Comparison of paediatric emergency department visits for attempted suicide, self-harm, and suicidal ideation before and during the COVID-19 pandemic: a systematic review and meta-analysis

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Summary

Background There is a lack of consensus about the effect of the COVID-19 pandemic on the mental health of children and adolescents. We aimed to compare rates of paediatric emergency department visits for attempted suicide, self-harm, and suicidal ideation during the pandemic with those before the pandemic.

Methods For this systematic review and meta-analysis, we searched MEDLINE, Embase, and PsycINFO for studies published between Jan 1, 2020, and Dec 19, 2022. Studies published in English with data on paediatric (ie, those aged <19 years) emergency department visits before and during the COVID-19 pandemic were included. Case studies and qualitative analyses were excluded. Changes in attempted suicide, self-harm, suicidal ideation, and other mental-illness indicators (eg, anxiety, depression, and psychosis) were expressed as ratios of the rates of emergency department visits during the pandemic compared with those before the pandemic, and we analysed these with a random-effects meta-analysis. This study was registered with PROSPERO, CRD42022341897.

Findings 10 360 non-duplicate records were retrieved, which yielded 42 relevant studies (with 130 sample-estimates) representing 11·1 million emergency department visits for all indications of children and adolescents across 18 countries. The mean age of the samples of children and adolescents across studies was 11·7 years (SD 3·1, range 5·5–16·3), and there were on average 57·6% girls and 43·4% boys as a proportion of emergency department visits for any health reasons (ie, physical and mental). Only one study had data related to race or ethnicity. There was good evidence of an increase in emergency department visits for attempted suicide during the pandemic (rate ratio 1·22, 90% CI 1·08–1·37), modest evidence of an increase in emergency department visits for suicidal ideation (1·08, 0·93–1·25), and good evidence for only a slight change in self-harm (0·96, 0·89–1·04). Rates of emergency department visits for other mental-illness indications showed very good evidence of a decline (0·81, 0·74–0·89), and paediatric visits for all health indications showed strong evidence of a reduction (0·68, 0·62–0·75). When rates for attempted suicide and suicidal ideation were combined as a single measure, there was good evidence of an increase in emergency department visits among girls (1·39, 1·04–1·88) and only modest evidence of an increase among boys (1·06, 0·92–1·24). Self-harm among older children (mean age 16·3 years, range 13·0–16·3) showed good evidence of an increase (1·18, 1·00–1·39), but among younger children (mean age 9·0 years, range 5·5–12·0) there was modest evidence of a decrease (0·85, 0·70–1·05).

Interpretation The integration of mental health support within community health and the education system—including promotion, prevention, early intervention, and treatment—is urgently needed to increase the reach of mental health support that can mitigate child and adolescent mental distress. In future pandemics, increased resourcing in some emergency department settings would help to address their expected increase in visits for acute mental distress among children and adolescents.

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Introduction

"Are the kids all right?" has been a repeated media headline and frequent discussion point during the COVID-19 pandemic. Stress, unpredictability, and disruptions can be precipitants of mental distress and psychiatric illness. During the pandemic, children and adolescents have had to endure repeated disruptions to schooling, social life, peer-group interactions, and extracurricular activities. Individual and family-level risk factors for paediatric mental distress have also increased during the pandemic, including increased screen time,[1] reduced physical activity,[2] and decreases in perceived connectedness to family and peers,[3] as well as increases in family violence,[4] parental depression and anxiety,[5] parental alcohol consumption,[6] parents losing jobs or facing disruptions, and caregiver death.[7] In population-based

Research in context

Evidence before this study

We searched MEDLINE, Embase, and PsycINFO for studies published in English reporting COVID-19-related differences in paediatric (ie, those aged <19 years) emergency department visits for severe mental distress, including attempted suicide, self-harm, suicidal ideation, and other mental-illness indicators (eg, anxiety, depression, and psychosis) published between Jan 1, 2020, and Dec 19, 2022. The main search terms were related to mental health (eg, "suicidal behavio(u)r", "psychological distress"), paediatric population groups (eg, "child" and "adolescent"), and coronavirus disease (eg, "COVID-19"). We found many independent studies comparing differences in emergency department visits for severe mental distress from periods before and during the COVID-19 pandemic, but no meta-analyses. Consequently, no cross-study quantitative estimate of COVID-19-related changes in child and adolescent psychiatric emergency department visits exists.

Added value of this study

To our knowledge, this systematic review and meta-analysis provides the first comprehensive synthesis of published studies reporting COVID-19-related changes in the absolute numbers of paediatric emergency department visits for attempted suicide, self-harm, suicidal ideation, and other mental-illness-related indicators. We included 42 studies representing 11·1 million unique paediatric emergency department visits for all indications across 18 countries. We found an overall reduction in paediatric emergency department visits during the COVID-19 pandemic (rate ratio 0·68, 90%CI 0·62–0·75), but we found good evidence that emergency department visits for suicide attempts increased (1·22, 1·08–1·37). Rates of emergency department visits for other mental-illness indications showed very good evidence of a decline (0·81, 0·74–0·89). We also found good evidence that the change in emergency department visits for suicidal ideation or attempt was larger for girls than for boys. Rates of self-harm increased among older children, but they decreased among younger children. By statistically pooling the available literature, this synthesis can more conclusively determine that indices of attempted suicide, self-harm, and suicidal ideation in children and adolescents have increased during the COVID-19 pandemic compared with before the pandemic.

Implications of all the available evidence

The COVID-19 pandemic represents a sociohistorical event with considerable implications for paediatric mental health. This study highlights the importance of, and need for, improved prevention strategies and greater sources of support for acute mental illness in children and adolescents.

samples, paediatric depression and anxiety[8] and eating disorders[9] have also been estimated to have increased during the pandemic.

Estimates of COVID-19-related change in indices of severe mental distress—including attempted suicide, self-harm, and suicidal ideation—have varied in the literature. Some authors report decreases in severe mental distress,[10–12] or no clear change,[13–16] whereas others report increases among children and adolescents, especially adolescent girls.[17–20] Changes in emergency department presentations for severe mental distress have also evolved during the pandemic; initial reports suggested a decline from March to May, 2020, whereas increases were documented, especially among girls, in June to December, 2020.[21] These discrepancies have fuelled confusion and have probably contributed to delays in public health and policy responses to address paediatric mental distress in the aftermath of the pandemic.[22] Such delays are concerning, since pre-pandemic world data indicate that suicide was the third leading cause of death in adolescent girls aged 15–19 years and the fourth leading cause of death in adolescent boys aged 15–19 years.[23] Moreover, there is evidence that suicidal ideation and self-harm were highly prevalent before the COVID-19 pandemic: one in seven adolescents aged 12–16 years reported that they had contemplated suicide,[24] and one in six adolescents aged 13–18 years reported that they engaged in self-harm behaviour.[25] More recent data indicate that one in three adolescent girls and one in seven adolescent boys had seriously considered attempting suicide in the past year, and rates of death by suicide in 13–17 year olds increased from July to December, 2020.[26]

To prepare and execute pandemic recovery policies adequately, and to determine resource allocation, explicit calls have been made to better understand the extent, severity, and pervasiveness of attempted suicide, self-harm, and suicidal ideation during the pandemic.[22] Although numerous published studies compare differences in mental-illness-related emergency department visits before and during the COVID-19 pandemic, to our knowledge, no systematic review or meta-analysis exists. Thus, our primary objective was to conduct a systematic review and meta-analysis of the published literature to quantify pandemic-related changes in paediatric emergency department visits for attempted suicide, self-harm, and suicidal ideation. We focused primarily on these three emergencies because they represent the most severe, and potentially fatal, forms of mental distress. Research suggests that girls and adolescents are more likely to visit the emergency department for severe mental distress compared with boys and younger children.[21,25] Therefore, our secondary objective was to estimate whether COVID-19-related changes in rates of attempted suicide, self-harm, and suicidal ideation differed among sociodemographic moderators.

Methods

Definitions of suicide-related outcomes

The terminology used to describe self-harm varies across settings and studies. Some studies apply self-harm as an umbrella term including all self-injurious behaviour regardless of suicidal intent; others reserve the term exclusively for non-suicidal self-injurious behaviour. As we were unable to examine the intent of self-harm at the level of individual participants, the outcome of self-harm was based on study-defined classifications and descriptions. Our definitions of suicide-related outcomes were consistent with approaches in other meta-analyses (appendix p 3).

Search strategy and selection criteria

We searched MEDLINE, Embase, and PsycINFO for English-language sources published between Jan 1, 2020, and May 17, 2022 (appendix p 4), and updated the search for studies on Dec 19, 2022. The search terms were related to mental health (eg, "suicidal behavio(u)r", "psychological distress"), paediatrics (eg, "child" and "adolescent"), and coronavirus disease (eg, "COVID-19"); the full search strategy for MEDLINE is in the appendix (p 4; searches of Embase and PsycINFO were similar to that of MEDLINE). To identify additional studies, we hand-searched reference lists of included studies. This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.[27] Retrieved studies were imported into Covidence software (Covidence; Melbourne, VIC, Australia) for title and abstract review. Studies were included if they reported emergency department visit data on attempted suicide, self-harm, or suicidal ideation, had data for before and during the COVID-19 pandemic, were for paediatric samples (ie, those aged <19 years), and were published in English. No lower age limit was applied to these inclusion criteria. Case studies and qualitative analyses were excluded. Titles and abstracts were reviewed by independent coders (SM, PP, JH, and BA; mean random agreement probability 92%). Full-text articles were reviewed by at least two independent coders (SM, PP, JH, and BA; mean random agreement probability 88%). Discrepancies were resolved via consensus between SM and PP.

The National Institute of Health Quality Assessment Tool for Observation Cohort and Cross-Sectional Studies was used to assess study quality. Studies were scored 0 (criterion unmet) or 1 (criterion met) for ten criteria and summed to derive a total score ranging from 0 to 10 (appendix p 6).

Data extraction and preparation

Summary data extracted from each study were the following: authors; year of publication; study characteristics (eg, country, setting, and duration of data collation); sample characteristics (eg, age, sex, race and ethnicity, and socioeconomic status); numbers of emergency department visits before and during the COVID-19 pandemic for attempted suicide, self-harm, and suicidal ideation; visits for other mental-illness-related reasons (eg, depression, anxiety, and psychosis; appendix p 5); total visits for any health reason (ie, mental or physical); and percentage differences or rate ratios (RRs) and their CIs associated with the onset of the COVID-19 pandemic (if the numbers of visits and time period for data collation were not reported). Data were extracted by two independent coders (PP and JH; intercoder agreement 87%) and discrepancies were resolved via consensus between the two coders.

Rates of emergency department visits before and during the COVID-19 pandemic were calculated by dividing the number of emergency department visits by the time period for data collation. RRs were calculated by dividing the rate during the COVID-19 pandemic by the pre-COVID-19 rate and were then log-transformed. RR SEs were calculated by taking the square root of the sum of the reciprocals of the absolute numbers of emergency department visits before and during the COVID-19 pandemic. When the RR but not the numbers of visits was reported in a study, the SE was derived from the CI of the ratio.

Data analysis

A random-effects meta-analysis model was prepared using the mixed-model procedure (Proc Mixed) in SAS OnDemand for Academics (version 9.4). In the primary meta-analysis, the dependent variable was the log of the sample-estimate RR. Sample-estimates were weighted by the inverse square of their SEs using the approach of Yang,[28] in which the random effects were estimated by setting the residual variance to unity.

A single fixed effect represented the category of emergency department visits at five levels: attempted suicide, self-harm, suicidal ideation, other mental-illness-related indications, and total health visits for any reason. The random effects were study identity and sample-estimate identity within studies (with separate variances specified for each category of emergency department visit); this parsimonious random-effects model allowed for RRs to be similar within settings compared with differences between settings. The square root of the sum of study and sample-estimate variances provided the τ statistic as an estimate of heterogeneity preferable to the I^2 statistic; heterogeneity was also assessed by combining the τ and the uncertainty in the mean into a confidence (prediction) interval for the RR in any given individual setting.[29,30]

There were insufficient study estimates with different values of a given moderator to include the moderator in an analysis with all category levels of emergency department visits. Sufficient data for meta-analysing the moderating effects of sex (ie, male and female) and geographical location (eg, North America and Europe) were obtained by combining counts for suicide attempts or suicidal ideation into a single measure of suicidal

ideation or attempt. The only other effects that could be meta-analysed were the moderating associations between age and sex and changes in self-harm. For the moderation analysis by age, age was assumed to have a numeric linear effect, and the magnitude of the effect was evaluated by predicting and comparing the RRs for self-harm for ages 1 SD less than and 1 SD more than the mean age.[31] For moderators with insufficient data for meta-analysis, we summarised the magnitude of rate changes from available studies.

	Country	Visit categories	Data collection periods	
			Before COVID-19	During COVID-19
Ashworth et al (2022)[34]	UK	Suicidal ideation and self-harm	March, 2019, to March, 2020	March, 2020, to March, 2021
Berger et al (2022)[35]	Switzerland	Suicidal ideation and self-harm	2019	2020
Bergmans and Larson (2021)[36]	USA	Self-harm	2015 to 2019	2020
Bortoletto et al (2022)[37]	Italy	Suicidal ideation	2018 and 2019	2020
Bothara et al (2021)[38]	New Zealand	Suicidal ideation and self-harm	Feb 15 to March 18, 2020	March 26 to April 28, 2020
Bozzola et al (2022)[39]	Italy	Suicidal ideation	March, 2019, to March, 2020	March, 2020, to March, 2021
Brewer et al (2022)[40]	USA	Suicidal ideation	November, 2017, to August, 2019	September, 2019, to June, 2021
Broomfield et al (2021)[41]	USA	Suicidal ideation	2019	2020
Bruns et al (2022)[11]	Germany	Self-harm and suicide attempt	2017 to 2019	2020
Carison et al (2022)[42]	Australia	Suicidal ideation	2018 and 2019	2020
Clavenna et al (2022)[43]	Italy	Self-harm	2019	2020
Corrigan et al (2022)[19]	Australia	Self-harm	2015 to 2020	2020
Cozzi et al (2022)[44]	Italy	Suicide attempt	2019 and 2020	2020 and 2021
Davico et al (2021)[45]	Italy	Suicidal ideation	2019	2020
DeLaroche et al (2021)[13]	USA	Suicidal ideation	2017 to 2019	2020
Díaz de Neira et al (2021)[46]	Spain	Suicidal ideation, self-harm, and suicide attempt	2019	2020
Edgcomb et al (2022)[16]	USA	Suicidal ideation	2019	2020
Ferrando et al (2021)[10]	USA	Suicidal ideation, self-harm, and suicide attempt	2020	2020
Gill et al (2021)[14]	USA	Self-harm	2017 to 2019	2020
Gracia et al (2021)[17]	Spain	Suicide attempt	2019	2020
Hill et al (2021)[47]	USA	Suicidal ideation and suicide attempt	2019	2020
Hiscock et al (2022)[20]	Australia	Self-harm	January, 2018, to March, 2020	March, 2020, to October, 2020
Ibeziako et al (2022)[48]	USA	Suicidal ideation and suicide attempt	March, 2019, to February, 2020	March, 2020, to February, 2021
Kemerer et al (2021)[49]	Ireland	Self-harm and suicide attempt	2019	2020
Kim et al (2022)[50]	South Korea	Suicide attempt	2018 to 2020	2020
Kim et al (2022)[15]	South Korea	Self-harm	2019	2020
Kirič et al (2022)[51]	Slovenia	Suicidal ideation and suicide attempt	March to December, 2019	March to December, 2020
Llorca-Bofí et al (2022)[52]	Spain	Suicidal ideation and suicide attempt	Jan 13 to March 14, 2020	March 15 to June 20, 2020
Mayne et al (2021)[18]	USA	Suicidal ideation	2019	2020
McDonnell et al (2022)[53]	Ireland	Self-harm	2019 to 2020	2020 to 2021
Miles and Zettl (2021)[54]	USA	Suicidal ideation and suicide attempt	2017 to 2019	2020
Ougrin et al (2022)[12]	Multiple*	Self-harm	March and April, 2019	March and April, 2020
Padela and Jyothish (2022)[55]	UK	Self-harm and suicide attempt	2019	2020
Petruzzelli et al (2022)[56]	Italy	Self-harm and suicide attempt	July to December, 2019	July to December, 2020
Ridout et al (2021)[21]	USA	Suicidal ideation and suicide attempt	Jan 1 to March 9, 2019, and March 10 to Dec 15, 2019	Jan 1 to March 9, 2020, and March 10 to Dec 15, 2020
Rodd and Graudins (2021)[57]	Australia	Self-harm	2019	2020
Shankar et al (2022)[58]	USA	Self-harm	2018 and 2019	2020
Sokoloff et al (2021)[59]	USA	Suicidal ideation	2018 and 2019	2020
Steeg et al (2021)[60]	UK	Self-harm	2019	2020 and 2021
Sveticic et al (2021)[61]	Australia	Self-harm	2019	2020
Wells et al (2022)[62]	USA	Suicide attempt	March 15, 2017, to March 14, 2020	March 15, 2020, to March 14, 2021
Zhang et al (2022)[63]	Canada	Self-harm	2019	2020

*The study by Ougrin et al (2022)[12] incorporated patient-records data received from hospital emergency departments in ten countries: England, Scotland, Ireland, Austria, Italy, Hungary, Serbia, Türkiye, Oman, and the United Arab Emirates.

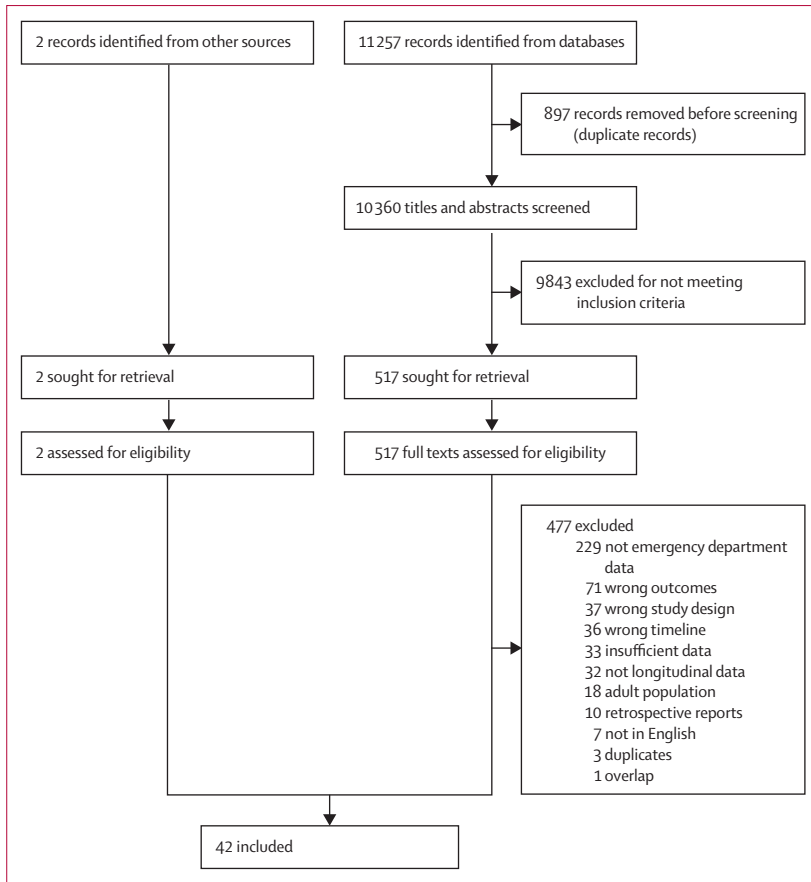*Table 1:* Characteristics of the included studies

Figure 1: Study profile

The meta-analysed effects and heterogeneity (τ) were back-transformed to RRs. We predefined thresholds for interpreting confidence limits of large (<0·50), moderate (0·50 to <0·70), small (0·70 to <0·90), and slight (0·90 to <1·00) rate decreases, and slight (1·00 to <1·11), small (1·11 to <1·43), moderate (1·43 to <2·00), and large (≥2·00) rate increases. Thresholds for interpreting confidence limits of τ are the square root of those for rate increases. Further justification for thresholds is described in the appendix (p 8). Precision of estimation is expressed as 90% CIs, as favoured by Rothman.[32] We inferred the magnitude of effects by interpreting the lower and upper confidence limits, which are consistent with an alpha of 0·05 (a maximum error rate of 5%) for rejection of significant and non-significant hypotheses.[33] If the lower and upper limit of the 90% CI for a meta-analysed mean (or τ) was substantial and of opposite direction (ie, both positive and negative), the ratio was deemed unclear (failure to reject a substantial hypothesis); otherwise, the ratio was deemed to have adequate precision at the 90% level.[33] The extent of overlap of the 90% CI with slight or substantial (ie, small, moderate, and large) values was used to assess the level of evidence[33] for or against the magnitude of the ratio. The extent of overlap was estimated as the areas of the sampling distribution

falling in substantial (ie, small, moderate, and large) and slight magnitudes. These areas represent the probabilities that the true ratio has those magnitudes in a Bayesian analysis in which the prior is non-informative.[33] Thresholds for interpreting the probabilities for a given magnitude are provided in the appendix (p 8). This study was registered with PROSPERO, CRD42022341897.

Role of the funding source
There was no funder for this study.

Results
10 360 non-duplicate records were identified by our search, 517 full texts were reviewed, and 42 studies met full inclusion criteria (table 1, figure 1). Sufficient data were reported across studies to derive 130 sample-estimate RRs (appendix pp 9–13). Funnel plots of sample-estimate SEs versus sample-estimates for the five categories of emergency department visits did not indicate substantial publication bias (appendix p 14).

Across the 42 studies, 11·1 million emergency department visits were recorded. The mean age of participants across studies was 11·7 years (SD 3·1, range 5·5–16·3). The average proportion of girls in a given study's total health emergency department visits was 57·6%, and that for boys was 43·4%. Pre-pandemic emergency department visits comparison dates ranged from early 2015 to 2020 (median 2019), and pandemic emergency department visits were from 2020 to 2021. Two (5%) studies reported data from Asia, 17 (40%) from Europe, 16 (38%) from North America, six (14%) from Australia or New Zealand, and one (2%) pooled data from multiple countries. The mean study quality score was 7·5 (range 5–9; appendix p 7).

The results of the meta-analysis showed good evidence of an increase in emergency department visits during the COVID-19 pandemic for attempted suicide (RR 1·22, 90% CI 1·08–1·37; slight-to-small magnitude) and modest evidence of an increase for suicidal ideation (1·08, 0·93–1·25; slight-to-small magnitude; table 2; figure 2; figure 3). The uncertainty in the change for self-harm amounts to good evidence for a slight change, weak evidence for a reduction, and strong evidence against an increase (0·96, 0·89–1·04; small-to-slight magnitude). Emergency department visits for other mental-illness indications showed very good evidence of a reduction (0·81, 0·74–0·89; small magnitude), and visits for all indications showed strong evidence of a reduction (0·68, 0·62–0·75; small-to-moderate magnitude). In comparison with the reduction for all indications (including physical and mental health), there was strong evidence for relative increases in attempted suicide, self-harm, and suicidal ideation, and good evidence for a relative increase in the other mental-illness indications (appendix p 15).

Each category of emergency department visit showed strong evidence of substantial heterogeneity (table 2).

	Number of settings	RR		Heterogeneity ratio	
		Mean (90% CI)	Magnitude*	τ (90% CI)	Magnitude†
Attempted suicide	16	1·22 (1·08–1·37)	Slight-to-small increase	1·26 (1·09–1·37)	Small to moderate
Self-harm	39	0·96 (0·89–1·04)	Slight-to-small decrease	1·26 (1·11–1·36)	Small to moderate
Suicidal ideation	21	1·08 (0·93–1·25)	Slight-to-small increase	1·43 (1·24–1·59)	Moderate to large
Other mental-illness indications	24	0·81 (0·74–0·89)	Small decrease	1·32 (1·19–1·42)	Small to large
All health indications	34	0·68 (0·62–0·75)	Small-to-moderate decrease	1·38 (1·27–1·47)	Moderate to large

τ is the between-setting factor standard deviation. RR=rate ratio. *Magnitude thresholds for interpreting confidence limits of RR decreases: 0·90 to <1·00 slight; 0·70 to <0·90 small; 0·50 to <0·70 moderate; and <0·50 large. Thresholds for increases: 1·00 to <1·11 slight; 1·11 to <1·43 small; 1·43 to <2·00 moderate; ≥2·00, large. †Thresholds for interpreting confidence limits of τ are the square root of those for RR increases.

Table 2: Changes in child and adolescent emergency department visits expressed as ratios of rates during the COVID-19 pandemic to those before the pandemic

The resulting uncertainties in the changes in the rates of emergency department visits predicted in a given setting (thin error bars in figure 3) are considerably greater than those of the means (thick error bars).

In meta-analyses by sex, in five studies[17,18,44,48,50] with ten study estimates there was good evidence that rates of emergency department visits for the combined measure of suicidal ideation or attempt increased during the COVID-19 pandemic among girls (RR 1·39, 90% CI 1·04–1·88; small-to-moderate magnitude; appendix p 16), whereas there was only modest evidence of an increase among boys (1·06, 0·92–1·24; slight-to-small magnitude). The comparison of these rates (girls:boys ratio 1·31, 90% CI 1·05–1·64; slight-to-moderate difference in magnitude) represents good evidence that the increase in suicidal ideation or attempt was greater for girls than for boys. In four studies[19,20,38,53] in which changes in rates of self-harm could be estimated for boys and girls, the difference between the sexes was inconclusive (appendix p 17).

Self-harm was the only indication for which there were sufficient data (14 study estimates across 11 studies[10,15,19,20,35,43,46,49,53,57,60]) to meta-analyse changes in emergency department visits by sample age. There was good evidence that rates of self-harm increased among older children (mean age 16·3 years [SD 1·0]), and modest evidence of a decrease among younger children (mean age 9·0 years [SD 1·0]) (appendix p 18). Rates of suicidal ideation or attempt at different ages were provided in only one study,[21] in which there was good evidence that changes in emergency department visits for suicidal ideation or attempt differed only slightly between children and adolescents (appendix p 19).
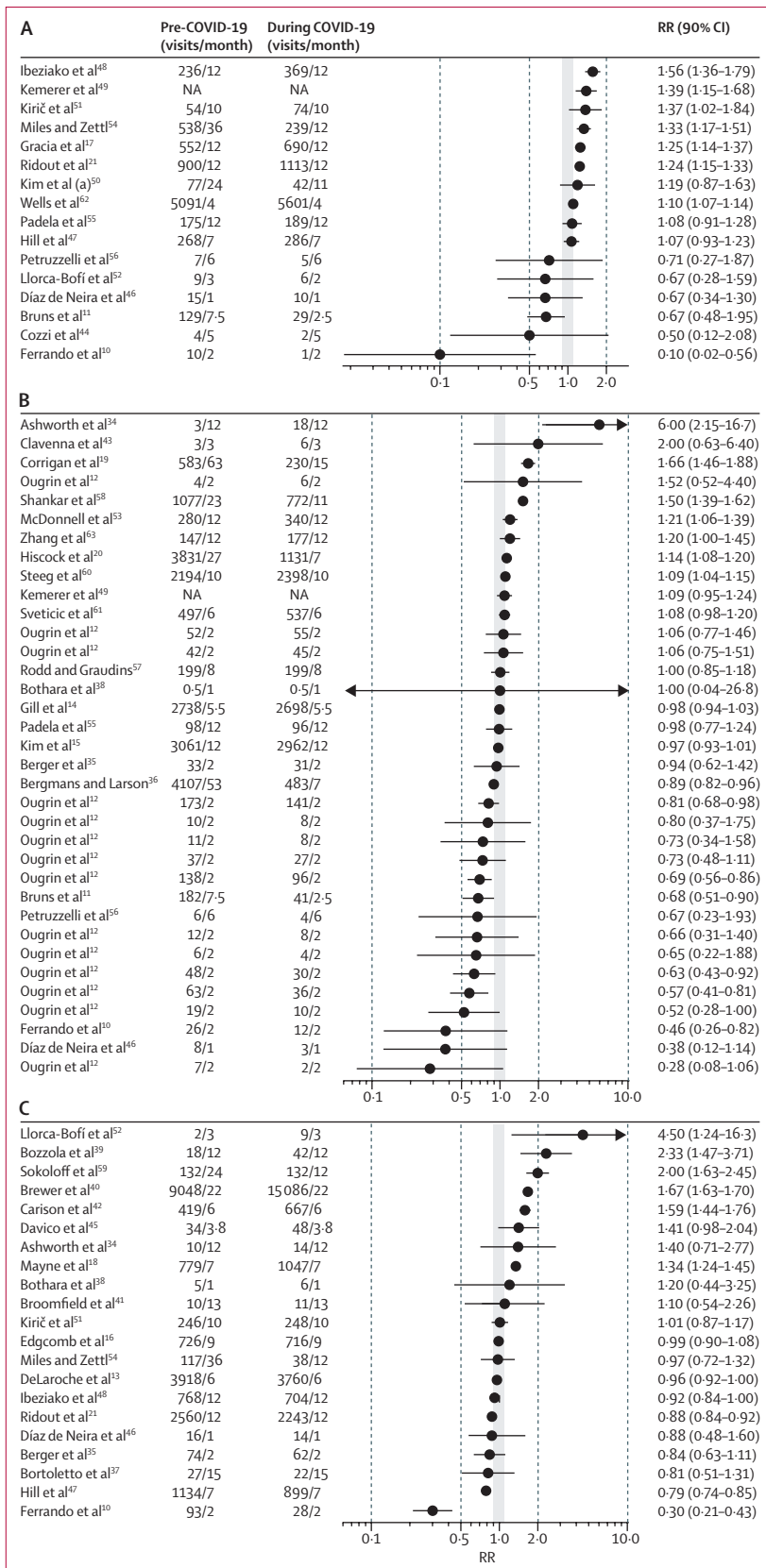
One study[18] in adolescents presented data from which to estimate the association between race and ethnicity and socioeconomic status and changes in suicidal ideation or attempt (appendix p 20). In that study, rates of suicidal ideation or attempt increased among White adolescents (RR 1·60, 90% CI 1·41–1·82; small-to-moderate magnitude), there was modest evidence of an increase among Black (1·12, 1·00–1·26; slight-to-small magnitude),

Hispanic or Latinx (1·25, 0·94–1·67; slight-to-moderate magnitude), and Asian American (1·38, 0·95–2·00; slight-large magnitude) adolescents, and rates of suicidal ideation or attempt increased in all but the lowest socioeconomic group. There was one study[20] from which to estimate the association between socioeconomic status and changes in self-harm; rates of self-harm only increased in the higher socioeconomic group (1·28, 1·18–1·39; small magnitude; appendix p 21).

The moderating effect of geographical region on changes in rate of emergency department visits for suicidal ideation or attempt was meta-analysed with 29 study estimates from 29 studies.[10,11,13,16–18,21,34,35,37–42,44–52,54–56,59,62] There was good evidence of increased rates in samples from both North America (RR 1·27, 90% CI 1·04–1·53; slight-to-moderate magnitude)[10,13,16,18,21,40,41,47,48,54,59,62] and Europe (1·18, 0·99–1·41; slight-to-small magnitude).[11,17,34,35,37,39,44–46,49,51,52,55,56] A single study from Australia[42] reported a moderate increase (1·59, 1·44–1·76). Further sample-estimates representing COVID-19-related changes in suicidal ideation or attempt in New Zealand[38] (1·20, 0·44–3·25) and South Korea[50] (1·19, 0·87–1·63) had small positive observed values but had unclear magnitudes.

Discussion

In this systematic review and meta-analysis of rates of child and adolescent visits to emergency departments, the evidence regarding attempted suicide and suicidal ideation indicates some of the adverse effects of the COVID-19 pandemic. Moderator analyses suggested that increases in suicidal ideation or attempt were more conclusive for girls than for boys, and that a conclusive increase in self-harm occurred only for older adolescents (aged around 16–17 years). We observed good evidence for a reduction in visits for all other mental-illness indications (eg, depression and psychosis) and strong evidence for a reduction in total emergency department visits for any health reason. In comparison with the reduction in total emergency department visits for any

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	Pre-COVID-19 (visits/month)	During COVID-19 (visits/month)	RR (90% CI)
Ibeziako et al[48]	236/12	369/12	1.56 (1.36–1.79)
Kemerer et al[49]	NA	NA	1.39 (1.15–1.68)
Kirič et al[51]	54/10	74/10	1.37 (1.02–1.84)
Miles and Zettl[54]	538/36	239/12	1.33 (1.17–1.51)
Gracia et al[17]	552/12	690/12	1.25 (1.14–1.37)
Ridout et al[21]	900/12	1113/12	1.24 (1.15–1.33)
Kim et al (a)[50]	77/24	42/11	1.19 (0.87–1.63)
Wells et al[62]	5091/4	5601/4	1.10 (1.07–1.14)
Padela et al[55]	175/12	189/12	1.08 (0.91–1.28)
Hill et al[47]	268/7	286/7	1.07 (0.93–1.23)
Petruzzelli et al[56]	7/6	5/6	0.71 (0.27–1.87)
Llorca-Bofí et al[52]	9/3	6/2	0.67 (0.28–1.59)
Díaz de Neira et al[46]	15/1	10/1	0.67 (0.34–1.30)
Bruns et al[11]	129/7.5	29/2.5	0.67 (0.48–1.95)
Cozzi et al[44]	4/5	2/5	0.50 (0.12–2.08)
Ferrando et al[10]	10/2	1/2	0.10 (0.02–0.56)

B

	Pre-COVID-19 (visits/month)	During COVID-19 (visits/month)	RR (90% CI)
Ashworth et al[34]	3/12	18/12	6.00 (2.15–16.7)
Clavenna et al[43]	3/3	6/3	2.00 (0.63–6.40)
Corrigan et al[19]	583/63	230/15	1.66 (1.46–1.88)
Ougrin et al[12]	4/2	6/2	1.52 (0.52–4.40)
Shankar et al[58]	1077/23	772/11	1.50 (1.39–1.62)
McDonnell et al[53]	280/12	340/12	1.21 (1.06–1.39)
Zhang et al[63]	147/12	177/12	1.20 (1.00–1.45)
Hiscock et al[20]	3831/27	1131/7	1.14 (1.08–1.20)
Steeg et al[60]	2194/10	2398/10	1.09 (1.04–1.15)
Kemerer et al[49]	NA	NA	1.09 (0.95–1.24)
Sveticic et al[61]	497/6	537/6	1.08 (0.98–1.01)
Ougrin et al[12]	52/2	55/2	1.06 (0.77–1.46)
Ougrin et al[12]	42/2	45/2	1.06 (0.75–1.51)
Rodd and Graudins[57]	199/8	199/8	1.00 (0.85–1.18)
Bothara et al[38]	0.5/1	0.5/1	1.00 (0.04–26.8)
Gill et al[14]	2738/5.5	2698/5.5	0.98 (0.94–1.03)
Padela et al[55]	98/12	96/12	0.98 (0.77–1.24)
Kim et al[15]	3061/12	2962/12	0.97 (0.93–1.01)
Berger et al[35]	33/2	31/2	0.94 (0.62–1.42)
Bergmans and Larson[36]	4107/53	483/7	0.89 (0.82–0.96)
Ougrin et al[12]	173/2	141/2	0.81 (0.68–0.98)
Ougrin et al[12]	10/2	8/2	0.80 (0.37–1.75)
Ougrin et al[12]	11/2	8/2	0.73 (0.34–1.58)
Ougrin et al[12]	37/2	27/2	0.73 (0.48–1.11)
Ougrin et al[12]	138/2	96/2	0.69 (0.56–0.86)
Bruns et al[11]	182/7.5	41/2.5	0.68 (0.51–0.90)
Petruzzelli et al[56]	6/6	4/6	0.67 (0.23–1.93)
Ougrin et al[12]	12/2	8/2	0.66 (0.31–1.40)
Ougrin et al[12]	6/2	4/2	0.65 (0.22–1.88)
Ougrin et al[12]	48/2	30/2	0.63 (0.43–0.92)
Ougrin et al[12]	63/2	36/2	0.57 (0.41–0.81)
Ougrin et al[12]	19/2	10/2	0.52 (0.28–1.00)
Ferrando et al[10]	26/2	12/2	0.46 (0.26–0.82)
Díaz de Neira et al[46]	8/1	3/1	0.38 (0.12–1.14)
Ougrin et al[12]	7/2	2/2	0.28 (0.08–1.06)

C

	Pre-COVID-19 (visits/month)	During COVID-19 (visits/month)	RR (90% CI)
Llorca-Bofí et al[52]	2/3	9/3	4.50 (1.24–16.3)
Bozzola et al[39]	18/12	42/12	2.33 (1.47–3.71)
Sokoloff et al[59]	132/24	132/12	2.00 (1.63–2.45)
Brewer et al[40]	9048/22	15086/22	1.67 (1.63–1.70)
Carison et al[42]	419/6	667/6	1.59 (1.44–1.76)
Davico et al[45]	34/3.8	48/3.8	1.41 (0.98–2.04)
Ashworth et al[34]	10/12	14/12	1.40 (0.71–2.77)
Mayne et al[18]	779/7	1047/7	1.34 (1.24–1.45)
Bothara et al[38]	5/1	6/1	1.20 (0.44–3.25)
Broomfield et al[41]	10/13	11/13	1.10 (0.54–2.26)
Kirič et al[51]	246/10	248/10	1.01 (0.87–1.17)
Edgcomb et al[16]	726/9	716/9	0.99 (0.90–1.08)
Miles and Zettl[54]	117/36	38/12	0.97 (0.72–1.32)
DeLaroche et al[13]	3918/6	3760/6	0.96 (0.90–1.00)
Ibeziako et al[48]	768/12	704/12	0.92 (0.84–1.00)
Ridout et al[21]	2560/12	2243/12	0.88 (0.84–0.92)
Díaz de Neira et al[46]	16/1	14/1	0.88 (0.48–1.60)
Berger et al[35]	74/2	62/2	0.84 (0.63–1.11)
Bortoletto et al[37]	27/15	22/15	0.81 (0.51–1.31)
Hill et al[47]	1134/7	899/7	0.79 (0.74–0.85)
Ferrando et al[10]	93/2	28/2	0.30 (0.21–0.43)

Figure 2: **Changes in child and adolescent emergency department visits for (A) attempted suicide, (B) self-harm, and (C) suicidal ideation expressed as ratios of rates during the COVID-19 pandemic to those before the pandemic**
Ratios are plotted on a log axis. The grey area represents slight changes (RR 0·90 to <1·11). Vertical dashed lines indicate thresholds for large (0·10 to <0·50 or 2·00 to <10·00) and extremely large (<0·10 or ≥10·00) reductions and increases. Error bars represent 90% CIs. When numbers of visits are not reported (ie, NA for Kemerer and colleagues[49]), RRs and their corresponding CIs were extracted directly from the study. A value of 0·5 replaced counts of zero (ie, for Bothara and colleagues[38]). RR=rate ratio. NA=not applicable.

health reason, the findings reported in this study provide strong evidence for relative increases in attempted suicide, self-harm, and suicidal ideation during the COVID-19 pandemic. Commensurate with an accumulation of pandemic stressors,[1,2,4,5,8,9] there were decreases in access to various sources of support shown to prevent mental distress or mitigate its progression to severe outcomes. Together, these factors could have pushed children and adolescents, particularly girls and older adolescents, beyond their vulnerability thresholds.[22]

Several points are important to contextualise our findings. First, the decrease in the rate of emergency department visits for all indications is in line with data from the USA suggesting that there have been system-wide reductions in emergency department visits, especially early in the pandemic, for many condition-specific acute and chronic health problems.[14] Reasons for such reductions include more watchful waiting of symptoms, shelter-in-place orders, and fear of COVID-19 infection.[14] We also found a decrease in the absolute number of paediatric emergency department visits for other mental-illness-related indications. When this finding is paired with Canadian data showing that calls to crisis hotlines increased substantively, and that increases of 10–15% were observed in community-based mental health settings,[64] it suggests that children and adolescents experiencing less acute (and potentially non-fatal) forms of mental distress during the COVID-19 pandemic could have used support outside of the emergency department to address their mental health needs. Our evidence of an increase in emergency department visits for suicide attempts and suicidal ideation during the pandemic is all the more notable when considered in the context of a system-wide reduction in emergency department visits for all indications.[14]

Second, the increase in the rate of visits for suicide-related outcomes could be due in part to a continuation of upward trends in rates of paediatric mental-illness-related issues that were well documented in the USA in the years before the pandemic.[65] To contextualise this further, we calculated the upward trend in the rates for suicidal ideation or attempts pre-pandemic (studies used are listed in the appendix; p 22). We expressed the rates as factor increases per year, averaged the factors (via logs) for North American studies (mean 1·08 or 8% per year), then averaged this value with the value from the only

European study (1·10) to give a mean of 1·09. The mean time between the midpoint of pre-COVID-19 and during-COVID-19 assessments of emergency department visits in the meta-analysed studies was 1·39 years, so on the assumption that the upward trend would have continued during the pandemic, the mean change in the rate of suicidal ideation or attempt in the meta-analysis due to the trend would have been a factor of $1·09^{1·38}=1·13$ or 13%. If this trend applied equally to suicide attempts, self-harm, and suicidal ideation, the effect of the COVID-19 pandemic would reduce to slight changes or a small decrease for self-harm, but the change relative to all emergency department visits would still be substantial increases. Uncertainty in the trend will contribute to uncertainty in the adjusted RRs, but even a doubling of the trend (a factor of $1·13^{2}=1·28$ or 28%) would leave reasonable evidence of relative increases due to the COVID-19 pandemic.

Third, substantial heterogeneity in the changes in rates was observed, indicating that, in some settings, the rates for each of the specific indications of suicide attempts, suicidal ideation, and self-harm did not increase or might even have reduced, whereas for others, they increased substantially. The specific settings in which rates showed evidence of substantial decreases and increases can be identified from the confidence limits for each indication and each study in the forest plot (figure 2) and in the appendix (pp 9–13).

Our moderator findings are consistent with pre-pandemic research observing a sex paradox of suicide, whereby girls are more likely to attempt suicide and engage mental health care, yet boys are more likely to die by suicide.[66] In keeping with previous research, we found that girls were considerably more likely than boys to present to the emergency department (mean increase of 39% for girls *vs* 6% for boys) for severe mental distress during the pandemic. Moreover, self-harm increased in adolescents (mean increase of 18%) but decreased in younger children (mean decrease of 15%). As such, current findings support previous recommendations highlighting the need for sex and age specificity in youth suicide prevention interventions. These findings suggest that strategies for adolescent girls should focus on risk stratification among those receiving mental health care and presenting with self-harm behaviour, whereas strategies for boys should focus on increasing engage-ment with mental health services and addressing earlier prevention or intervention targets (ie, identifying and expressing emotion) in non-mental health, community settings.

Our finding of an increase of presentations with acute mental distress to emergency departments during the pandemic, concomitant with a decrease in general presentations for youth, implies that a greater proportion of the workload of emergency department staff was likely to comprise acute mental illness compared with before the pandemic. Research has found that even before the
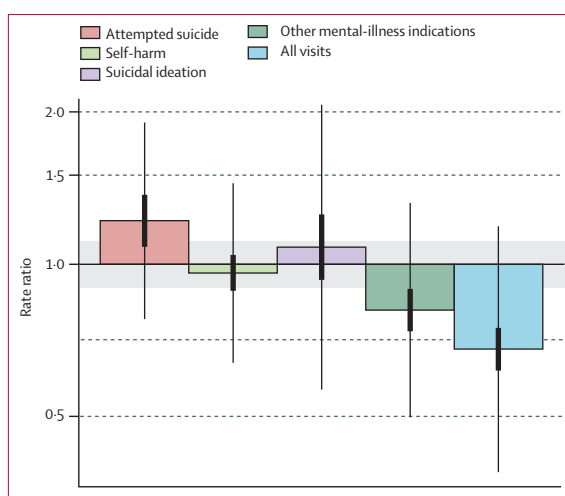
Figure 3: **Meta-analysed mean changes in child and adolescent emergency department visits expressed as ratios of rates during the COVID-19 pandemic to those before the pandemic**
Ratios are plotted on a log axis. Grey area represents slight changes (rate ratio 0·90 to <1·11). Horizontal dashed lines indicate thresholds for reductions (moderate reduction 0·50 to <0·70; large reduction <0·50) and increases (moderate increase 1·43 to <2·00; large increase ≥2·00). Thick error bars represent 90% CIs for means and thin error bars represent 90% CIs for individual settings.

pandemic, paediatric care providers reported inadequate clinical training in mental-illness emergencies during residency.[67] These findings suggest that an increase in multidisciplinary emergency department provider training, clinical capacity, and resources for managing acute psychiatric distress might be required in response to the changing landscape of emergency department care, should the changes observed in our meta-analysis be maintained over time.

Several limitations should be noted. First, data for this study are based on electronic health records capturing relevant diagnostic codes for presentation to the emergency department. As health records are based on individual clinician or organisational classifications, reporting is rarely standardised across sites, resulting in measurement error. Greater standardisation in data collection and reporting in this field is urgently needed to increase confidence in the generalisability of study results across settings. Second, this study does not identify the prevalence of suicidal thoughts and behaviour in the population more broadly, but rather presentation to the emergency department for these indications. Third, cross-study moderation analyses were limited to estimations of differences in rates of suicidal ideation or attempt by age and sex, and estimations of regional rates for samples from North America, Europe, and Australia. Due to the variability of reporting socioeconomic status and race and ethnicity data in individual studies, we were only able to assess such data reported in two studies. No individual study examined the effect of gender identity on changes in emergency department visits during the COVID-19 pandemic,

which is a crucial avenue for future research. Fourth, 18 countries are represented in the analyses; however, most (>90%) were from North America, Europe, and Australia. The disproportionate focus on these continents is challenging for global generalisability, given that these regions only represent less than 10% of the world's population. Finally, only journal articles written in English were included.

This study provides good evidence of an exacerbation in severe mental distress and resultant emergency department presentations over the course of the COVID-19 pandemic among children and adolescents. Our findings are in line with pandemic-related research documenting population-level increases in paediatric mental illnesses such as depression and anxiety symptoms[8] and eating disorders,[9] as well as help-seeking behaviour.[67] Thus, efforts to both understand and mitigate underlying factors associated with mental distress among children and adolescents are needed to inform prevention strategies. Our findings should also encourage health initiatives, clinical capacity, and targeted emergency department-provider training for managing acute psychiatric distress.

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