cai et al., 2020; Every-Palmer et al., 2020).

2.3. Meta-Analysis

We used Comprehensive Meta-Analysis (Borenstein et al., 2005) to calculate overall effects using random-effect models. For studies with measurement occasions occurring in both the pre-pandemic and the pandemic periods, we extracted data collected during the pandemic period, as there were not enough studies to analyze pre- to post-pandemic changes in our suicide behavior variables. For studies that assessed suicide behavior at multiple time-points during the pandemic period, we averaged the prevalence of these behaviors across measurement occasions to derive a more reliable estimate (see Card, 2016).

Homogeneity was assessed by determining the total heterogeneity of weighted mean effects (Q_T) and the total variation across studies attributable to heterogeneity (I^2). When Q_T was significant, and when there was sufficient content coverage (five or more studies for continuous moderators and three or more samples per subgroup for categorical moderators), random-effect meta-regressions with maximum likelihood estimation were used to test the moderating effect of three continuous and four categorical variables: sex (mean percentage of females), age (mean age), democracy index score (where a higher score indicates a greater level of democracy), sample type (clinical, community, and frontline), COVID-19 restriction type (various restrictions, lockdown, and quarantine), region (North America, Western Europe, and Asia-Australasia), and study design (case-control, cross-sectional, and longitudinal) on observed event rates. We refer to these analysis as "moderation" (e.g., Schmidt and Hunter, 2015; p. 317) because we tested whether point estimates for suicide behavior event rates depended on levels of the different study variables that we coded for. Eight models were tested for each suicide behavior event rate. These models included the following predictors: sex; age; sample type; democracy index score; COVID-19 restriction type; region; study design; and sex, age, sample type, democracy index score, COVID-19 restriction type, region, and study design simultaneously (Supplemental Material A). When moderators were significant, corresponding scatter plots are provided in Supplemental Material B.

2.4. Description of studies

Our search identified 54 studies (51 journal articles, two pre-prints, and one newsletter) suitable for inclusion (Table 1). All included studies were published in the year 2020. Sample size varied (range: 14 to 69,054, $M = 4977.35$, $SD = 11,897.88$). The number of participants pooled across samples was 308,596. There were 32 community samples, 21 clinical samples, and nine frontline samples. The mean sample age was 34.2 ($SD = 10.5$) years. The mean percentage of females was 57.5% ($SD = 20.1$). The mean percentage of White participants was 66.3% ($SD = 19.0$). In terms of geopolitical characteristics, 29 samples (46.8%) were located in the Asia-Australasia region, 15 samples (24.2%) in North America, 13 samples in Western Europe (21.0%), two samples (3.2%) in Eastern Europe, two samples (3.2%) in Latin America, and one sample

Table 1.
Characteristics of samples included in the meta-analysis.

	Sample					Study		Geopolitics			Measures
	N	Sampletype	Meaneage	Female %	White %	Design	Status	Country	Regime type	Democracy index	Suicide Behaviors
Acharya et al. (2020)	14	clinical	NR	4.16	NR	longitudinal	article	India	flawed democracy	6.90	attempts
Ammerman et al. (2020)	907	community	36.43	42.60	76.40	cross-sectional	pre-print	United States	flawed democracy	7.96	ideation attempts
Benatti et al. (2020)	79	clinical	39.95	44.30	NR	cross-sectional	article	Italy	flawed democracy	7.52	ideation
Benatti et al. (2020)a	44	clinical	39.75	45.50	NR	cross-sectional	article	Italy	flawed democracy	7.52	ideation
Bryan et al. (2020)	10,625	community	45.20	50.70	61.90	cross-sectional	pre-print	United States	flawed democracy	7.96	ideation attempts
Caballero-Dominguez et al. (2020)	700	community	37.10	68.00	NR	cross-sectional	article	Colombia	flawed democracy	7.13	ideation
Cai et al. (2020)	1173	frontline	NR	69.80	NR	case-control	article	China	authoritarian	2.26	ideation
Cai et al. (2020)	1173	community	30.50	70.30	NR	case-control	article	China	authoritarian	2.26	ideation
Capuzzi et al. (2020)	225	clinical	44.20	48.40	NR	longitudinal	article	Italy	flawed democracy	7.52	attempts
Crasta et al. (2020)	1003	community	40.90	72.50	82.40	cross-sectional	article	United States ^b	flawed democracy	7.96	ideation
Czeisler et al. (2020)	5412	community	NR	50.90	63.10	cross-sectional	article	United States	flawed democracy	7.96	ideation
Dragovic et al. (2020)	654	clinical	39.50	54.60	NR	longitudinal	article	Australia	full democracy	9.09	ideation self-harm
Enos (2020)	1500	clinical	NR	NR	NR	cross-sectional	newsletter	United States	flawed democracy	7.96	ideation
Every-Palmer et al. (2020)	2010	community	NR	52.90	61.20	cross-sectional	article	New Zealand	full democracy	9.26	ideation attempts
Feng et al. (2020)	671	frontline	NR	53.90	NR	cross-sectional	article	China	authoritarian	2.26	ideation
Ferrando et al. (2020)	136	clinical	37.10	45.60	43.40	cross-sectional	article	United States	flawed democracy	7.96	ideation attempts self-harm
Ferrando et al. (2020)c	65	clinical	13.80	58.50	35.40	cross-sectional	article	United States	flawed democracy	7.96	ideation attempts self-harm
Fisher et al. (2020)	13,829	community	NR	75.50	NR	cross-sectional	article	Australia	full democracy	9.09	ideation
Fitzpatrick et al. (2020)	10,368	community	NR	51.00	60.40	cross-sectional	article	United States	flawed democracy	7.96	ideation
Graell et al. (2020)	365	clinical	14.62	87.95	NR	longitudinal	article	Spain	full democracy	8.29	ideation
Gratz et al. (2020)	500	community	40.00	47.00	85.00	cross-sectional	article	United States	flawed democracy	7.96	ideation
Hamm et al. (2020)	71	clinical	69.00	68.50	76.70	longitudinal	article	United States	flawed democracy	7.96	ideation
Hao et al. (2020)	76	clinical	NR	NR	NR	case-control	article	China	authoritarian	2.26	ideation
Hao et al. (2020)e	185	community	33.10	NR	NR	case-control	article	China	authoritarian	2.26	ideation
Hong et al. (2020)	4692	frontline	NR	96.90	NR	cross-sectional	article	China	authoritarian	2.26	ideation
Hou et al. (2020)	527	community	NR	0.00	NR	cross-sectional	article	China	authoritarian	2.26	ideation attempts
Hou et al. (2020)d	332	community	NR	100.00	NR	cross-sectional	article	China	authoritarian	2.26	ideation attempts
Iob et al. (2020)	44,775	community	NR	51.00	88.30	cross-sectional	article	UK	full democracy	8.52	ideation self-harm
Jhanwar et al. (2020)	32	clinical	29.90	65.60	NR	longitudinal	article	India	flawed democracy	6.90	attempts
Killgore et al. (2020)	3120	community	NR	54.20	NR	longitudinal	article	United States	flawed democracy	7.96	ideation
Kim et al. (2020a)	72	frontline	39.20	75.00	NR	cross-sectional	article	South Korea	flawed democracy	8.00	ideation
Kim et al. (2020b)	33	clinical	45.00	NR	NR	cross-sectional	article	South Korea	flawed democracy	8.00	ideation
Lewis (2020)	179	community	NR	NR	NR	longitudinal	article	United States	flawed democracy	7.96	ideation
Li et al. (2020)	1970	community	37.81	66.20	NR	cross-sectional	article	Taiwan	flawed democracy	7.73	ideation
Mamun et al. (2020a)	834	frontline	30.70	56.00	NR	cross-sectional	article	Bangladesh	hybrid regime	5.88	ideation
Mamun et al. (2020a)e	2554	community	29.60	50.40	NR	cross-sectional	article	Bangladesh	hybrid regime	5.88	ideation
Mamun et al. (2020b)	10,067	community	29.90	43.90	NR	cross-sectional	article	Bangladesh	hybrid regime	5.88	ideation

(continued on next page)

Table 1. (continued)

	Sample					Study		Geopolitics			Measures
	N	Sampletype	Meanage	Female %	White %	Design	Status	Country	Regime type	Democracy index	
McAndrew et al. (2020)	152	clinical	NR	NR	NR	longitudinal	article	Ireland	full democracy	9.24	ideation self-harm
McIntyre et al. (2020)	576	clinical	NR	NR	NR	longitudinal	article	Ireland	full democracy	9.24	self-harm
Molina et al. (2020)	197	community	NR	NR	NR	cross-sectional	article	Cuba	authoritarian	2.84	ideation
Nalleballe et al. (2020)	40,469	clinical	NR	55.00	37.00	cross-sectional	article	United States	flawed democracy	7.96	ideation
O'Connor et al. (2020)	3077	community	NR	55.10	90.50	longitudinal	article	UK	full democracy	8.52	ideation attempts self-harm
Olding et al. (2020)	30	clinical	30.60	10.00	NR	longitudinal	article	UK	full democracy	8.52	self-harm
Pignon et al. (2020)	553	clinical	NR	47.00	NR	longitudinal	article	France	full democracy	8.12	attempts
Ren et al. (2020)	1172	community	22.00	69.30	NR	cross-sectional	article	China	authoritarian	2.26	ideation
Saiz et al. (2020)	21,207	community	39.70	69.60	NR	cross-sectional	article	Spain	full democracy	8.29	ideation
Sharif et al. (2020)	375	frontline	NR	NR	NR	cross-sectional	article	NR ^f	–	–	ideation
Smalley et al. (2020)	2477	clinical	NR	NR	NR	longitudinal	article	United States	flawed democracy	7.96	ideation
Staples et al. (2020)	5455	clinical	35.40	75.50	NR	longitudinal	article	Australia	full democracy	9.09	ideation
Talarowska et al. (2020)	443	community	31.90	78.60	NR	cross-sectional	article	Poland	flawed democracy	6.62	ideation
Tan et al. (2020)	673	community	30.80	25.60	NR	cross-sectional	article	China	authoritarian	2.26	ideation
Teksin et al. (2020)	452	frontline	35.80	66.20	NR	cross-sectional	article	Turkey	hybrid regime	4.09	ideation
Wang et al. (2020)	1994	community	22.88	61.64	NR	cross-sectional	article	United States	flawed democracy	7.96	ideation
Wathelet et al. (2020)	69,054	community	20.00	72.80	NR	cross-sectional	article	France	full democracy	8.12	ideation
Winkler et al. (2020)	3021	community	46.84	52.33	NR	longitudinal	article	Czech Republic	flawed democracy	7.69	ideation
Xiaoming et al. (2020)	8817	frontline	33.25	78.00	NR	cross-sectional	article	China	authoritarian	2.26	ideation
Xin et al. (2020)	23,863	community	NR	NR	NR	cross-sectional	article	China	authoritarian	2.26	ideation
Xin et al. (2020) ^g	515	community	NR	NR	NR	cross-sectional	article	China	authoritarian	2.26	ideation
Zhang et al. (2020)	1241	community	12.60	40.70	NR	longitudinal	article	China	authoritarian	2.26	attempts self-harm
Zhao et al. (2020)	106	clinical	35.90	56.60	NR	cross-sectional	article	China	authoritarian	2.26	ideation
Zhou et al. (2020)	606	frontline	NR	81.20	NR	cross-sectional	article	China	authoritarian	2.26	ideation
Zhou et al. (2020) ^e	1099	community	29.23	NR	NR	cross-sectional	article	China	authoritarian	2.26	ideation

Note. NR = not reported; N = total number of participants; clinical samples are comprised of help-seeking individuals; mean age is expressed in years; Female% = percentage female; White% = percentage White; Status = publication status of study; Country = participants' country; Regime type = form of government; Democracy index = democracy index weighted average, based on a nation's electoral process and pluralism, civil liberties, functioning of government, political participation, and political culture (higher scores represent more democratic political regimes); Suicide Behaviors = type of suicide behavior assessed.

^a Patients with worsening obsessive-compulsive disorder symptoms

^b 97.3% of sample was from the United States.

^c Child and adolescent sample.

^d Female sample.

^e Community sample.

^f Respondents from 52 countries.

^g Quarantined subsample.

was comprised of participants from 52 different countries (1.6%). Most samples (n = 26; 41.9%) were from countries with “flawed” democratic political regimes, 18 samples (29.0%) were from countries with “authoritarian” regimes, 13 samples (21.0%) were from “full democratic” regimes, and four samples (6.5%) were from counties with “hybrid” regimes. The political regime of one sample (1.6%) was not classified because its participants were from 52 different countries. The

mean democracy index score (Economist Intelligence Unit, 2020) was 6.19 (SD = 2.68). In terms of suicide behavior, the presence of suicide ideation was assessed in 55 samples, suicide attempts in 13 samples, and self-harm in nine samples.

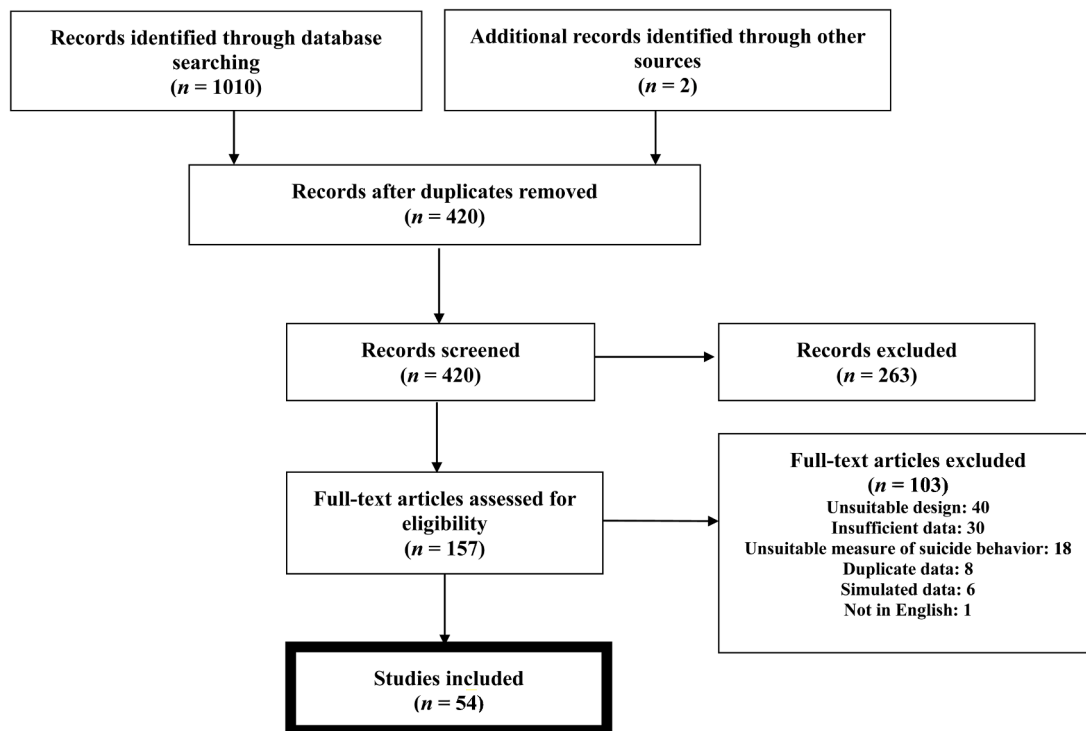


Fig. 1. Study selection procedure.

2.5. Suicide behaviors

Suicide ideation was measured by self-report ($k = 38$; 69.1%), medical record review ($k = 7$; 12.7%), and psychiatric evaluation or interview ($k = 5$; 9.1%); the method for assessing suicide ideation was unreported for five samples (9.1%). Suicide attempts were measured by

self-report ($k = 6$; 46.2%), medical record review ($k = 6$; 46.2%), and semi-structured interview ($k = 1$; 7.6%). Self-harm was measured by medical record review ($k = 6$; 66.7%) and self-report ($k = 3$; 33.3%).

Table 2.

Summary of overall effect sizes for suicide ideation, suicide attempts, and self-harm during the COVID-19 pandemic.

Variable	k	Events/Total	Event Rate	95% CI	Q_T	I^2 (%)	Egger's intercept	95% CI	k^{TF}	"Trim and fill" estimates [95% CI]
<i>Combined samples</i>										
Suicide ideation	55	34,435 / 305,926	10.81%	[9.325; 12.504]	8715.72***	99.38	-2.99	[-7.54; 1.56]	0	10.812% [9.325; 12.504]
Suicide attempts	13	486 / 19,744	4.68%	[2.346; 9.118]	595.01***	97.98	2.39	[-6.19; 10.98]	0	4.680% [2.346; 9.118]
Self-harm	9	2980 / 50,706	9.63%	[9.626; 23.227]	2116.50***	99.62	5.42	[-11.40; 22.24]	1	7.671% [2.977; 18.366]
<i>Community samples</i>										
Suicide ideation	30	30,452 / 236,366	11.84%	[10.082; 13.848]	5189.47***	99.44	-3.20	[-10.40; 4.00]	0	11.836% [10.082; 13.848]
Suicide attempts	7	361 / 18,719	2.68%	[1.232; 5.712]	294.91***	97.97	2.06	[-16.86; 20.98]	2	1.581% [0.643; 3.838]
Self-harm	3	2782 / 49,093	6.11%	[0.796; 34.587]	1934.97***	99.90	13.97	[-487.02; 514.96]	0	6.114% [0.796; 34.587]
<i>Clinical samples</i>										
Suicide ideation	16	2750 / 51,868	10.70%	[5.809; 18.869]	2286.40***	99.34	-4.93	[-13.74; 3.89]	0	10.695% [5.809; 18.870]
Suicide attempts	6	125 / 1025	10.87%	[4.774; 22.875]	64.12***	91.20	-1.55	[-9.09; 5.99]	0	10.868% [4.774; 22.875]
Self-harm	6	198 / 1613	12.03%	[6.452; 21.315]	70.05***	92.86	-2.40	[-11.31; 6.52]	0	12.025% [6.452; 21.32]
<i>Frontline samples</i>										
Suicide ideation	9	1233 / 17,692	6.96%	[5.473; 8.820]	102.104***	92.16	0.04	[-5.11; 5.19]	0	6.962% [5.473; 8.882]
Suicide attempts	0	—	—	—	—	—	—	—	—	—
Self-harm	0	—	—	—	—	—	—	—	—	—

Note. k = number of included samples; *Events/Total* = number of participants reporting a behavior relative to the total number of participants; *CI* = confidence interval; Q_T = measure of heterogeneity; I^2 = percentage of heterogeneity; k^{TF} = number of imputed studies as part of "trim and fill" method.

* $p < .05$. ** $p < .01$. *** $p < .001$.

3. Results

3.1. Meta-Analysis

The overall weighted mean prevalence rates of suicide ideation, suicide attempts, and self-harm during COVID-19 appear in Table 2. The event rate for suicide ideation was 10.81% for the combined samples; it was 11.84%, 10.70%, and 6.96% for community, clinical, and frontline samples, respectively. For suicide attempts, the event rate was 4.68% for the combined samples, 2.68% for the community samples, and 10.87% for the clinical samples. The event rate for self-harm was 9.63% in the combined samples, 6.11% in the community samples, and 12.03% for the clinical samples. The percentage of total heterogeneity across samples ranged from 91.20% to 99.90%, suggesting the potential influence of moderators on certain prevalence rates.

3.2. Moderator analysis

After the inclusion of covariates, meta-regressions revealed the following. The sex of participants moderated the prevalence of suicide ideation during the pandemic (see Supplementary Table A1), indicating the prevalence of ideation increased as the mean percentage of female participants in the sample increased ($B^1 = 2.19, p = .036$; Supplementary Figure B1). Likewise, mean age and democracy index score moderated the prevalence of suicide ideation during the pandemic, such that the prevalence of ideation increased as sample age decreased ($B = -0.29, p = .015$; Supplementary Figure B2) and the prevalence of ideation increased as the democracy index score increased ($B = 0.15, p = .004$; Supplementary Figure B3).

Regarding other suicide behaviors, democracy index scores also moderated the prevalence of suicide attempts during the pandemic, suggesting the prevalence of attempts decreased as the democracy index score increased ($B = -0.57, p = .040$; Supplementary Figure B4). Mean age and democracy index score moderated the prevalence of self-harm, such that the prevalence of self-harm decreased as age increased ($B = -0.04, p = .020$; Supplementary Figure B5), and the prevalence of self-harm decreased as democracy index score increased ($B = -0.17, p = .004$; Supplementary Figure B6).

As Supplementary Table A1 shows, meta-regression indicated suicide ideation was more prevalent in clinical vs community and frontline samples (see Supplementary Figure B7). Suicide ideation was also more prevalent in Asia-Australasia and in North America vs Western Europe (see Supplementary Figure B8). Results also indicated the prevalence of suicide attempts was significantly higher in clinical versus community samples (see Supplementary Figure B9).

3.3. Publication bias

Funnel plots (see Supplemental Material C) and Egger's regression intercepts (see Table 2) provided mixed evidence for publication bias. Egger's regression intercept was non-significant for all effects.

4. Conclusion

Experts caution mental health and behavioral problems, serious economic difficulties, and multiple psychosocial stressors linked to the COVID-19 pandemic may lead to a rise in suicide behaviors (Gunnell et al., 2020; McIntyre and Lee, 2020). But narrative reviews, inconsistent findings, and underpowered studies have clouded understanding of

the prevalence of suicide behaviors during the COVID-19 pandemic. We addressed these limitations by conducting a rigorous meta-analytic review of suicide behavior rates during the COVID-19 pandemic. Findings derived from 308,596 participants and 54 studies suggested suicide ideation, suicide attempts, and self-harm have increased during the COVID-19 pandemic (relative to event rates from pre-pandemic studies), with younger people, women, and individuals from democratic countries appearing most vulnerable to suicide ideation.

4.1. Advancing understanding of COVID-19 and suicide

Consistent with hypotheses, our meta-analysis suggested increased event rates for suicide ideation, suicide attempts, and self-harm during the COVID-19 pandemic. These event rates are high in relation to pre-pandemic studies; for example, Liu et al. (2020) in their pre-pandemic meta-analysis of nine studies and 40,292 participants, concluded: "approximately one in 20 individuals in the general population experience passive ideation in any given year" (p. 374). However, amid the COVID-19 pandemic, an estimated 11.84% of community members are experiencing suicide ideation (see Table 2). This suggests that during the COVID-19 pandemic 2.37 in 20 individuals in the general population are experiencing suicide ideation. Put differently, whereas Lui et al.'s (2020) 12-month rate of suicide ideation was 5.81% for community members, our observed rate of suicide ideation for a similar group was 11.84% during the COVID-19 pandemic.

The magnitude of the difference between suicide behaviors before and during the COVID-19 pandemic will depend, in part, on the comparison made. Such comparisons also are much less rigorous than longitudinal data, which we did not cover in the current study due to insufficient data. Thus, pre- to post-pandemic comparisons should be interpreted with great caution. That said, in examining several pre-pandemic meta-analyses of suicide behaviors (e.g., Castillejos et al., 2020; Liu et al., 2020), our observed event rates for suicide ideation, suicide attempts and self-harm stand out as elevated and point toward a serious crisis in suicide behaviors occurring during the COVID-19 pandemic. As most participants in our study reported on their suicide behaviors for a relatively brief time period (i.e., the early days of the COVID-19 pandemic as opposed to reporting on their suicide behaviors for a full 12-months of the pandemic), it is also possible a longer reporting time period would capture an even higher prevalence of suicide behaviors.

We also brought greater specificity to understanding the pandemic-suicidality link, with our moderation analyses suggesting younger individuals, women, and those residing in democratic countries are more vulnerable to suicide behaviors during the COVID-19 pandemic. This complements a wider literature suggesting COVID-19's negative impacts are felt disproportionately by some people or in some places (e.g., Bray et al., 2020). In a pandemic where so many are in need, these findings can inform more targeted interventions. Finally, the degree to which a country is democratic appears pivotal in understanding the pandemic-suicide link, with suicide ideation increasing and suicide attempts and self-harm decreasing as democracy increases. There is much to learn about how political systems, public health measures, healthcare, media, and perceived or actual loss of control and freedom influence how suicide behaviors manifest during the COVID-19 pandemic.

4.1. Limitations and future directions

Most included studies were cross-sectional, meaning our meta-analysis offers a static picture of an evolving pandemic and suggests more multi-wave longitudinal studies are needed. The absence of such studies from our analyses precludes us making any strong statements about changes from before to after the pandemic. Mono-source designs were also common in our included studies, leaving our results vulnerable to the distorting influence of potentially biased self-reporting and

¹ The point estimate, B , represents the rate of change in the "log odds" of an event as the independent variable changes. For example, the effect of sex is $e^{2.19} = 8.93$, which means that a one-unit change in the mean percentage of female participants would make suicide ideation during the COVID-19 pandemic 8.93 times more likely (0.899/0.101) to occur.

indicating a need for alternative methods (e.g., informant reports). Additionally, included studies involved mainly younger (mean age of 35.3, $SD = 11.7$), female, and White participants, placing limits on the generalizability of our results, and underlining the need to study the pandemic-suicide link in more diverse samples. Finally, reliable data regarding deaths by suicide during the COVID-19 pandemic were scarce at the time of writing and are therefore absent from our analyses. Future research could use population level statistics (e.g., from national census bureaus and/or police databases) to determine the prevalence of deaths by suicide during the pandemic once these data are available.

4.2. Implications

Both policymakers and helping professionals are advised that suicide behaviors are rising during the COVID-19 pandemic. It is challenging to identify (Franklin et al., 2017) and to treat (Fox et al., 2020) an individual who is likely to die by suicide, perhaps especially during a pandemic that can monopolize healthcare resources and that can discourage help-seeking (e.g., due to COVID-19 contamination fears or lockdown conditions). Despite the difficulty in doing so, population-wide, evidence-based public health interventions designed to prevent suicide should be implemented during the COVID-19 pandemic, such as limiting access to lethal means (e.g., guns) and to suicide-linked substances (e.g., alcohol; see Gunnell et al., 2020). Strong and continued protections from governments against economic stressors (e.g., protections against unemployment or loss of income) are also needed to reduce suicide behaviors during the COVID-19 pandemic (see Norström & Grönqvist, 2015). Consistent with Wang et al. (2021), we believe our findings speak to the importance of adopting measures to mitigate the psychological burden of living amidst a pandemic. These measures include psychoeducation about the impact of individual behaviors on mental health (e.g., media consumption; Burhamah et al., 2020), increased access to mental health supports and effective prevention programs that reduce suicidal ideation for vulnerable groups (e.g., Kelly et al., 2020), and normalizing help-seeking behavior (Schwartz et al., 2020).

4.3. Conclusions

Our meta-analysis provides the most comprehensive test of the pandemic-suicide ideation link to date. COVID-19, and efforts to mitigate its spread, are linked to a rise in suicide behavior, including increased event rates for suicide ideation, suicide attempts, and self-harm. In particular, our results suggest younger people, women, and individuals from democratic countries are most vulnerable to suicide ideation during the COVID-19 pandemic. Our study also aligns with theory and research indicating that the mental, economic, behavioral, and psychosocial problems linked to the COVID-19 pandemic are tied to a rise in suicide behaviors relative to event rates from pre-pandemic meta-analyses.

Suicide COVID19 MA Supplemental.docx

Table A1 Mean percentage of female participants, mean sample age, sample type, democracy index score, restrictions, region, and study design as moderators of the proportion of suicide behaviors during COVID-19

Figure B1. Suicide ideation prevalence regressed on percentage female controlling for mean age, sample type, democracy index, restrictions, region, and study design.

Figure B2. Suicide ideation prevalence regressed on mean age controlling for percentage female, sample type, democracy index, restrictions, region, and study design.

Figure B3. Suicide ideation prevalence regressed on democracy index score controlling for mean age, percentage female, sample type, restrictions, region, and study design. For democracy score, higher scores

indicate more democratic political regimes.

Figure B4. Regression of Logit event rate for suicide attempt on Democracy index, where higher scores represent more democratic political regimes.

Figure B5. Self-harm prevalence regressed on mean age controlling for democracy index score, where higher scores represent more democratic political regimes.

Figure B6. Regression of Logit event rate for self-harm on Democracy index, where higher scores represent more democratic political regimes.

Figure B7. Suicide ideation prevalence regressed on sample type controlling for mean age, percentage female, democracy index, restrictions, region, and study design.

Figure B8. Suicide ideation prevalence regressed on region controlling for mean age, percentage female, sample type, restrictions, democracy index, and study design.

Figure B9. Suicide attempt prevalence regressed on sample type controlling for mean age, percentage female, democracy index, and study design.

Figure C1. Funnel plot for suicide ideation prevalence with imputed studies. Open circles correspond to observed point estimates. The expected direction of missing studies was to the left of the mean.

Figure C2. Funnel plot for suicide attempt prevalence with imputed studies. Open circles correspond to observed point estimates. Filled circles corresponds to the imputed point estimates. The expected direction of missing studies was to the left of the mean.

Figure C3. Funnel plot for self-harm prevalence with imputed studies. Open circles correspond to observed point estimates. Filled circles corresponds to the imputed point estimates. The expected direction of missing studies was to the left of the mean.

Authorship contribution statement

Justin Dubé, Dr. Martin Smith, and Dr. Simon Sherry were involved in research conception and design, data analysis, and the interpretation of the results. Justin Dubé was involved in data collection. Dr. Sherry Stewart and Dr. Paul Hewitt were involved with data analysis and interpretation of the results. All authors contributed to the writing and the revision of the manuscript.

Declaration of Competing Interest

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2021.113998.

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