

Changes in Depression and Anxiety Among Children and Adolescents From Before to During the COVID-19 Pandemic

A Systematic Review and Meta-analysis

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IMPORTANCE There is a growing body of high-quality cohort-based research that has examined changes in child and adolescent mental health during the COVID-19 pandemic vs before the pandemic. Some studies have found that child and adolescent depression and anxiety symptoms have increased, while others have found these symptoms to have remained stable or decreased.

OBJECTIVE To synthesize the available longitudinal cohort-based research evidence to estimate the direction and magnitude of changes in depression and anxiety symptoms in children and adolescents assessed before and during the pandemic.

DATA SOURCES Medline, Embase, and PsycInfo were searched for studies published between January 1, 2020, and May 17, 2022.

STUDY SELECTION Included studies reported on depression and/or anxiety symptoms, had cohort data comparing prepandemic to pandemic estimates, included a sample of children and/or adolescents younger than 19 years, and were published in English in a peer-reviewed journal.

DATA EXTRACTION AND SYNTHESIS In total, 53 longitudinal cohort studies from 12 countries with 87 study estimates representing 40 807 children and adolescents were included.

MAIN OUTCOMES AND MEASURES Standardized mean changes (SMC) in depression and anxiety symptoms from before to during the pandemic.

RESULTS The analysis included 40 807 children and adolescents represented in pre-COVID-19 studies and 33 682 represented in during-COVID-19 studies. There was good evidence of an increase in depression symptoms (SMC, 0.26; 95% CI, 0.19 to 0.33). Changes in depression symptoms were most conclusive for study estimates among female individuals (SMC, 0.32; 95% CI, 0.21 to 0.42), study estimates with mid to high income (SMC, 0.35; 95% CI, 0.07 to 0.63), and study estimates sourced from North America (SMC, 0.25; 95% CI, 0.15 to 0.36) and Europe (SMC, 0.35; 95% CI, 0.17 to 0.53). There was strong evidence that anxiety symptoms increased slightly during the pandemic (SMC, 0.10; 95% CI, 0.04 to 0.16), and there was some evidence of an increase in study estimates with mid to high income.

CONCLUSIONS This systematic review and meta-analysis of longitudinal studies including children and adolescents found an increase in depression symptoms during the COVID-19 pandemic, particularly among female individuals and those from relatively higher-income backgrounds.

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There has been considerable debate as to whether the mental health of children and adolescents has been impacted by the disruptions and restrictions introduced during the COVID-19 pandemic. A meta-analysis by Racine et al¹ with 29 cross-sectional studies and more than 80 000 individuals found that 25.2% of children and 20.5% of adolescents reported clinically elevated (ie, moderate to severe) depression (eg, sadness, hopelessness, and mood lability) and anxiety (eg, excessive worry and fear) symptoms during the pandemic. Although this meta-analysis¹ was valuable for highlighting the potential deterioration of mental health in children and adolescents during a global crisis, researchers have warned against heavy reliance on cross-sectional data for driving policy decisions, as they are prone to methodological biases.²

Longitudinal cohort studies of children and adolescents with data collected both before and during the COVID-19 pandemic provide more reliable information about the state of child and adolescent mental health.² These studies were slower to emerge during the pandemic compared to cross-sectional snapshots of depression and anxiety symptoms during the COVID-19 pandemic. Meta-analyses of longitudinal changes in the general mental health of young people during the pandemic have been published.^{3,4} A meta-analysis⁵ of change in depression and anxiety symptoms during the pandemic across population groups has also been published; however, the findings specific to children and adolescents aged 10 to 19 years were from a small sample of studies ($k = 8$ for depression symptoms; $k = 10$ for anxiety symptoms) in children aged 10 to 19 years only, and lacked adjustment for baseline pre-COVID-19 symptoms.

There are many reasons to expect changes in depression and anxiety symptoms among children and adolescents during the pandemic. Social isolation and quarantine orders have been associated with a 4-fold increased risk in stress-related symptoms among children.⁶ Numerous etiological factors for psychopathology also appeared or were exacerbated during the pandemic, including increased screen time,⁷ closures and disruptions related to schooling,^{8,9} cancellation of extracurricular activities,⁹ increased loneliness,¹⁰ decreased physical activity,¹¹ and lack of access to school mental health supports.¹² Commensurate with these risk factors were considerable changes to the family milieu, which can have spillover effects on child and adolescent well-being,^{13,14} such as increases in parent depression and anxiety symptoms,^{15,16} family violence,¹⁷ job loss, and alcohol consumption.¹⁸ However, longitudinal cohort studies examining changes from before to during the pandemic have revealed a range of different findings: some studies reported that depression and anxiety symptoms have decreased^{19,20} or remained stable,^{21,22} while others showed various levels of increase.²³⁻²⁵ When study results are inconsistent, it can cast doubt on the reliability of findings, thus slowing or even halting the adoption or integration of mental health policy changes aimed at supporting children and adolescents.²⁶

The primary aim of this study was to provide a comprehensive synthesis of longitudinal cohort studies comparing pre-pandemic estimates of depression and anxiety symptoms in children and adolescents to pandemic estimates. The second-

Key Points

Question Did depression and anxiety symptoms increase in cohorts of children and adolescents monitored before and during the COVID-19 pandemic?

Findings This systematic review and meta-analysis of 53 longitudinal studies including more than 40 000 children and adolescents across 12 countries found an increase in depression symptoms during the COVID-19 pandemic, particularly among female individuals and those from relatively higher-income backgrounds. Anxiety symptoms increased slightly during the pandemic, although there was some evidence of a small increase in anxiety symptoms for children and adolescents from relatively higher-income backgrounds.

Meaning The findings of longitudinal changes in child and adolescent mental health during the COVID-19 pandemic in this study can inform policy and public health responses to address mental health concerns.

ary objective was to estimate whether the direction and magnitude of changes differed by sex, age, race, ethnicity, income, and geographical region. An examination of moderating variables was considered critical because some groups may be at greater risk of mental distress, including female individuals,²⁷⁻²⁹ adolescents (vs younger children),^{1,30} racial and ethnic minoritized groups,^{31,32} and people from lower income backgrounds.³³⁻³⁵

Methods

Search Strategy

Using Medline, Embase, and PsycInfo, we searched for studies published between January 1, 2020, and May 17, 2022 (eTable 1 in Supplement 1). Search terms were related to mental health (eg, *depress*** and *anxi*et**), coronavirus (eg, *COVID-19*), and pediatric populations (eg, *child** and *adolescen**). We hand-searched reference lists of studies meeting our inclusion criteria to identify other relevant studies. This review followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) reporting guideline (eFigure 1 in Supplement 1)^{36,37} and was registered with PROSPERO (CRD42022341897).

Selection Criteria

All retrieved titles and abstracts were imported into Covidence software. Studies were included if they reported on depression or anxiety symptoms using validated measures, had data comparing prepandemic to pandemic estimates, included pediatric samples (younger than 19 years), and were published in English in a peer-reviewed journal. Exclusion criteria were qualitative analyses, unpublished preprints, case studies, or reports. A minimum of 2 coders independently screened each title or abstract (mean random agreement probability: 92%). Two coders independently screened full-text articles meeting initial screening (mean random agreement probability: 88%). Discrepancies were resolved via discussion and consensus.

Data Extraction

We extracted the pre- and during-COVID-19 sample means and SDs for depression and anxiety symptoms, as well as predicted mean changes and inferential statistics (ie, change-score SD, *P* value, or 95% CI to calculate the SEs of these mean changes). We also extracted study characteristics (ie, study design, sample size, and duration of time between pre- and during-COVID-19 assessments), sample characteristics (geographical region, median age, sex, race, ethnicity, percentage with clinical diagnosis or medical condition, and the income of the sample, categorized by the original study authors as having low or mid to high income), and methodological characteristics (child-, parent-, or clinician-reported data and study quality criteria). Race and ethnicity were reported to account for the possibility that some racial and ethnic minoritized groups may be at greater risk of mental health issues. Racial and ethnic groups are reported according to the original studies and included American Indian or Alaska Native, Asian, Black, Hispanic, and White. Two coders independently conducted data extraction. Inter-coder agreement was 87%. Discrepancies were resolved via discussion and consensus.

Study Quality

We used an adapted version of the National Institutes of Health Quality Assessment Tool for Observation Cohort and Cross-Sectional Studies³⁸ (eTables 2-3 in Supplement 1). All studies meeting full inclusion criteria were scored 1 (criterion met) or 0 (criterion unmet) for 10 criteria and summed to a score between 0 and 10 with higher scores indicating better study quality.

Data Preparation and Analysis

Standardized mean changes (SMCs) in depression and anxiety symptoms were calculated following the principle of standardization³⁹—that is, by subtracting the study estimate pre-COVID-19 means for depression and anxiety from their corresponding during-COVID-19 values, and then dividing these values by their respective pre-COVID-19 SDs. The SEs for SMCs were mostly calculated from their corresponding *P* values or 95% CIs. When both the pre- and during-COVID-19 SD or SE of depression and anxiety symptoms were reported in a study (but not the *P* value or 95% CI for mean changes), the formula for imputing SDs for changes from baseline was used to derive a change-score SE.⁴⁰

Two separate random-effects meta-analyses were performed in SAS OnDemand for Academics version 9.4 (SAS Institute). The inverse variance method was used to weight each meta-analysis.⁴¹ In both meta-analyses, a single study identity random effect was estimated to account for between-study heterogeneity. This heterogeneity was evaluated as the magnitude of the τ statistic,⁴² which represents the average difference in the SMC between studies. Categorical moderators were sex, age, income (ie, study estimates of individuals coded by study authors as having low or mid to high income), and geographical region. Continuous moderators were baseline depression or anxiety symptoms, study quality, race, and ethnicity (the moderating influence of race and ethnicity was calculated by comparing the changes in depression and anxiety

symptoms between study estimates with higher and lower proportions of individuals from a racial or ethnic minoritized heritage). The discrepancy in symptom reporting between children, adolescents, parents, or caregivers was controlled for using a dummy variable and a numeric value for informant held constant at its mean.

The results for categorical moderators represent SMCs calculated at different values or at different levels of the moderator. SMCs for samples of male and female individuals were calculated at values of 0 and 100, respectively, for the moderator female (ie, since the moderator female represented the proportion of female individuals in each study). SMCs for children and adolescents were calculated from study estimates with median ages less than 12 years and greater than 12 years, respectively. SMCs for different geographical regions and different income were calculated using dummy variables (eg, a value of 1 identifying study estimates from North America as distinct from the remaining study estimates, which were given a value of 0, and a value of 1 identifying study estimates with mid to high income as distinct from those characterized as having low income). The results for continuous moderators represent the difference in the SMC in anxiety symptoms between study estimates with below average (mean -1 standard deviation) and above average (mean $+1$ standard deviation) values for the moderator.⁴³ The results for each individual moderator were calculated with the remaining moderators held constant at their mean values.

Thresholds for slight, small, moderate, large, and very large SMCs and moderating associations were 0.2, 0.6, 1.2, and 2.0 standardized units, respectively.⁴³ Sampling uncertainty was deemed inadequate when the 95% CI included substantial positive and negative values (ie, values ± 0.2 standardized units).⁴⁴⁻⁴⁶ The extent of overlap of the 95% CIs with slight or substantial (ie, small, moderate, and large) values was used to assess the level of evidence for or against the magnitude of the SMC and its moderators, as described in eTable 4 in Supplement 1. Probabilities representing the chances that the SMCs in depression and anxiety and their moderators were substantially negative, slight, or substantially positive are listed in full in eTables 5 and 6 in Supplement 1.

Publication Bias and Outliers

Publication bias was assessed by visually inspecting scatterplots of the random-effect solutions from the meta-analyses and the SE for each study estimate. Random-effect solutions with a *P* value less than .05 divided by the degrees of freedom for this residual value were considered statistical outliers.^{6,11}

Results

A total of 6822 nonduplicate records were identified by our search strategy, 351 of which were screened for inclusion. Fifty-three studies met the full inclusion criteria (eFigure 1 in Supplement 1), from which 87 study estimate SMCs were extracted (49 SMCs in depression and 38 SMCs in anxiety symptoms).

Study Characteristics

Across the 53 studies (Table 1), 40 807 children and adolescents were represented during COVID-19. The mean (SD; range) age for study estimates of changes in depression and anxiety symptoms were 13.5 (2.4; 4.6-17.5) years and 12.6 (3.7; 3.3-17.5) years, respectively. The proportions of female individuals in studies of changes in depression and anxiety symptoms were 54% and 52%, respectively. In terms of informant, 46 individuals (87%) were self-report, 5 (9%) were parent-report, 1 (2%) was parent and child report, and 1 (2%) did not report the informant. Twenty-seven studies reported data from North America (51%), 13 (24%) from Europe, 10 (19%) from Asia, 2 (4%) from Australia, and 1 (2%) from Israel. The mean (range) study quality score was 7.5 (5-10).

Changes in Depression Symptoms

The forest plot of study estimates of changes in depression symptoms is displayed in Figure 1. There was strong evidence of an increase in depression symptoms (SMC, 0.26; 95% CI, 0.19-0.33; slight to small magnitude). Between-study heterogeneity was small (τ , 0.23; 95% CI, 0.16-0.28). Six statistical outliers were identified; however, removal of outliers did not alter the direction or magnitude of the SMC in depression symptoms. Minimal publication bias was evident.

Moderation of Changes in Depression Symptoms

Moderators of changes in depression symptoms are displayed in Table 2. Probabilities representing the level of evidence for substantial negative, slight, and substantial positive changes in depression symptoms are displayed in eTable 5 in Supplement 1. There was good evidence that depression symptoms increased among female individuals (SMC, 0.32; 95% CI, 0.21 to 0.42; small magnitude) and slightly increased among male individuals. There was good evidence that changes in depression symptoms differed slightly between children and adolescents (depression symptoms increased in study estimates of children and adolescents by a slight to small magnitude). There was some evidence that changes in depression symptoms were larger for study estimates with mid to high income, with good evidence of an increase for study estimates drawn from individuals from a more affluent background (SMC, 0.35; 95% CI, 0.07 to 0.63; slight to moderate in magnitude). There was very good evidence of an increase in depression symptoms among study estimates from Europe ($k = 10$; SMC, 0.35; 95% CI, 0.17 to 0.53; slight to small magnitude) and good evidence of an increase among study estimates from North America ($k = 26$; SMC, 0.25; 95% CI, 0.15 to 0.36; slight to small magnitude). There was good evidence of a slight change in study estimates from Asia ($k = 10$). There was good evidence that changes in depression symptoms differed slightly between study estimates with lower (14%) and higher (44%) proportions of study individuals from racial and ethnic minoritized groups. There was good evidence that changes in depression symptoms differed slightly between study estimates with lower and higher baseline values for depression (SMC, -0.12; 95% CI, -0.27 to 0.04). There was very good evidence that changes in depression symptoms differed slightly between higher- and lower-quality studies.

Changes in Anxiety Symptoms

Inspection of the scatterplot of the random-effect solution vs the SE of each study estimate revealed evidence of considerable publication bias, which was addressed by excluding 3 statistical outliers and 4 study estimates with an SE greater than 0.3 (eFigure 2 in Supplement 1). The forest plot of study estimates included in the meta-analysis of changes in anxiety symptoms is displayed in Figure 2. There was good evidence that anxiety symptoms increased slightly (SMC, 0.10; 95% CI, 0.04 to 0.16). Between-study heterogeneity was slight to small in magnitude (τ , 0.13; 95% CI, 0.02 to 0.19).

Moderation of Changes in Anxiety Symptoms

Moderators of changes in anxiety symptoms are displayed in Table 3. Probabilities representing the level of evidence for substantial negative, slight, and substantial positive changes in anxiety symptoms are displayed in eTable 6 in Supplement 1. There was good evidence that changes in anxiety symptoms differed slightly between female (SMC, 0.12; 95% CI, -0.03 to 0.27) and male (SMC, 0.04; 95% CI, -0.12 to 0.21) individuals, and modest evidence of a difference between children (SMC, -0.02; 95% CI, -0.21 to 0.17) and adolescents (SMC, 0.16; 95% CI, 0.07 to 0.25). There was some evidence that anxiety symptoms increased in study estimates with mid to high income (SMC, 0.14; 95% CI, -0.13 to 0.41; slight to small magnitude). There was good evidence that changes in anxiety symptoms differed slightly between study estimates with lower (12%) and higher (40%) proportions of study individuals from racial and ethnic minoritized groups (SMC, 0.06; 95% CI, -0.15 to 0.27). There was very good evidence that changes in anxiety symptoms differed slightly between study estimates with lower and higher baseline values for anxiety. There was also good evidence that changes in anxiety symptoms differed slightly between higher- and lower-quality studies (SMC -0.08; 95% CI, -0.23 to 0.07), and between study estimates from different geographical regions (North America: SMC, 0.10; 95% CI, 0.002 to 0.20; Asia: SMC, 0.06; 95% CI, -0.11 to 0.24; Europe: SMC, 0.10; 95% CI, -0.03 to 0.23).

Discussion

This systematic review and meta-analysis included 53 studies with 87 study estimates (49 for depression symptoms; 38 for anxiety symptoms) representing 40 807 children and adolescents across 12 countries. Contrary to a meta-analysis of 8 studies showing minimal change in depression symptoms in youth aged 10 to 19 years,⁵ our comprehensive systematic review and meta-analysis of child and adolescents samples showed that there was evidence of an increase in depression symptoms during the COVID-19 pandemic compared to pre-pandemic estimates. The magnitude of this increase was more than what could be expected based on time trends⁹⁴ and can therefore likely be attributed to the disruptions, restrictions, and stress imposed on children and adolescents and their families during the pandemic.^{6-8,11,15,17,18,95} Anxiety symptoms increased slightly during the pandemic. Such differences between changes in depression and anxiety symptoms are

Table 1. Characteristics of the Included Studies

Source	Individuals, No.		Age, mean (SD) y	Female, No. (%)	Country	Individuals in racial and ethnic minoritized groups, ^a %	Outcome	Measure	Informant	Data collection dates	
	Before COVID-19	During COVID-19								Before COVID-19	During COVID-19
Adeboye et al, ²³ 2021	142	142	6.2 (5.0-10.0) ^b	45 (32)	UK	17	Anxiety	SCARED	Parent	March 2017	July 2020
Alt et al, ⁴⁷ 2021	739	739	16.1 (14.0-17.0) ^b	327 (58)	Germany	NR	Depression	STDS	Child	October 2018	May 2020
Bano et al, ⁴⁸ 2022	25	25	13.0 (11.0-15.0) ^c	9 (35)	US	24	Depression	PHQ-9	Child	August 2019	August 2020
Bélanger et al, ⁴⁹ 2021	7354	1880	14.1 (0.1)	3898 (53)	Canada	17	Depression	CESDR-10	Child	2018 and 2019	May 2020
Bignardi et al, ²⁴ 2021	168	168	8.6 (0.6)	88 (52)	UK	NR	Depression	RCADS	Child and parent	June 2018	April 2020
Bouter et al, ⁵⁰ 2022	445	445	17.7 (0.7)	266 (60)	Netherlands	14	Depression	YSR ASEBA	Child	April 2020	January 2021
Breaux et al, ²² 2021	238	238	15.0-17.0 ^c	106 (45)	US	12	Depression	RCADS	Child	September 2018	May 2020
Caha, ⁵¹ 2022	148	108	17.1 (1.5)	77 (52)	US	NR	Depression	MASQ	Child	NR	NR
Cantiani et al, ⁵² 2021	90	90	2.0-6.0 ^c	39 (34)	Italy	NR	Anxiety	CBCL	Parent	February 2020	April 2020
Charmaraman et al, ⁵³ 2022	586	586	12.5 (1.2)	311 (53)	US	43	Depression	CESDR-10	Child	October 2019	October 2020
Chavarría et al, ⁵⁴ 2021	258	258	13.2 (2.0-18.0) ^b	139 (54)	US	NR	Depression	PHQ-9	NR	NR	NR
Chen et al, ⁵⁵ 2022	575	575	10.8 (0.8)	NR	China	NA	Depression	DASS-21	Child	January 2020	March 2020
Cohen et al, ⁵⁶ 2021	24	24	14.8 (1.2)	14 (58)	US	37	Depression	PROMIS	Child	August 2019	May 2021
Defrance et al, ⁵⁷ 2022	184	136	13.9 (0.8)	93 (50)	Canada	8	Depression	CDI	Child	NR	NR
Duttweiler et al, ⁵⁸ 2022	53	53	12.5 (2.3)	41 (77)	US	47	Depression	MASC	Child	NR	June and September 2020
Ertanir et al, ⁵⁹ 2021	377	319	12.7 (0.7)	99 (47)	Switzerland	NR	Depression	SCARED	Child	September 2019	August 2020
Feurer et al, ⁶⁰ 2022	29	29	12.6 (2.4)	24 (83)	US	41	Depression	HSLC-25	Child	NR	August 2020
Gadassi Polack et al, ⁶¹ 2021	112	112	11.8 (2.1)	62 (55)	US	NR	Depression	CES-D	Child	NR	June and September 2020
Giménez-Dasí et al, ⁶² 2020	113	113	7.2 (2.6)	47 (42)	Spain	NR	Depression	SCARED	Child	January 2019	March 2020
							Depression	SENA	Parent	February 2020	April 2020

(continued)

Table 1. Characteristics of the Included Studies (continued)

Source	Individuals, No.		Age, mean (SD) y	Female, No. (%)	Country	Individuals in racial and ethnic minoritized groups, ^a %	Outcome	Measure	Informant	Data collection dates	
	Before COVID-19	During COVID-19								Before COVID-19	During COVID-19
Giménez-Dasí et al, ⁶³ 2021	133	42	8.5 (1.7)	69 (52)	Spain	NR	Anxiety	SENA	Child	December 2019	December 2020
Gladstone et al, ⁶⁴ 2022	228	228	14.5 (1.6)	121 (53)	US	27	Depression	PHQ-A	Child	November 2019	May 2020
Hawes et al, ⁶⁵ 2022	451	451	17.5 (1.4)	295 (65)	US	17	Depression	CDI	Child	March 2019	March 2020
He et al, ⁶⁶ 2022	1687	1687	12.5 (0.5)	668 (40)	China	NA	Depression	CES-DC	Child	October 2019	October 2020
Hite et al, ²⁵ 2021	258	258	NR	NR	US	NR	Depression	PHQ-9	Child and clinician	NR	NR
Hollenstein et al, ⁶⁷ 2021	178	146	12.5 (12.0-13.0) ^b	77 (43)	Canada	NR	Depression	GAD-7	Child	September 2019	May 2020
Houghton et al, ⁶⁸ 2022	785	785	14.1 (1.3)	454 (58)	Australia	NR	Depression	BAI	Child	October 2019	June 2020
Huang et al, ⁶⁹ 2021	26	26	8.0-17.0 ^c	16 (62)	US	NR	Depression	PROMIS	Child	October 2019	2020
Janssen et al, ⁷⁰ 2020	34	34	16.0 (1.2)	22 (65)	Netherlands	NR	Depression	PHQ-9	Child	September 2018	April 2020
Kwok et al, ⁷¹ 2022	50	50	14.4 (3.2)	28 (56)	Canada	NR	Depression	CDI-2	Child	November 2018	August 2020
Li et al, ⁷² 2021	1020	831	15.9 (0.7)	601 (59)	China	NA	Depression	BDI-2	Child	December 2019	March 2020
Li et al, ²⁰ 2022	621	621	14.4 (11.0-17.0) ^b	313 (50)	China	NA	Depression	ZSRAS	Child	2018	January to June 2020
Liao et al, ⁷³ 2021	2496	2496	13.4 (0.9)	1253 (50)	China	NA	Depression	GEAS	Child	December 2019	July 2020
Liu et al, ⁷⁴ 2022	175	86	16.0 (2.6)	86 (49)	US	57	Depression	CES-DC	Child	2015 to 2018	April to May 2020
Magson et al, ⁷⁵ 2021	248	248	14.4 (0.5)	126 (51)	Australia	18	Depression	SMFQ-C	Child	2019	May 2020
McArthur et al, ⁷ 2023	846	846	10.0 (9.0-11.0) ^b	398 (47)	Canada	17	Anxiety	SCAS-C	Child	January 2017	July 2020
Menter et al, ⁷⁶ 2022	109	109	4.6 (0.5)	59 (54)	Canada	15	Depression	BASC-2	Parent	September 2019	May 2020
Mlawer et al, ⁷⁷ 2022	96	96	16.0 (0.6)	53 (55)	US	35	Anxiety	BASC-3	Child	June 2019	May 2020
Operto et al, ⁷⁸ 2022	383	383	9.9 (4.4)	150 (39)	Italy	NR	Depression	CASI	Parent	2018	March 2020
Rau et al, ⁷⁹ 2021	777	777	12.9 (2.0)	414 (53)	Germany	NR	Anxiety	CBCL	Parent	January 2020	June 2020
							Depression	RCADS	Child	January 2020	June 2020
							Anxiety				

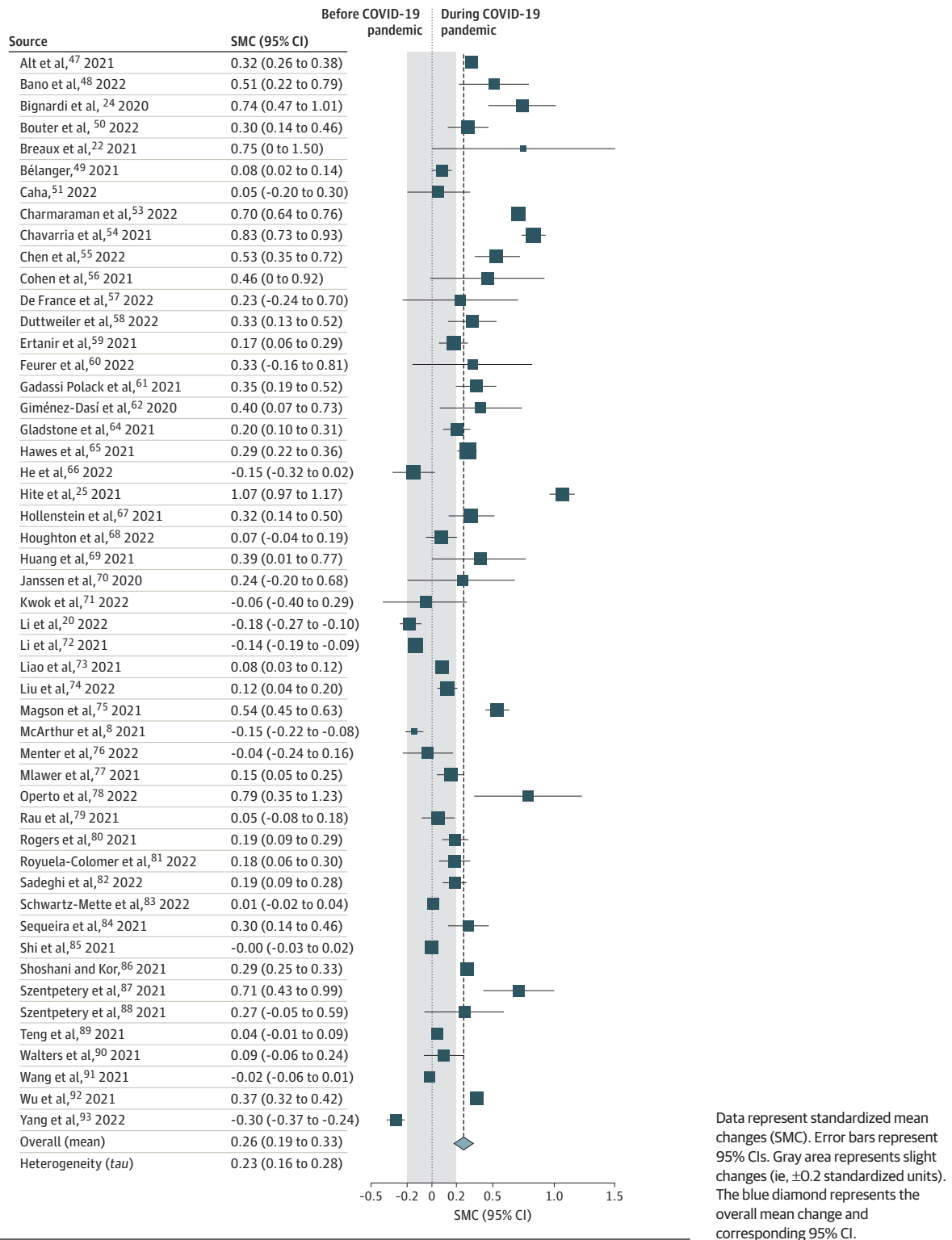
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Table 1. Characteristics of the Included Studies (continued)

Source	Individuals, No.		Age, mean (SD) y	Female, No. (%)	Country	Individuals in racial and ethnic minoritized groups, ^a %	Outcome	Measure	Informant	Data collection dates	
	Before COVID-19	During COVID-19								Before COVID-19	During COVID-19
Rogers et al, ⁸⁰ 2021	407	407	15.4 (1.2)	203 (50)	US	48	Depression Anxiety	CDI-5 GAD-7	Child	October 2019	April 2020
Royuela-Colomer et al, ⁸¹ 2022	383	383	15.6 (1.3)	222 (58)	Spain	NR	Depression Anxiety	DASS-21	Child	October 2019	October 2020
Sadeghi et al, ⁸² 2022	166	166	16.4 (11.0-17.0) ^b	109 (59)	US	34	Depression Anxiety	MFQ SCARED	Child	March 2019	March 2020
Schwartz-Mette et al, ⁸³ 2022	362	362	15.0 (1.1)	203 (63)	US	18	Depression	CESDR-10	Child	January 2020	June 2020
Sequeira et al, ⁸⁴ 2021	92	92	15.1 (1.2)	93 (100)	US	28	Depression	MFQ	Child	April 2016	April 2020
Shi et al, ⁸⁵ 2021	7958	7958	12.0 (2.3)	3850 (48)	China	NA	Depression Anxiety	CES-D SCARED	Child	December 2019	June 2020
Shoshani et al, ⁸⁶ 2022	1537	1537	14.0 (2.0)	799 (52)	Israel	NR	Depression Anxiety	BSI-18	Child	September 2019	May 2020
Szentpetery et al, ⁸⁷ 2021	20	20	12.0-17.0 ^c	NR	US	NR	Depression	PHQ-9	Child	2020	2021
Szentpetery et al, ⁸⁸ 2021	26	26	12.0-17.0 ^c	NR	US	NR	Depression	GAD-7 PHQ-9	Child	2019	2020
Teng et al, ⁸⁹ 2021	1778	1778	NR	877 (49)	China	NA	Depression Anxiety	CES-D STAI	Child	October to November 2019	April to May 2020
Walters et al, ⁹⁰ 2021	170	170	12.4 (1.0)	87 (51)	US	56	Depression	CES-D	Child	November 2019	November 2020
Wang et al, ⁹¹ 2022	1831	1790	13.6 (1.5)	963 (49)	China	NA	Depression	CES-D	Child	October 2019	October 2020
Wu et al, ⁹² 2021	1627	1627	12.7 (0.6)	758 (47)	China	NA	Depression	GAD-7	Child	October 2019	May 2020
Yang et al, ⁹³ 2022	1125	1125	14.3 (0.7)	576 (51)	China	NA	Depression	MMHI-60 CES-DC	Child	November 2019	August 2020

Abbreviations: BAI, Beck Anxiety Inventory; BASC-2, Behavior Assessment System for Children, 2nd Edition; BASC-3, Behavior Assessment System for Children, 3rd Edition; BDI-2, Beck Depression Inventory, 2nd Edition; BSI-18, Brief Symptom Inventory 18; CASI, Child and Adolescent Symptom Inventory; CBCL, Child Behavior Checklist; CDI, Children's Depression Inventory; CDI-2, Children's Depression Inventory, 2nd Edition; CDI-S, Children's Depression Inventory, Short Version; CES-D, Centre for Epidemiological Studies Depression Scale; CES-DC, Centre for Epidemiological Studies Depression Scale for Children; CESDR-10, 10-Item Centre for Epidemiological Studies Depression Scale-Revised; DASS-21, Depression, Anxiety and Stress Scale, 21 items; GAD-7, Generalized Anxiety Disorder Scale 7; GEAS, Global Early Adolescent Study; HSCI-25, Hopkins Symptoms Checklist-25; MASQ, Multidimensional Anxiety Scale for Children; MASQ-2, Multidimensional Anxiety Scale for Children, second Edition; MASQ, Mood and Anxiety Symptom Questionnaire; MFQ, Mood and Feelings Questionnaire; MMHI-60, Mental Health Inventory of Middle School Students Tool; NA, not applicable; NR, not reported; PHQ-9, Patient Health Questionnaire-9; PHQ-A, Patient Health Questionnaire for Adolescents; PROMIS,

Figure 1. Forest Plot of Changes in Depression Symptoms Among Children and Adolescents Surveyed Before and During the COVID-19 Pandemic



consistent with research highlighting COVID-19-related impacts on social isolation and activity restrictions on children’s sadness, sense of purpose, and hopelessness,⁹⁶⁻⁹⁸ which mostly perpetuate depressed mood. Moreover, there tends to

be greater reactivity and episodicity of mood, whereas anxiety has greater intraindividual stability over time.⁹⁹

Our findings suggest increases occurred equally for samples of children and adolescents displaying clinical, threshold, sub-

Table 2. Variables Associated With Changes in Depressive Symptoms Among Children and Adolescents Comparing Measurements Taken Before vs During the COVID-19 Pandemic

Variable	SMC (95% CI)	Magnitude ^a
Categorical moderators		
Sex (n = 51)		
Female	0.32 (0.21 to 0.42)	Small ^b
Male	0.10 (-0.02 to 0.22)	Slight to small
Difference (female - male)	0.22 (0.06 to 0.38)	Slight to small ^b
Age group (n = 50)		
Children (<12 y)	0.21 (0.03 to 0.39)	Slight to small ^b
Adolescents (≥12 y)	0.27 (0.19 to 0.34)	Slight to small ^b
Difference (adolescents - children)	0.05 (-0.16 to 0.26)	Slight to small
Income (n = 17)		
Low	0.18 (-0.06 to 0.41)	Slight to small ^b
Mid to high	0.35 (0.07 to 0.63)	Slight to moderate ^b
Difference (Mid to high - low)	0.17 (-0.17 to 0.51)	Slight to small ^b
Region (n = 50)		
North America	0.25 (0.15 to 0.36)	Slight to small ^b
Asia	0.11 (-0.05 to 0.27)	Slight to small
Europe	0.35 (0.17 to 0.53)	Slight to small ^b
Continuous moderators		
Baseline depressive symptoms (n = 50)	-0.12 (-0.27 to 0.04)	Small to slight
Study quality ^c (n = 50)	-0.03 (-0.18 to 0.12)	Slight
Racial and ethnic minoritized group ^d (n = 21)	-0.01 (-0.23 to 0.21)	Small to slight ^e

Abbreviation: SMC, standardized mean change.²³

^a Magnitude thresholds for interpreting the confidence limits of SMCs were <0.2, slight; 0.2 to 0.6, small; 0.6 to 1.2, moderate; >1.2, large.^{39,44}

^b For these magnitudes, there was at least some evidence of a substantial increase (ie, where the chances of a substantial increase in magnitude and the chances of there being a slight change in magnitude were greater than 25% and less than 95%, respectively).

^c All studies meeting full inclusion criteria were scored 1 (criterion met) or 0 (criterion unmet) for 10 criteria and summed to a score between 0 and 10 with higher scores indicating better study quality.

^d Racial and ethnic minoritized group was defined as individuals in the sample who were not White in a country where the majority of the population is White. This was included as a moderator because persons in racial and ethnic minoritized groups are known to be at greater risk of mental distress.

^e Despite the 95% CI crossing thresholds for small negative and small positive magnitudes (ie, SMC ±0.20), there was still good evidence (93% probability) that the magnitude in question was only slight.

threshold, and even low levels of depression symptoms before the pandemic. The widespread nature of the disruptions caused by the pandemic impacted samples across the full spectrum of mental health symptomatology (relative to their baseline value for mood). These findings are consistent with sensitizing effects in 2 ways. First, those who were experiencing depression before the pandemic may have had difficulty cop-

ing when faced with additional stressors; second, those with less experience with stress may have had difficulty coping with new unfamiliar and accumulating stressors.¹⁰⁰ Thus, children and adolescents who did not previously seek or need mental health support potentially needed such support during the pandemic. When children and adolescents experience mental distress without access to evidenced-based interventions, their risk of relapse prior to age 17 years is 7 times higher than children and adolescents who receive treatment services.¹⁰¹ Thus, to match the potential increase in demand across the spectrum of mental health, increased resource allocation and provision of mental health services are needed to address the mental health system burden.

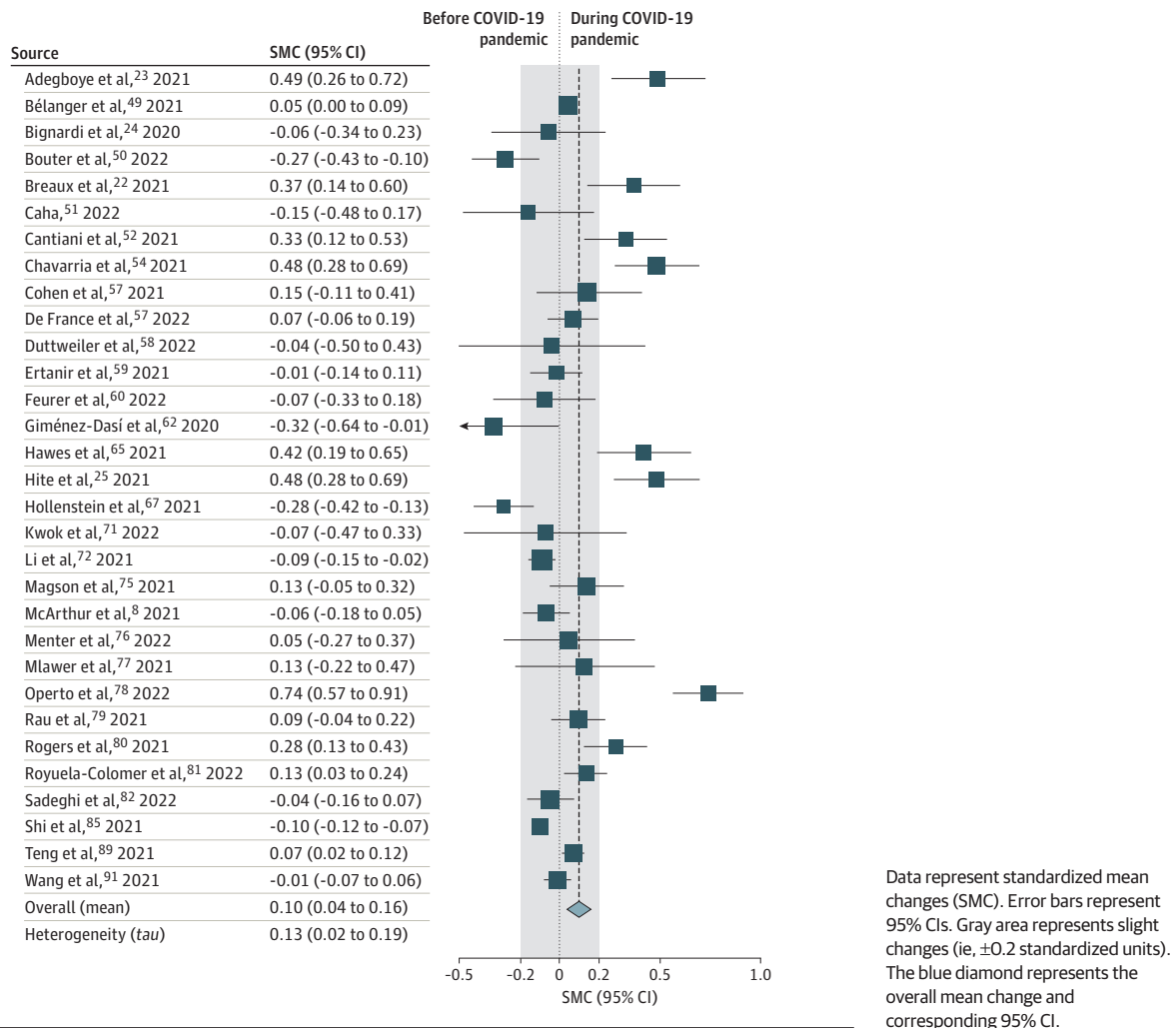
Consistent with prior research,^{1,16,102} increases in depression in this systematic review and meta-analysis were greater among samples of female individuals vs samples of male individuals. In general, depression and anxiety are twice as common in female youth compared to male youth¹⁰³; this sex difference appears to arise after puberty¹⁰⁴ and persists across the lifecourse.¹⁰⁵ Potential explanations for the sex difference in COVID-19 pandemic-related changes in depression include a greater propensity to ruminate,¹⁰⁶ higher reported rates of loneliness,¹⁰⁷ and increased exposure to adversity and violence¹⁰⁸ as well as social media use among female young people compared to their male counterparts.¹⁰⁷ In contrast, male youth are more likely to exhibit externalizing symptoms (eg, aggression and violence),¹⁰⁹ and as such, consideration of internalizing (ie, depression and anxiety) symptoms in isolation may underestimate the magnitude of mental distress and pandemic-related behavioral change among boys. Future research examining internalizing and externalizing symptoms in tandem is needed to gain a more comprehensive perspective on sex differences.

We found some evidence that changes in depression and anxiety symptoms during the COVID-19 pandemic were larger for samples drawn from higher income backgrounds. This finding could be related to greater accessibility to digital devices,¹¹⁰ given the increased use of digital devices during the pandemic⁶ and their known association with depression.^{111,112} It is also possible that children and adolescents from higher income backgrounds had more violated expectations and routine disruptions (eg, the cancellation of extracurricular activities, such as music lessons and sports clubs) during the pandemic due to their more frequent engagement with extracurricular activities.

Our findings are in line with other mental health-related studies which report increases in eating disorders^{113,114} and emergency department visits for suicide attempts and ideation during the COVID-19 pandemic.¹¹⁵ Accordingly, countries should continue to prioritize nationally representative longitudinal studies on child and adolescent mental health. A nimble approach requires a strategy that includes the monitoring of the entire population so that a comprehensive understanding of individual variations in risk is afforded, and in turn, the appropriate allocation of services to those most in need, now and in the future.¹¹⁶

The burden of mental illness experienced at any point in the life course is considerable. Child and adolescent mental ill-

Figure 2. Forest Plot of Changes in Anxiety Symptoms Among Children and Adolescents Surveyed Before and During the COVID-19 Pandemic



ness is associated with poor personal outcomes, such as impaired cognition, academic performance, quality of life, interpersonal functioning, employment, and physical health,^{117,118} and presents a considerable risk for experiencing later psychopathology.¹¹⁹⁻¹²¹ For example, adolescents with persistently high social anxiety are 13 times more likely to meet diagnostic criteria for generalized anxiety disorders and 20 times more likely to be diagnosed with depression in adulthood compared to adolescents with low social anxiety symptoms.¹²² Such continuity between early and later life psychopathology is striking given that mental health problems are leading causes of disability and disease worldwide.^{94,123} Furthermore, if sustained into adulthood, mental illness can disrupt financial support and stability for individuals and families. More broadly, mental health disability leads to an approximate 4% in losses in high-income countries¹²⁴ in gross domestic product annually.^{125,126}

Limitations

This study has limitations. First, our findings should be further verified with studies that incorporate diagnostic inter-

views. Second, while we included studies from 7 non-native English-speaking countries and 2 bilingual countries, language limits to studies published in English may limit the generalizability of our findings. Third, there was only 1 study estimate⁵⁴ of COVID-19-related changes in mental health outcomes among gender-diverse children and adolescents. This represents a potential limitation because gender-diverse children and adolescents bear a disproportionate burden of mental health symptoms.¹²⁷⁻¹²⁹ Fourth, this synthesis can only speak to population-based samples of children and adolescents. Fifth, most studies included in this systematic review and meta-analysis collected data on child and adolescent mental health within the first year of the pandemic.

Conclusions

Results from this systematic review and meta-analysis of longitudinal cohorts suggest that the widespread uncertainty, at times severe restrictions, and repeated disruptions during the pandemic might have pushed some youth, especially female

Table 3. Moderators of Changes in Anxiety Symptoms Among Children and Adolescents Comparing Measurements Taken Before vs During the COVID-19 Pandemic

Variable	SMC (95% CI)	Magnitude ^a
Categorical moderators		
Sex (n = 36)		
Female	0.12 (−0.03 to 0.27)	Slight to small
Male	0.04 (−0.12 to 0.21)	Slight to small
Difference (female - male)	0.08 (−0.13 to 0.29)	Slight to small
Age group (n = 32)		
Children (<12 y)	−0.02 (−0.21 to 0.17)	Small to slight
Adolescents (≥12 y)	0.16 (0.07 to 0.25)	Slight to small
Difference (adolescents - children)	0.18 (−0.03 to 0.39)	Slight to small ^b
Income (n = 15)		
Low	0.03 (−0.18 to 0.24)	Slight to small
Mid to high	0.14 (−0.13 to 0.41)	Slight to small ^b
Difference (mid to high - low)	0.11 (−0.09 to 0.31)	Slight to small
Region (n = 31)		
North America	0.10 (0.002 to 0.20)	Slight to small
Asia	0.06 (−0.11 to 0.24)	Slight to small
Europe	0.10 (−0.03 to 0.23)	Slight to small
Continuous moderators		
Baseline anxiety symptoms (n = 31)	0.07 (−0.07 to 0.20)	Slight to small
Study quality ^c (n = 31)	−0.08 (−0.23 to 0.07)	Slight to small
Racial and ethnic minoritized group (n = 15)	0.06 (−0.15 to 0.27)	Slight to small

Abbreviation: SMC, standardized mean change.

^a Magnitude thresholds for interpreting the confidence limits of SMCs were: <0.2, slight; 0.2 to 0.6, small; 0.6 to 1.2, moderate; >1.2, large.^{39,44}

^b For these magnitudes, there was at least some evidence of a substantial increase (ie, where the chances of a substantial increase in magnitude and the chances of there being a slight change in magnitude were greater than 25% and less than 95%, respectively).²³

^c All studies meeting full inclusion criteria were scored 1 (criterion met) or 0 (criterion unmet) for 10 criteria and summed to a score between 0 and 10 with higher scores indicating better study quality.

individuals and adolescents, beyond their typical stress threshold. Our results, as well as those of many other scholars, sound a clarion call to policy makers that a response is needed to directly address the mental health crisis being experienced by children and adolescents. The development and widespread availability of timely and evidence-based global mental health prevention and intervention efforts to address childhood mental illness are critical and urgently needed.

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