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A Systematic Review and Meta-Analysis: Child and Adolescent Healthcare Utilization for Eating Disorders During the COVID-19 Pandemic

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Objective: To conduct a meta-analysis documenting healthcare service utilization rates for pediatric (age <19 years) eating disorders during compared to before the COVID-19 pandemic.

Method: PsycINFO, MEDLINE, Embase, and Web of Science Core Collection were searched for studies published up to May 19, 2023. Studies with pediatric visits to primary care, inpatient, outpatient, and emergency department for eating disorders before and during the pandemic were included. This preregistered review (PROSPERO CRD42023413392) was reported using PRISMA guidelines. Data were analyzed with random-effects meta-analyses.

Results: A total of 52 studies reporting >148,000 child and adolescent eating disorder–related visits to >300 health settings across 15 countries were included (mean age, 12.7 years; SD = 4.1 years; 87% girls). There was strong evidence of an increase in healthcare use for eating disorders during the pandemic (rate ratio [RR] = 1.54, 95% CI = 1.38-1.71). Moderator analysis revealed larger rate increases among girls (RR = 1.48, 95% CI = 1.28-1.71) compared to boys (RR = 1.24, 95% CI = 1.06-1.45) and for adolescents (age ≥12 to 19 years) (RR = 1.53, 95% CI = 1.29-1.81) compared to children (RR = 0.87, 95% CI = 0.53-1.43). Moderator analysis demonstrated strong evidence of increased use of emergency department (RR = 1.70, 95% CI = 1.48-1.97), inpatient (RR = 1.56, 95% CI = 1.33-1.84), and outpatient (RR = 1.62, 95% CI = 1.35-1.95) services, as well as strong evidence of increased rates of anorexia nervosa (RR = 1.48, 95% CI = 1.24-1.75).

Conclusion: Healthcare use for pediatric eating disorders increased substantially during the COVID-19 pandemic, particularly among girls and adolescents. It is important to continue to monitor whether changes in healthcare use associated with acute pediatric mental distress are sustained beyond the COVID-19 pandemic.

Plain language summary: In this study, the authors analyzed data from 52 studies from 15 countries and found a significant increase in healthcare utilization for eating disorders during the COVID-19 pandemic. The study findings suggest a larger rate increase among adolescents as compared to children, in girls versus boys, and for anorexia nervosa in particular. Results also indicate increased use of emergency department, inpatient and outpatient services for eating disorders during the pandemic.

Study preregistration information: Risk factors for eating disorders for youth during the COVID-19 pandemic; https://www.crd.york.ac.uk/; CRD42023413392.

Diversity & Inclusion Statement: One or more of the authors of this paper self-identifies as a member of one or more historically underrepresented racial and/or ethnic groups in science. One or more of the authors of this paper self-identifies as living with a disability. We actively worked to promote sex and gender balance in our author group. We actively worked to promote inclusion of historically underrepresented racial and/or ethnic groups in science in our author group. While citing references scientifically relevant for this work, we also actively worked to promote sex and gender balance in our reference list. While citing references scientifically relevant for this work, we also actively worked to promote inclusion of historically underrepresented racial and/or ethnic groups science in our reference list. The author list of this paper includes contributors from the location and/or community where the research was conducted who participated in the data collection, design, analysis, and/or interpretation of the work. One or more of the authors of this paper self-identifies as a member of one or more historically underrepresented sexual and/or gender groups in science.

Key words: eating disorders; children; adolescents; COVID-19; meta-analysis

Mounting empirical evidence indicates that the COVID-19 pandemic and its associated public health restrictions contributed to distress among many children and adolescents. It was anticipated and confirmed that certain types of psychopathology, such as depression and anxiety,[1] and more acute distress, including attempted suicide[2] and self-harm,[3] would increase during periods of social isolation and heightened contagion fear.

There are also several reasons to expect the emergence or exacerbation of disordered eating attitudes and behavior (ie, "disordered eating"), such as persistent binge eating, purging and other inappropriate compensatory behaviors, and food restriction, among youth during periods of high stress,[4] such as a global pandemic. Disordered eating patterns can emerge in response to social isolation and the sudden and severe disruption of daily routines,[5] conditions experienced by more than 1.5 billion children and adolescents globally during the pandemic.[6] Furthermore, recent comprehensive meta-analyses of movement behavior during the pandemic have shown considerable evidence that decreases in physical activity[7] occurred in parallel with increased use of screen-based digital devices.[8] These factors, individually or cumulatively, could have triggered or exacerbated shape and weight concerns, particularly given the known links between prolonged media exposure, social comparison, negative self-evaluations, and body image dissatisfaction.[9,10] Many children and adolescents may have also witnessed or experienced increased food scarcity or insecurity during the pandemic, which, in turn, could lead to anxiety about food and eating, including heightened preoccupation with food and portion control, and related compensatory eating behavior.[5] These precipitants of disordered eating also occurred in combination with a removal or reduction of buffering supports for many children and adolescents, including in-person access to peer social networks, support from teachers in school, and access to mental health settings and services.[5]

Numerous individual studies have investigated changes in rates of eating disorders and disordered eating during the pandemic, using various methodologies (eg, self-report, diagnostic interviews, electronic health records). However, the desire for quick and accessible data on pandemic impacts, coupled with the rapid proliferation of online surveys and cross-sectional data, has given rise to uncertainty and, at times, scepticism regarding the behavioral and mental health impacts of the pandemic.[11] Consequently, explicit calls have emerged to enhance the methodological rigor of evidence related to pandemic impacts.[12,13] It has been suggested that, in heeding this call, researchers should more responsibly and reliably inform policy initiatives, public health responses, practice efforts, and scholarly debates regarding the extent to which children and adolescents were negatively affected by the pandemic.[11,12]

Healthcare use data can encompass national registries of electronic health records, discharge codes via hospital records, and/or retrospective patient file reviews, which collectively capture specific diagnostic codes assigned by practitioners during health setting visits. Consequently, such codes offer the most reliable sources to assess change in service use for a given health outcome. Comparing health settings visit rates over time using electronic health records can also yield valuable insights into the shifting landscape of healthcare use, which can, in turn, inform health sector policies, workload management, as well as staffing and training needs.[14]

In this systematic review and meta-analysis, our first objective was to estimate the degree of change in healthcare use for eating disorders among children and adolescents during COVID-19 by comparing pandemic and pre-pandemic rates. To the best of our knowledge, a systematic review of these data does not yet exist. Our second objective was to estimate whether COVID-related changes in use rates for eating disorders differed among socio-demographic moderators, including child sex, age, and geographic region. Our third objective was to estimate whether COVID-related changes in rates of eating disorders differed between healthcare settings or were unique to specific eating disorder diagnoses.

METHOD

Search Strategy and Study Selection

On May 19, 2023, we searched for studies in PsycINFO, MEDLINE, Embase, and Web of Science Core Collection that reported differences in pediatric presentation to healthcare for eating disorders before vs during the COVID-19 pandemic. Controlled vocabulary and keywords were searched for the following concepts: pediatric populations; eating disorders/disordered eating behavior and attitudes; and COVID-19 (Table S1 through Table S4, available online). This review was reported using PRISMA guidelines[15] and was preregistered (PROSPERO: CRD42023413392).

Retrieved studies were imported into Covidence software (Covidence, Melbourne, Australia), and were included if they (1) reported eating disorder–related visit data from any healthcare setting before and during the pandemic for pediatric samples (age <19 years), and (2) were published in English. Titles, abstracts, and full-text articles meeting inclusion criteria were independently reviewed by 3 coders (SM, PP, SK; mean agreement 94%); discrepancies were resolved through consensus.

Our quality assessment of included studies followed the National Institutes of Health Quality Assessment Tool for Observation Cohort and Cross-Sectional Studies.[16] Each study was scored 0 (criterion unmet) or 1 (criterion met) for 10 criteria and summed to obtain a total score ranging from 0 to 10 (Table S5, available online).

Data Extraction and Preparation

Summary data extracted from each study included the following: author names, year of publication, healthcare

setting (eg, primary care, emergency department, inpatient or outpatient clinics), sample characteristics (eg, age, sex/gender, race/ethnicity, socioeconomic status), study characteristics (country, duration of data collation), method for identifying eating disorder–related healthcare use, and number of service visits before and during the COVID-19 pandemic for any eating disorder. Data extraction was conducted independently by 4 coders (PP, SK, KZ, SP; mean agreement 84.3%); discrepancies were resolved between senior authors (SM, RN).

Rates of healthcare use before and during the COVID-19 pandemic were determined by dividing the number of visits to a given setting by the corresponding data collation time. Rate ratios were calculated by dividing the relative rate during COVID-19 by the relative rate before COVID-19. This rate ratio was subsequently log-transformed. Rate ratio standard errors were calculated by taking the square root of the sum of the reciprocals of the absolute numbers of visits for both before and during the COVID-19 periods. To address instances in which cell counts were zero, a value of 0.5 was applied.

Data Analysis

We conducted random-effects meta-analyses using the linear mixed-model procedure in SAS OnDemand for Academics (Version 9.4; SAS Institute). The dependent variable in each meta-analysis was the natural logarithm of the study estimate rate ratio across health settings and diagnostic criteria. Study estimates were weighted by the inverse square of their standard errors. We applied a single random effect to represent the identity of each study; the square root of the between-study variance (the tau [τ] statistic) provided an estimate of heterogeneity. We also added a single fixed effect into the mixed model to control for the potential confounding effect of study quality.

Categorical moderators were assessed by predicting and comparing rate ratios between different levels of the moderator (eg, comparing rate ratios between girls and boys). Only 2 studies reported data for samples with different sociodemographic characteristics (ie, race and ethnicity and level of social advantage). We therefore conducted a narrative assessment of the level of evidence in these studies.

The meta-analyzed effects and τ values were back-transformed to rate ratios. We applied predefined[2] thresholds for interpreting the confidence limits of slight (1.00 to <1.11), small (1.11 to <1.43), moderate (1.43 to <2.00), and large (≥2.00) rate increases, and for large (<0.50), moderate (0.50-<0.70), small (0.70-<0.90), and slight (0.90-<1.00) rate decreases. Thresholds for interpreting the confidence limits of τ values were determined by taking the square root of each threshold for rate increases. Precision of estimation is expressed as 95% CIs. We inferred the magnitude of effects and τ values by interpreting the lower and upper confidence limits. If the CI for a meta-analysed mean or τ value had substantial and opposite direction lower and upper limits (ie, both positive and negative confidence limits), the ratio was deemed inconclusive (failure to reject a substantial hypothesis); otherwise, the ratio was deemed to have adequate precision at the 95% level.[17] The extent of overlap of the 95% CI 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 ratio.[17] These areas represent the probabilities that the true ratio has those magnitudes in a Bayesian analysis when the prior is non-informative.[17] Thresholds for interpreting the probabilities for a given magnitude are provided in Table S6 (available online). In brief, the level of evidence for an increase in healthcare use for eating disorders was regarded as "good" when the probability of a substantial increase (ie, a rate ratio >1.11) and decrease (rate ratio <0.90) were respectively likely (75% to 95%) and unlikely (5% to 25%). The level of evidence for an increase was regarded as "very good" when the probability of a substantial increase and decrease were respectively very likely (95% to 99.5%) and very unlikely (0.5% to 5%). Finally, the level of evidence for an increase was regarded as "strong" when the probability of a substantial increase and decrease were respectively most likely (≥99.5%) and most unlikely (≤0.5%).

RESULTS

A total of 2,298 non-duplicate records were identified by our search, 217 full texts were reviewed, and 52 studies met full inclusion criteria (Figure 1). Characteristics of included studies are displayed in Table 1[18-69] and Table S7 (available online).

Study Characteristics

Across 52 studies, more than 47.5 million child and adolescent visits to >300 health settings were recorded, of which more than 148,000 were eating disorder–related visits. The average age of participants across data collection points was 12.7 years (SD = 4.1, range = 2.0-19.0). The average proportion of girls was 84.3% before and 89.6% during the pandemic. Pre-pandemic visits ranged from 2006 to 2020, and pandemic visits covered 2020 to 2022. One study (2%) reported data from Asia, 19 studies (36.5%) reported data from Europe, 19 (36.5%) from

FIGURE 1 PRISMA Flow Chart
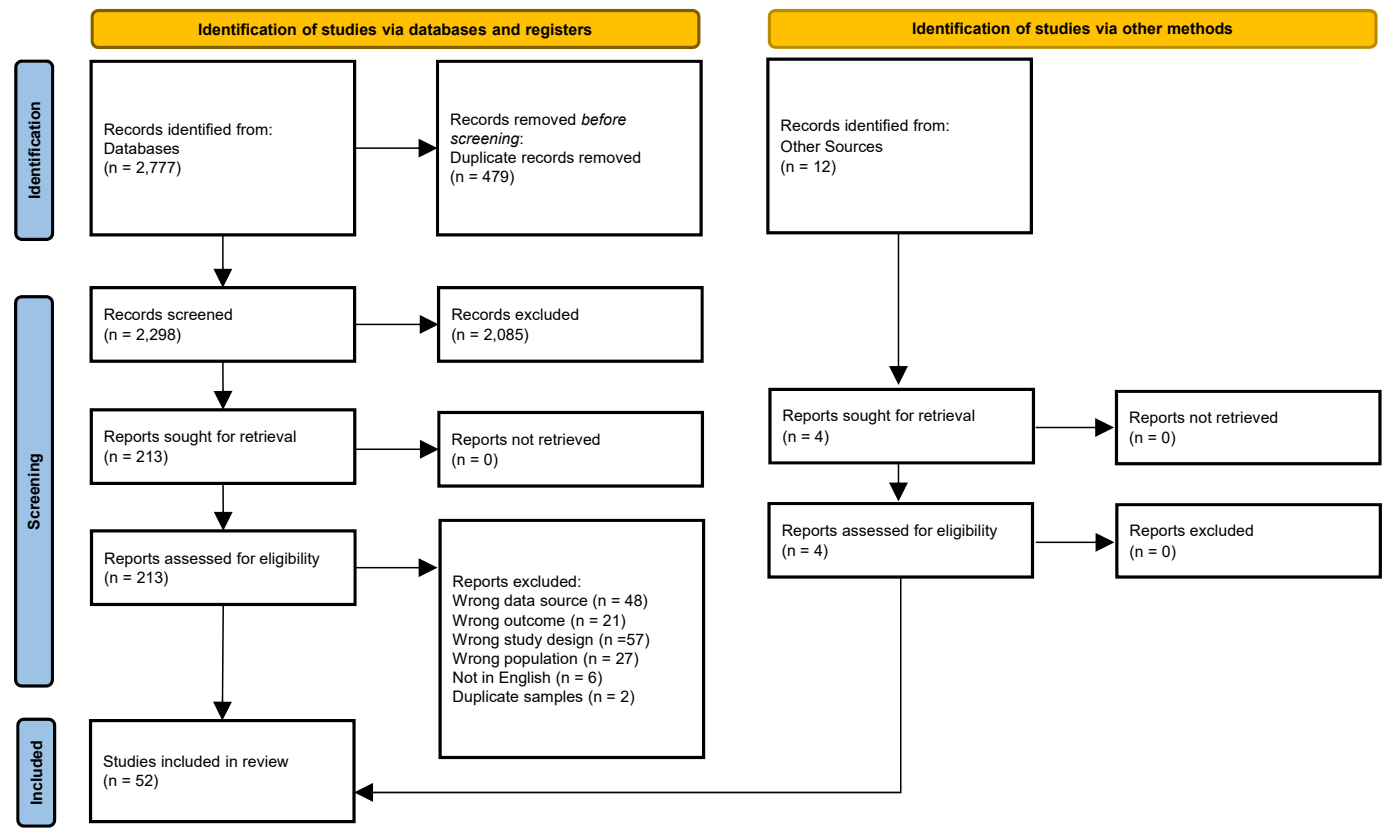
North America, 8 (15%) from Oceania, and 5 (10%) from the Middle East. The average study quality score was 7.3 (range = 5-9; quality scores for individual studies are displayed in Table S8, available online).

Changes in Use for Pediatric Eating Disorders

The study estimate rate ratios (RRs) included in the overall meta-analysis are displayed in Figure 2 alongside their corresponding 95% CIs. Further details about the derivation of these study-estimate RRs, including raw numbers of visits for each study, the duration of time over which these healthcare use data were collated, relative rates of healthcare use before and during COVID, as well as the final RR applied to our meta-analyses, are displayed in Table S9 (available online). Results indicate strong evidence of an increase in healthcare use during the COVID-19 pandemic for eating disorders (RR = 1.54, 95% CI = 1.38-1.71; small-to-moderate magnitude). There was also strong evidence of substantial heterogeneity (τ = 1.40, 95% CI = 1.40-1.50). Publication bias, outliers, or influential cases were not clearly evident, as shown in the funnel plot in Figure S1 (available online) and confirmed by the results of

a sensitivity analysis and "leave-one-out" analysis in Tables S10 and S11 (available online), respectively.

Sensitivity Analysis

Although the COVID-19 pandemic began in some regions of the world in January 2020, widespread physical and social distancing measures, including lockdowns, were implemented in most countries only in March 2020. This raised the possibility that our meta-analysis could be constrained by the date cut points designated by study authors, with some studies (K = 10) including numbers of visits during January and February 2020 in their "during COVID" data (along with additional data from 2020 or 2021). To ensure that our results were not confounded by this slight difference in the conceptualization of the "before" and "during" COVID data collation periods across studies, we conducted a sensitivity analysis to determine the impact, if any, of removing these 10 studies on the meta-analyzed mean. After their exclusion, healthcare use for eating disorders increased slightly to 1.61 (95% CI = 1.43-1.81) from an RR of 1.54 (95% CI = 1.38-1.71). Consequently, we interpret the

TABLE 1 Characteristics of the Included Studies

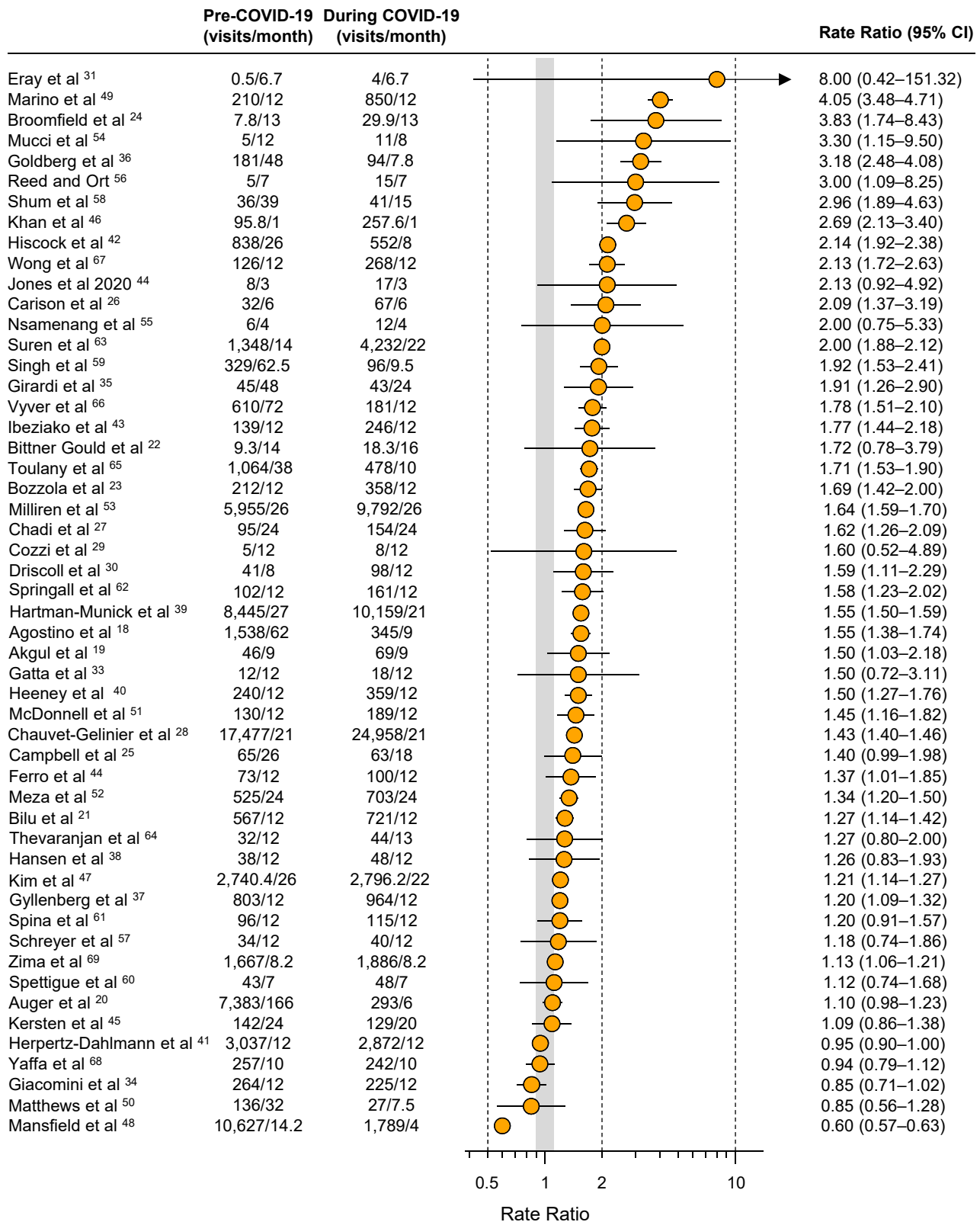| Source	Country	Visit categories	Data collection periods	
			Pre-COVID	**During COVID**
Agostino et al. (2021)[18]	Canada	AN and AAN	January 1, 2015, to February 28, 2020	March 1, 2020, to November 30, 2020
Akgul et al. (2023)[19]	Turkey	AN-BP, AN-R, AAN, BN, ARFID, UFED	June 2019 to February 2020	June 2021 to February 2022
Auger et al. (2023)[20]	Canada	AN, BN, BED, ARFID, OSFED, UFED	April 1, 2006, to February 2020	March to August 2020 and September to March 2021
Bilu et al. (2022)[21]	Israel	ED	November 1, 2019, to October 31, 2020	November 1, 2020, to October 31, 2021
Bittner Gould et al. (2022)[22]	US	ED	January 2019 to February 2020	June 2020 to September 2021
Bozzola et al. (2022)[23]	Italy	ED	March 1, 2019, to March 1, 2020	March 2, 2020, to March 2, 2021
Broomfield et al. (2021)[24]	UK	ED	January 2019 to February 2020	February 2020 to February 2021
Campbell et al. (2022)[25]	Ireland	AN, ARFID, EDNOS	January 2018 to February 2020	March 2020 to August 2021
Carison et al. (2022)[26]	Australia	ED	April 2019 to September 2019	April 2019 to September 2020
Chadi et al. (2021)[27]	Canada	ED	January 2018 to December 2019	January 2020, to December 2022
Chauvet-Gelinier et al. (2022)[28]	France	AN	June 2018 to February 2020	March 2020 to November 2021
Cozzi et al. (2023)[29]	Italy	ED	March 1, 2019, to February 28, 2020	March 1, 2020, to February 28, 2021, and March 1, 2021, to February 28, 2022
Driscoll et al. (2023)[30]	Ireland	AN, BN, ARFID, BED, OSFED, feeding disorder secondary to other	May 2019 to December 2019	January 2020 to December 2020
Eray et al. (2021)[31]	Turkey	ED	March 11, 2019, to September 30, 2019	March 11, 2020, to September 30, 2020
Ferro et al. (2023)[32]	Italy	ED	March 10, 2019, to March 10, 2020	March 11, 2020, to March 10, 2021
Gatta et al. (2022)[33]	Italy	ED	February 2019 to February 2020	March 2020 to March 2021
Giacomini et al. (2022)[34]	Italy	ED	January 2019 to December 2019	January 2020, to December 2020, and January 2021, to September 2021
Girardi et al. (2022)[35]	Italy	AN, AAN	March 2016 to March 2020	March 2020 to March 2022
Goldberg et al. (2022)[36]	Israel	AN, AAN	January 2015 to December 2019	May 1, 2020, to May 2021

(continued)

TABLE 1 Continued

Source	Country	Visit categories	Data collection periods	
			Pre-COVID	**During COVID**
Gyllenberg et al. (2023)[37]	Finland	ED	2019	2020 and January to September 2021
Hansen et al. (2021)[38]	New Zealand	AN, BN, EDNOS, UFED, and other feeding and eating disorders of childhood, specific phobia related to eating	January 2019 to December 2019	January 2020 to December 2020
Hartman-Munick et al. (2022)[39]	US	ED	January 1, 2018, to March 31, 2020	April 2020 to December 2021
Heeney et al. (2022)[40]	Australia	AN	January 2016 to December 2019	January 2020 to December 2020
Herpertz-Dahlmann et al. (2022)[41]	Germany	AN	2019	2020 and 2021
Hiscock et al. (2022)[42]	Australia	ED	January 2018 to February 2020	March to October 2020
Ibeziako et al. (2022)[43]	US	ED	March 2019 to February 2020	March 2020 to February 2021
Jones et al. (2020)[44]	Australia	ED	May 1, 2019, to July 31, 2019	May 1, 2020, to July 31, 2020
Kersten et al. (2023)[45]	Netherlands	ED	2017 to 2019	2020 to September 2021
Khan et al. (2023)[46]	Australia	ED	July 2017 to February 2020	March 2020, to December 2021, and January 2022, to June 2022
Kim et al. (2022)[47]	Korea	AN	January 2018, to February, 2020	March 2020 to May 2021
Mansfield et al. (2021)[48]	UK	ED	January 2019, to March 7, 2020	March 28, 2020, to July 18, 2020
Marino et al. (2021)[49]	Italy	AN	2019	2020
Matthews et al. (2021)[50]	US	AN	July 15, 2017, to March 14, 2020	March 15, 2020, to May 12, 2020, and May 13, 2020, to October 1, 2020
McDonnell et al. (2022)[51]	Ireland	AN, OED	March 1, 2019, to February 28, 2020	March 1, 2020, to February 28, 2021
Meza et al. (2023)[52]	US	ED	February 2018 to February 2020	June 2020 to June 2022
Milliren et al. (2023)[53]	US	AN, ARFID, BN, OSFED, UFED	January 2018 to March 2020	April 2020 to June 2022
Mucci et al. (2022)[54]	Italy	ED	March 9, 2019, to March 8, 2020	March 9, 2020, to October 10, 2020, and October 11, 2020, to March 30, 2021

TABLE 1 Continued

Source	Country	Visit categories	Data collection periods	
			Pre-COVID	**During COVID**
Nsameng et al. (2022)[55]	Canada	ED	January 1, 2015, to October 31, 2019	January 1. 2020, to October 31, 2020
Reed and Ort (2022)[56]	US	ED	September 1, 2019, to March 31, 2020	September 1, 2020, to March 31, 2021
Schreyer et al. (2023)[57]	US	ED	March 13, 2018, to March 13, 2020	March 13, 2020, to March 13, 2022
Shum et al. (2022)[58]	US	ED	January 1, 2017, to February 28, 2020	March 1, 2020, to June 30, 2021
Singh et al. (2022)[59]	Canada	ED	January 2015	December 2020
Spettigue et al. (2021)[60]	Canada	AN-R, AN-BP, ARFID, AAN, UFED, OED	April 1, 2019, to October 31, 2019	April 1, 2020, to October 31, 2020
Spina et al. (2022)[61]	Italy	ED	March 9, 2019, to March 8, 2020	March 9, 2020, to March 8, 2021
Springall et al. (2022)[62]	Australia	ED	2019	2020
Suren et al. (2022)[63]	Norway	ED	January 2017 to February 2018, and March 2018 to December 2019	January 2019, to February 2020, and March 2020, to December 2021
Thevaranjan et al. (2022)[64]	Canada	ED	March 2019 to February 2020	March 2020, to March 2021
Toulany et al. (2022)[65]	Canada	ED	January 1, 2017, to February 29, 2020	March 1, 2020, to December 26, 2020
Vyver et al. (2022)[66]	Canada	AN	March 11, 2014, to March 10, 2020	March 11, 2020, to March 10, 2021
Wong et al. (2023)[67]	Australia	AN	2019	2020
Yaffa et al. (2021)[68]	Israel	ED	January 1, 2015, to October 31, 2019	January 1, 2020, to October 31, 2020
Zima et al. (2022)[69]	US	ED	March 18, 2019, to November 24, 2019	March 16, 2020, to November 22, 2020

Note: AAN= atypical anorexia nervosa; AN = anorexia nervosa; AN-BP = binge/purge-type anorexia nervosa; AN-R = restrictive-type anorexia nervosa; ARFID = avoidant–restrictive food intake disorder; BED = binge eating disorder; BN = bulimia nervosa; ED = eating disorder; EDNOS = eating disorder not otherwise specified; OED = other eating disorder; OSFED = other specified feeding or eating disorder; UFED = unspecified feeding and eating disorder.

FIGURE 2 Changes in Child and Adolescent Health Service Use for an Eating Disorder Expressed as Ratios of Rates During the COVID-19 Pandemic to Those Before the Pandemic

	Pre-COVID-19 (visits/month)	During COVID-19 (visits/month)		Rate Ratio (95% CI)
Eray et al [31]	0.5/6.7	4/6.7		8.00 (0.42–151.32)
Marino et al [49]	210/12	850/12		4.05 (3.48–4.71)
Broomfield et al [24]	7.8/13	29.9/13		3.83 (1.74–8.43)
Mucci et al [54]	5/12	11/8		3.30 (1.15–9.50)
Goldberg et al [36]	181/48	94/7.8		3.18 (2.48–4.08)
Reed and Ort [56]	5/7	15/7		3.00 (1.09–8.25)
Shum et al [58]	36/39	41/15		2.96 (1.89–4.63)
Khan et al [46]	95.8/1	257.6/1		2.69 (2.13–3.40)
Hiscock et al [42]	838/26	552/8		2.14 (1.92–2.38)
Wong et al [67]	126/12	268/12		2.13 (1.72–2.63)
Jones et al 2020 [44]	8/3	17/3		2.13 (0.92–4.92)
Carison et al [26]	32/6	67/6		2.09 (1.37–3.19)
Nsamenang et al [55]	6/4	12/4		2.00 (0.75–5.33)
Suren et al [63]	1,348/14	4,232/22		2.00 (1.88–2.12)
Singh et al [59]	329/62.5	96/9.5		1.92 (1.53–2.41)
Girardi et al [35]	45/48	43/24		1.91 (1.26–2.90)
Vyver et al [66]	610/72	181/12		1.78 (1.51–2.10)
Ibeziako et al [43]	139/12	246/12		1.77 (1.44–2.18)
Bittner Gould et al [22]	9.3/14	18.3/16		1.72 (0.78–3.79)
Toulany et al [65]	1,064/38	478/10		1.71 (1.53–1.90)
Bozzola et al [23]	212/12	358/12		1.69 (1.42–2.00)
Milliren et al [53]	5,955/26	9,792/26		1.64 (1.59–1.70)
Chadi et al [27]	95/24	154/24		1.62 (1.26–2.09)
Cozzi et al [29]	5/12	8/12		1.60 (0.52–4.89)
Driscoll et al [30]	41/8	98/12		1.59 (1.11–2.29)
Springall et al [62]	102/12	161/12		1.58 (1.23–2.02)
Hartman-Munick et al [39]	8,445/27	10,159/21		1.55 (1.50–1.59)
Agostino et al [18]	1,538/62	345/9		1.55 (1.38–1.74)
Akgul et al [19]	46/9	69/9		1.50 (1.03–2.18)
Gatta et al [33]	12/12	18/12		1.50 (0.72–3.11)
Heeney et al [40]	240/12	359/12		1.50 (1.27–1.76)
McDonnell et al [51]	130/12	189/12		1.45 (1.16–1.82)
Chauvet-Gelinier et al [28]	17,477/21	24,958/21		1.43 (1.40–1.46)
Campbell et al [25]	65/26	63/18		1.40 (0.99–1.98)
Ferro et al [44]	73/12	100/12		1.37 (1.01–1.85)
Meza et al [52]	525/24	703/24		1.34 (1.20–1.50)
Bilu et al [21]	567/12	721/12		1.27 (1.14–1.42)
Thevaranjan et al [64]	32/12	44/13		1.27 (0.80–2.00)
Hansen et al [38]	38/12	48/12		1.26 (0.83–1.93)
Kim et al [47]	2,740.4/26	2,796.2/22		1.21 (1.14–1.27)
Gyllenberg et al [37]	803/12	964/12		1.20 (1.09–1.32)
Spina et al [61]	96/12	115/12		1.20 (0.91–1.57)
Schreyer et al [57]	34/12	40/12		1.18 (0.74–1.86)
Zima et al [69]	1,667/8.2	1,886/8.2		1.13 (1.06–1.21)
Spettigue et al [60]	43/7	48/7		1.12 (0.74–1.68)
Auger et al [20]	7,383/166	293/6		1.10 (0.98–1.23)
Kersten et al [45]	142/24	129/20		1.09 (0.86–1.38)
Herpertz-Dahlmann et al [41]	3,037/12	2,872/12		0.95 (0.90–1.00)
Yaffa et al [68]	257/10	242/10		0.94 (0.79–1.12)
Giacomini et al [34]	264/12	225/12		0.85 (0.71–1.02)
Matthews et al [50]	136/32	27/7.5		0.85 (0.56–1.28)
Mansfield et al [48]	10,627/14.2	1,789/4		0.60 (0.57–0.63)

Rate Ratio

0.5 1 2 10

Note: Rate ratios are plotted on a log axis. Note that the rate ratio of 1 represents no change. Gray area represents slight changes (0.90× to 1.11×). Vertical dashed lines indicate thresholds for large reductions (0.50×) and large and extremely large increases (2.0× and 10.0x). Error bars represent 95% CIs. A value of 0.5 replaced counts of zero.

TABLE 2 Changes in Child and Adolescent Health Service Use for Eating Disorders Expressed as Ratios of Rates During the COVID-19 Pandemic to Those Before the Pandemic Predicted for Different Levels of Categorical Moderators

	No. of study estimates (K)[a]	Rate ratio	
		Mean (95% CI)	Magnitude[b,c]
Sex			
Female	24	1.48 (1.28-1.71)	Small to moderate ↑
Male	23	1.24 (1.06-1.45)	Slight to moderate ↑
Age group			
Children (<12 y)	10	0.87 (0.53-1.43)	Inconclusive
Adolescents (≥12 to 19 y)	21	1.53 (1.29-1.81)	Small to moderate ↑
Geographic region			
North America	19	1.52 (1.30-1.77)	Small to moderate ↑
Europe	19	1.42 (1.22-1.66)	Small to moderate ↑
Oceania	8	1.89 (1.49-2.40)	Moderate to large ↑
Middle East	5	1.56 (1.14-2.14)	Small to large ↑
Asia	1	1.21 (1.14-1.27)	Small ↑
Health service used			
Emergency department	11	1.70 (1.37-2.10)	Small to large ↑
Inpatient	28	1.68 (1.41-2.00)	Small to large ↑
Outpatient	11	1.47 (1.24-1.74)	Small to moderate ↑
Primary care	3	1.21 (0.28-5.27)	Inconclusive
Diagnostic category			
Anorexia nervosa	15	1.60 (1.31-1.95)	Small to moderate ↑
Bulimia nervosa	5	1.42 (0.78-2.58)	Inconclusive
ARFID	4	1.67 (0.78-3.57)	Inconclusive
EDNOS	5	1.63 (0.84-3.15)	Inconclusive

Note: ARFID = avoidant–restrictive food intake disorder; EDNOS = eating disorder not otherwise specified; ↑ = substantial increase.
[a]K represents the number of study estimates used in a given meta-analysis for each level of the categorical moderator being analyzed.
[b]Magnitude thresholds for interpreting confidence limits of rate-ratio decreases: 0.90 to <1.00, slight; 0.70 to <0.90, small; 0.50 to <0.70, moderate; <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.
[c]Inconclusive indicates inadequate precision (ie, where the 95% CI includes substantial increases and decreases).

sensitivity of the results to this slight difference in the conceptualization of "before" and "during" COVID data collation periods as mostly trivial.

Moderation of Changes in Use for Pediatric Eating Disorders

The outcomes of moderation analysis are displayed in Table 2. There was strong evidence of increased eating disorders among girls, and good evidence of an increase among boys. The comparison of these rates represents good evidence that the increase was greater for girls than for boys (girls:boys ratio = 1.19, 95% CI = 1.05-1.36; slight-to-small difference in magnitude).

Moderation by age was assessed by estimating and comparing rate ratios between samples of children (age <12 years) and adolescents (age ≥12 to 19 years). There was strong evidence of increased eating disorders among adolescents. The comparison of rate ratios represented good evidence that the rate change was greater for adolescents than for children (adolescent:child ratio = 1.75, 95% CI =

1.07-2.87; slight-to-large difference in magnitude). Changes among children were inconclusive.

There was strong evidence of increased eating disorders in studies from North America, Europe, and Oceania, and very good evidence in samples from the Middle East. One study from Asia reported strong evidence of increased eating disorders. There was good evidence that changes in eating disorders were larger in studies from Oceania than in those from Europe, and modest evidence that changes were larger in studies from Oceania than those from North America and Asia. Other comparisons were inconclusive (Table S12, available online).

There was strong evidence of an increase in emergency department and outpatient clinic visits, as well as hospitalizations resulting from eating disorders. Change in primary care service use for eating disorders was inconclusive.

Anorexia nervosa, bulimia nervosa, avoidant–restrictive food intake disorder, and eating disorders not otherwise specified were the only categories for which there were sufficient data to assess moderation by diagnostic profile.

There was strong evidence of an increase in healthcare use for anorexia nervosa. Changes in healthcare use for other categories were inconclusive.

One study[20] involving adolescents presented inconclusive evidence of disparities in changes in eating disorders among groups with differing levels of socioeconomic advantage (Table S13, available online). One study[58] involving children and adolescents provided inconclusive evidence of differences in changes in eating disorders among different racial and ethnic groups (Table S14, available online).

DISCUSSION

In the current meta-analysis of 52 studies, across 15 countries and encompassing 300 health settings with more than 148,000 recorded visits, we identified strong evidence of an increase in healthcare use for eating disorders during the COVID-19 pandemic, which was largely consistent across geographical regions. Findings are commensurate with increases in risk factors for disordered eating during the pandemic. These risk factors include lifestyle changes such as disrupted routines, school closures, weight gain, decreases in physical activity,[7] increases in screen time and social comparison,[8] food insecurity,[5] as well as greater loneliness, depression, and anxiety symptoms.[1,70] Any one of these factors can challenge children and adolescents, prompting preoccupation with food, feelings of helplessness, compensatory eating behavior, and body image.[71]

In addition to the increased risk factors observed for disordered eating, it is also possible that barriers to help-seeking diminished for children and parents during the pandemic. For example, the rapid adoption of telemental health may have reduced transportation challenges for families needing assessment and treatment services.[72] The shift to online schooling may have also allowed children and adolescents to leave school less conspicuously, which could have reduced the stigma that some children experience when engaging in help seeking.[73] Moreover, the rise in mental distress[1,74] and help seeking[2,75] among children and adolescents during the pandemic may have influenced attitudes toward discussing and seeking mental health supports. In addition, restrictions on attending workplaces and schools meant that many families were at home together, providing parents with more oversight of their child's potentially maladaptive eating behavior and mental health. If they observed concerning signs and symptoms of disordered eating, this may have prompted them to seek out assessment or intervention supports for their child. Finally, "high achievers" in academics and/or extracurriculars may have viewed the pandemic as a reprieve from their (over)commitments,[76] providing them with time and space to focus on their mental health and well-being.

An increase in healthcare use for eating disorders is consistent with studies showing increases in healthcare use for other pediatric psychopathologies.[3] For example, in a meta-analysis of >11 million emergency department visits across 18 countries,[2] rates of suicide attempts increased by 22% among children and adolescents during the pandemic, surpassing expected time trends. Prospective research is needed to determine whether increases in healthcare use for acute psychological distress are short-lived or sustained over time.[77]

We observed an increase in healthcare use for eating disorders among both girls and boys, although the increase was more pronounced among girls. It is possible that eating disorders increased in boys to some degree, but that their healthcare use did not increase to the same extent as in girls. Nonetheless, girls have consistently been more likely to be diagnosed with an eating disorder, especially bulimia nervosa and binge-eating disorder,[78] and also to engage in more disordered eating behavior.[79,80] Girls tend to feel more pressure than boys to be thin and are more likely to use more extreme measures to accomplish "thinness."[81-84] Conversely, boys are likely to experience heightened pressures to bulk up and build muscles. Depression is a key risk factor for problematic disordered eating,[85] and depression symptoms increased, particularly for girls, during the pandemic.[1] These findings suggest that, since the onset of the pandemic, healthcare providers have been far more likely to encounter (adolescent) girls who are engaging in disordered eating behavior to address body image and weight concerns compared to before the pandemic.

When we analyzed data that specifically addressed changes in eating disorder diagnostic categories before vs during the pandemic, we found that healthcare use for anorexia nervosa increased. Changes in healthcare use for bulimia nervosa, avoidant–restrictive food intake disorder, and eating disorder not otherwise specified were inconclusive, likely due to too few studies of children reporting on these discrete diagnoses. A recent retrospective study by Couturier *et al.* on healthcare use among eating disorder subgroups (unrelated to COVID-19) found that anorexia nervosa was associated with the highest rates of healthcare use among the eating disorders, particularly for mental health–related hospitalizations, mental health pediatric visits, and psychiatrist visits. Their finding of increased rates of anorexia nervosa herein could be attributed to several factors. Anorexia nervosa is associated with a high mortality rate.[83] This should, in principle, lead to a more urgent demand for healthcare services—even within the context of public health restrictions—reflecting the need to prioritize

services for the most severe and potentially fatal cases of eating disorders. Our findings could also reflect factors such as greater familiarity with anorexia nervosa among parents and practitioners, as well as the more visible signs (ie, underweight, skeletal) of anorexia nervosa in comparison to other eating disorders than can be more readily "hidden."

We found strong evidence of an increase in rates of help seeking for eating disorders across healthcare settings, including an increase in emergency department visits, hospitalizations, and use of outpatient services during the pandemic. However, change in primary care service use was inconclusive, based on the studies available for inclusion in this meta-analysis. These findings suggest that rates increased consistently across the eating disorder severity spectrum, so the increase in observed rates cannot be attributed to small but potentially clinically meaningful changes in symptom severity for children and adolescents who might have been hovering near the diagnostic threshold prior to the pandemic. As such, the course of illness for newly affected children and adolescents cannot be assumed to be transient, and future research examining the outcomes of children and adolescents with eating disorders identified during the pandemic is needed. Greater targeted and specialized funding and training are also needed to respond to the increased influx of eating disorders in acute care services, as studies have found that health professionals working outside of specialized eating disorder programs report a lack of training and confidence in their ability to identify and manage eating disorders, particularly disorders other than anorexia nervosa.[86,87]

Several study limitations should be noted. First, although healthcare use data provide valuable information across settings and countries, it is important to note that case definitions vary across studies (Table S7, available online), and discussions regarding diagnostic accuracy (sensitivity, specificity) were infrequent. In this study, we applied a broad definition of healthcare use, encompassing any individual seeking support for an eating disorder–related reason, irrespective of diagnosis. Consequently, changes in healthcare use within the context of this study cannot be interpreted as reflecting changes in diagnosis. Second, there is a potential for non-differential misclassification bias arising from heterogeneity in the case definitions used to identify help seeking for an eating disorder. As a result, there could be a bias toward the null, resulting in potential underreporting of use rates. Third, the included studies spanned substantive changes in eating disorder nosology, such as the transition from *DSM-IV* to *DSM-5* criteria. This also could have contributed to underreporting, particularly for eating disorders for which definitions have appeared

(binge-eating disorder, avoidant–restrictive food intake disorder), disappeared (eating disorders not otherwise specified), or changed significantly (anorexia nervosa, bulimia nervosa). Fourth, although 15 countries were represented in our analysis across Asia, Europe, North America, the Middle East and Oceania, they represent only a subset of the global population. Finally, although we narratively summarized data from individual studies about social disadvantage and ethnic and racial disparities, there were no studies available that had reported data on gender minority youth. This represents a limitation insofar as gender diversity is itself a risk factor for disordered eating.[88]

It is critical to continue to examine the psychological impact of the COVID-19 pandemic to determine the urgency of addressing the current and potentially unmet mental health needs of children and adolescents. In the current meta-analysis, we found that presentation to healthcare settings for eating disorders increased by a factor of more than 1.5 during the pandemic. Because personal control is proposed to be associated with eating disorder etiology and persistence,[89] clinicians should be vigilant about the emergence or exacerbation of eating disorders when personal control is challenged, as it was for many children and adolescents during the pandemic because of social and physical distancing restrictions.

Understanding changes in service-use across healthcare settings, such as increases in healthcare use for eating disorders, is essential for ensuring that adequate training and resources are available to service providers to manage capacity, provide tailored support, and respond promptly and effectively to the changing needs of youth at risk forf acute and chronic psychological distress. Future research is needed to determine the outcomes of children and adolescents with eating disorders treated during vs before the pandemic, factors underpinning the rise in rates observed in healthcare settings, and whether increasingly-frequent presentation to healthcare settings for eating disorders is sustained over time.

CRediT authorship contribution statement

Sheri Madigan: Writing – original draft, Supervision, Resources, Project administration, Methodology, Investigation, Data curation, Conceptualization. **Tracy Vaillancourt:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Gina Dimitropoulos:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Shainur Premji:** Writing – review & editing, Visualization, Methodology, Data curation. **Selena M. Kahlert:** Writing – review & editing, Methodology, Data curation. **Katie**

Zumwalt: Writing – review & editing, Methodology, Data curation. **Daphne J. Korczak:** Writing – review & editing, Validation. **Kristin M. von Ranson:** Writing – review & editing, Validation. **Paolo Pador:** Methodology, Data curation. **Heather Ganshorn:** Writing – review & editing, Methodology, Data curation. **Ross D. Neville:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Data curation, Conceptualization.

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