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ORIGINAL ARTICLE

The prevalence and risk factors of screen-based disordered eating among university students: a global systematic review, meta-analysis, and meta-regression

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Abstract

Purpose The purpose of this review was to estimate the prevalence of screen-based disordered eating (SBDE) and several potential risk factors in university undergraduate students around the world.

Methods An electronic search of nine data bases was conducted from the inception of the databases until 1st October 2021. Disordered eating was defined as the percentage of students scoring at or above established cut-offs on validated screening measures. Global data were also analyzed by country, research measure, and culture. Other confounders in this review were age, BMI, and sex.

Results Using random-effects meta-analysis, the mean estimate of the distribution of effects for the prevalence of SBDE among university students ($K=105$, $N=145{,}629$) was [95% CI] = 19.7% [17.9%; 21.6%], $I^2=98.2\%$, Cochran's Q p value = 0.001. Bayesian meta-analysis produced an estimate of 0.24, 95% credible intervals [0.20, 0.30], $\tau=92\%$. Whether the country in which the students were studying was Western or non-Western did not moderate these effects, but as either the mean BMI of the sample or the percentage of the sample that was female increased, the prevalence of SBDE increased.

Conclusions These findings support previous studies indicating that many undergraduate students are struggling with disordered eating or a diagnosable eating disorder, but are neither receiver effective prevention nor accessing accurate diagnosis and available treatment. It is particularly important to develop ever more valid ways of identifying students with high levels of disordered eating and offering them original or culturally appropriate and effective prevention or early treatment.

Level of evidence I, systematic review and meta-analysis.

Keywords Adolescences · Body image · Body mass index · Eating disorders · Feeding and eating disorders

Introduction

Eating disorders are serious mental illnesses that usually begin in adolescence [1], and in many instances recovery requires intensive professional treatment and support [2]. Ideally, these disorders are diagnosed by a professional multidisciplinary healthcare team after a comprehensive physical and psychological assessments against established diagnostic criteria of mental disorders. The two commonly used diagnostic systems are *The International Classification of Diseases* (ICD), currently in its 10th edition [3], and the *Diagnostic and Statistical Manual of Mental Disorders* (DSM), currently in its 5th edition) [4]. The latter is used much more often for research purposes, such as epidemiological studies. Anorexia Nervosa (AN), Bulimia Nervosa (BN), Binge Eating Disorder (BED), Avoidant/Restrictive Food Intake Disorder (ARFID), and Other Specified Feeding and Eating Disorders (OFSED) are the five major eating disorders listed in the DSM-5 [4]. Each eating disorder has its own set of criteria based on extensive research and clinical experience [4].

The causes of eating disorders are unknown, although there is general agreement that a variable and complicated combination of biological, psychological, social, and cultural risk factors increase the probability of eating disorder [2]. According to Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2019 eating disorders impact

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about 42 million people globally [5], and they are frequently misdiagnosed and undertreated [6]. Moreover, their prevalence worldwide is well-documented and appears to be increasing [7–9].

The prevailing view of eating disorders is that they are categorically distinct patterns of maladaptive eating habits linked to profound cognitive modification centered on the overvaluation of weight and shape as determinants of one's identity and worthiness [1, 2]. In this regard, many experts in the field believe that "disordered eating" (defined and discussed below) is qualitatively different from the eating disorders [10–12]. For this reason, screening tests aimed at measuring patterns of disordered eating are thought not to be a good proxy for estimating the prevalence of eating disorders based on large samples. Screening tests are best used in a typical two-stage design, in which people who were found positive for the screening test criteria then participate in semi-standardized or standardized interviews to ascertain the correspondence of those interview data with internationally agreed-upon diagnostic criteria [13] For example, consider the findings of a recent systematic review and meta-analysis of the prevalence of eating disorders and disordered eating in Western Asia [14]. The prevalence of disordered eating, as measured by three widely used screening tools (see Table 1) was: Eating Attitudes Scale 26 (EAT-26) and Eating Attitudes Scale 40 (EAT-40) = 22.1%; Sick, Control, One Stone, Fat, Food (SCOFF) questionnaire = 22.3%; and the Eating Disorder Examination-Questionnaire (EDEQ) was 8.0%. On the other hand, from those studies using semi-structured interviews against established criteria ICD/DSM, the estimated prevalence of anorexia nervosa was 1.6%, while the figures for bulimia nervosa and eating disorder not otherwise specified (EDNOS [BED + OSFED]) were 2.4% and 3.5%, respectively [14].

Table 1 Detailed description of the clinical measures involved in the systematic review and meta-analysis of disordered eating among university students, psychometric properties, cut-off points and full citation

Measure/Scale	Cut-off point	Psychometric properties
ANIS	≥ 65	Cronbach's α ranged from 0.80 to 0.90. In the three samples the ANIS total score correlated 0.41 to 0.51 with the 28- item General Health Questionnaire, and 0.15 to 0.26 with the percentage of ideal body weight [184]
BEDS-7	–	Cohen's Kappa = 0.827 [185]. Sensitivity = 100%, specificity = 38.7% [186]
DEBQ	–	Cronbach's α ranged from 0.80 to 0.95. All Pearson's correlation coefficients assessing interrelationships between scales (for restrained, emotional, and external eating) were significant, indicating that the measures have a high internal consistency and factorial validity [187]
EAT-26	≥ 20	Cronbach's α = 0.90. EAT-26 correlates highly with the original EAT-40 scale (r = 0.98)
EAT-40	30	Cronbach's α = 0.94. Sensitivity = 35.3%, specificity = 88.8%, positive predictive value = 24.0%, and negative predictive value = 93.2% [182]
EDDS	16.5	Cronbach's α = 0.89. Anorexia nervosa: Sensitivity = 93%, specificity = 100%, positive predictive value = 93%, negative predictive value = 100% Bulimia nervosa: Sensitivity = 81%, specificity = 98%, positive predictive value = 97%, negative predictive value = 96% Binge-eating disorder: Sensitivity = 77%, specificity = 96%, positive predictive value = 95%, negative predictive value = 93%
EDE-Q	≥ 4	Cronbach's α for the global score = 0.90 Women diagnosed with eating disorders scored significantly higher on the EDE-Q than the control women (sensitivity = 0.83, specificity = 0.96, positive predictive value = 0.56) [188, 189]
EDI	≥ 50	Cronbach's α ranged from 0.82 to 0.90. Sensitivity = 52.9%, specificity = 85.2%, positive predictive value = 26.4%
EDS-5	–	Cronbach's α ranged from 0.83 to 0.86. Sensitivity = 0.90 and specificity = 0.88
ORTO-11	< 25	Cronbach's α ranged between 0.74 and 0.83. Sensitivity = 75% and specificity = 84% [190]
ORTO-15	< 40	Cronbach's α = 0.83. The ORTO-15 showed significant associations with eating psychopathology (EAT-26 and SR-YBC-EDS; range r = 0.64 – 0.29; p < 0.05) [191]
Q-EDD	-	Cohen's Kappa = 0.94. Sensitivity = 0.97, specificity = 0.98, positive predictive power = 0.94, and negative predictive power = 0.99
SCOFF	≥ 2	kappa statistic = 0.82. Sensitivity = 100%; specificity = 87.5%; and positive predictive value = 90.6%
WCS	≥ 52	Cronbach's α = 0.65, 0.61, and 0.63 at ages 5, 7, and 9 years [192]. Skewness values for all items ranged from 0.02 to 0.95; and Kurtosis values ranged between -0.83 and -0.53 [193]

ANIS Anorexia Nervosa Inventory for Self-Rating [184, 194]. *BEDS-7* the 7-Item Binge-Eating Disorder Screener [186]. *DEBQ* The Dutch Eating Behavior Questionnaire [187]. *EAT-26* Eating Attitude Test-26 [195]. *EAT-40* Eating Attitude Test-40. *EAT-40* Eating Attitude Test-40 [195]. *EDDS* Eating Disorder Diagnostic Scale [196]. *EDE-Q* Eating Disorder Examination – Questionnaire [197]. *EDI* Eating Disorder Inventory [195, 198, 199]. *EDS-5* Eating Disorder Scale [200]. *ORTO-11* ORTO-11 [190]. *ORTO-15* ORTO-15 [201]. *Q-EDD* The Questionnaire for Eating Disorder Diagnoses [202]. *SCOFF* Sick, Control, One Stone, Fat, Food [203]. *WCS* the Weight Concerns scale [204]

Disordered eating

By comparison with the criteria for the eating disorders, the widely used phrase "disordered eating" is a broad construct that encompasses unhealthy (i.e., disordered) relationships with food, exercise, body weight, and one's body/body image. It sometimes refers to the presence of individual features of the clinical syndromes, and other times to unhealthy attitudes and practices such as negative body image and calorie-restrictive dieting. Typically, it is assumed that the constituents of disordered eating are less severe than the syndromes codified by DSM and ICD. Nevertheless, as is the case for negative body image, disordered eating is in and of itself a public health problem in many countries because it is associated with a number of negative health consequences, including depression, anxiety, and binge drinking [15–17].

Yet, "disordered eating" is used loosely in the literature, and rarely is it defined theoretically. Smolak and Levine have argued that disordered eating is defined by (a) "subclinical" but unhealthy, maladaptive, and misery-inducing levels of negative body image, weight and shape concerns, and calorie-restrictive dieting and/or binge eating [10–12]; plus (b) at least several of the following: individual eating disorder symptoms such as self-induced vomiting after eating; abuse of laxatives, diuretics, diet pills, and exercise; unrealistic beauty standards, including an idealization of thinness; irrational and maladaptive beliefs about body fat and fat people, often coupled with a high drive for thinness; and harsh self-surveillance and self-criticism, often in transaction with low and unstable self-esteem [10–12].

Longitudinal risk factor research consistently shows that negative body image and disordered eating are perhaps the best predictors of the development of full-blown eating disorders, at least in adolescent girls and adult women [13]. Another way of looking at disordered eating as an "at risk" status is the fact that its components constitute many of the items making up the measures used to screen people to determine, relatively quickly and at low cost, who is "at risk" for actually having an eating disorder upon closer examination using a structured diagnostic interview. Table 1 presents a list of these measures in alphabetic order. The principal purpose of this meta-analysis is to examine the prevalence of disordered eating, as assessed by these measures; hereafter we refer to this concept as screen-based disordered eating, using the acronym SBDE.

Risk and the transition to college or university

Eating disorders can emerge at any age, ranging from early childhood to older adulthood [18, 19]. However, given what is known about risk factors and the modal ages of onset, one high-risk period is late adolescence and emerging adulthood, that is, roughly ages 17 through 22 [20]. Within that developmental period, one general context associated with increased risk for eating disorders is the transition, for some people, from high school to college or university. University students are under increased pressure to conform to body and appearance ideals because romantic/sexuality expectations and peer comparisons, intensified by social media, grow alongside parental and academic demands for competitive excellence, if not perfection [21–23]. The confluence of these pressures, along with the distinct possibility of specific stressors such as parental divorce or sexual harassment/assault at college, amplify general sociocultural risk factors for disordered eating and eating disorders.

The transition to college or university also increases the probability of initiation or more frequent use of cognitive enhancers and psychostimulants to boost weight/shape/stamina management and cognitive capabilities. Drugs with potential connections to disordered eating, as well to purported success at (or at least coping with) college and its social life, include nicotine, caffeine in coffee and energy drinks, alcohol, stimulants, and dietary and ergogenic supplements [24–27]. Moreover, pressures contributing to disordered eating and eating disorders are greater for university students who fall into one or more of the following categories: identify as female; are LGTBQ+; are involved in the performative arts (e.g., dance) or certain competitive sports; or are overweight or obese [12, 28, 29].

The reported prevalence of SBDE among various, different types of samples of university students in the literature varies from 3.1% (Liao et al. 2006) to 74.5% [30]. Variations between samples are likely due to variability in sampling methodology, sex, age, BMI, measure, and country, but this has not been investigated in a systematic way. A recent systematic review and meta-analysis by our group showed that among medical students higher BMI, Westernized culture, and the research tool used were the main confounders [31].

The explicit purpose of this meta-analysis is to provide an overall or 'absolute' estimate of the prevalence of SBDE among university students as a population at risk for eating disorders and for the distress and comorbid problems attendant to disordered eating itself.

A search of the literature and other registration platforms yielded no previous global meta-analytic review of SBDE among university students in general. Thus, this meta-analysis extends previous reviews by our research team of SBDE in medical students [31–33] by evaluating the prevalence and several potential confounders of disordered eating in more general and diverse samples of undergraduate university students across the world. Specifically, the event rate was categorized using pre-defined cut-off scores from validated screening devices, that is, continuous measurements of eating disorder risk such as the EAT-26 and SCOFF (Table 1).

To examine the sources of the expected heterogeneity in disordered eating estimates, confounder analyses, adjusting for age and BMI, will be also conducted for country, percentage of the sample that is female, culture (Western vs non- Western), measure, and timeframe/year. Results of these meta-analyses should be useful in determining allocation of resources in the development and dissemination of prevention programs for undergraduates.

Methods

This study's protocol was registered on 2021–09-19 at Open Science Framework (OSF; https://doi.org/10.17605/OSF.IO/MB74E), an open-source platform that allows researchers to share their findings with others and get assistance throughout their research. To make the review visible and avoid duplication the protocol was also entered into the PROSPERO International prospective register of systematic reviews (CRD42022303882).

This study was reported using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA2020; [34]. Statistical analyses were conducted and presented according the Meta-analysis of Observational Studies in Epidemiology (MOOSE) protocol [35].

Search strategy

During September 2021 two authors (DS and MK) did an electronic search of the literature using nine databases: PubMed/MEDLINE, American Psychological Association PsycINFO, ScienceDirect, Springer, EBSCOhost, Embase, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Scopus, and Web of Science. The full-text search was conducted according to the following keywords and lists: List A: university student [OR] tertiary student [OR] college student [AND] List B: eating disorder* [OR] eating behavior/behaviour* [OR] feeding disorder* [OR] eating symptom* [OR] eating attitude* [OR] eating problem*. The * ensures that the search term covers both the singular noun forms, as well as the reverse order of the words in the phrase. For example, searching for "eating disorder" encompasses "disordered eating" and "eating disorders".

To verify that we included all relevant publications, we also examined the reference lists of selected articles to identify other potentially relevant articles and reviews. Meta-analyses that do not include grey literature are more likely to inflate effect size estimates, and produce less exact effect size estimates than those that do [36]. Consequently, while examining the reference sections we looked for organizational reports, unpublished studies, and studies published outside of widely known journals.

Three team members (DS, MJ, and SH) then independently assessed the initial set of articles identified by screening the titles, abstracts, and full-text articles according to the inclusion and exclusion criteria. All duplicate studies were eliminated. Initial data extraction and quality assessment were conducted independently by two team members (DS and OA). Any disputes regarding the suitability of a study for inclusion in the review were resolved by a conversation with the senior reviewer/expert clinician (ML or HJ), followed by consensus of the research team.

Eligibility inclusion and exclusion criteria

This meta-analysis included the full text of original English-language articles, published before 1 October 2021, related to SBDE among university (all countries) or college (in the USA) students. The population was defined as undergraduate students from different disciplines and majors.

To cast the net widely, we included studies that met the following criteria: (1) were published in an English-language journal; (2) the entire sample or a distinct subset of the sample consisted of university or college (in the U.S. sense of the term, i.e., not a private high school) undergraduate students; (3) participants completed one of the screening measures (see Table 1) for determining who is at-risk for an eating disorder, such that scores could indicate endorsement of the extremes of attitudes and behaviors that may exist in many cultures [10, 37, 38]; and, given the preceding criterion, (4) participant responses to the screening measure (e.g., the EAT-26) were scored and reported such that the percentages of participant falling above and below established cut-off points could be determined.

The following sources of data were excluded: (1) studies of students in post-baccalaureate programs (e.g., those pursuing masters or doctoral degrees); (2) investigations of mental health issues other than the prevalence of SBDE; and (3) studies for which we were unable to get the necessary data even after contacting the authors. Figure 1 shows the PRISMA 2020 [39] flow diagram for study selection.

Procedure

ASReview, a free online tool that combines digital technologies (e.g., natural language processing) with artificial intelligence and machine learning, was used to screen and code the 89 studies selected for systematic review [40]. The Abstrackr semi-automated abstract screening tool for systematic reviews was used to increase the precision of abstract screening [41]. When necessary, data were extracted from plot images using WebPlotDigitizer v4.5, an open-source web-based tool [42].

To standardize data description the following variables, in addition to the key result of the event rate of screen-based disordered eating among university students, were independently extracted by three members of the research team (DS, MK, and SH): Author names, year

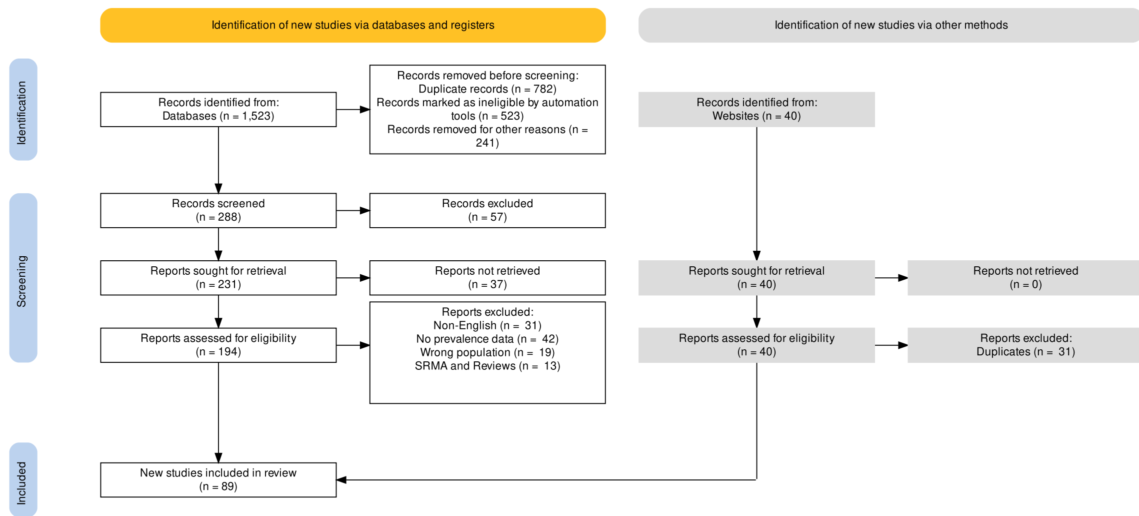


Fig. 1 PRISMA 2020 flow diagram for study selection

of publication, country in which the data were collected, sample size, mean age (years), sex (percentage of female participants), mean body mass index (kg/m^2), and measure used to determine presence or absence of SBDE. This meta-analysis study included samples from 40 countries, which were further coded into two categories, Western and non-Western countries, according to regional groups of member states defined by the United Nations [43].

Consensus among the aforementioned three reviewers was used to settle disagreements. If consensus could not be reached, a fourth author (ZS) was involved in resolving the issue by discussion. If relevant data were missing from a publication, the corresponding author of the article was contacted.

Assessment of study quality and risk of bias

The Newcastle–Ottawa Scale (NOS) was used by two authors (ZS and HJ) independently to evaluate the quality of the studies included [44]. The NOS checklist consists of three items: participants selection (sampling), comparability, and outcome and statistics. The NOS is based on a rating system [44] in which each item receives 1 to 3 (or 4) stars. This means that the maximum score for each study is either nine (cross-sectional and cohort studies) or 10 stars (randomized controlled trials and case–control studies). A study with 8 stars has good quality and low risk of bias, a study with a score of 5–7 stars has the moderate quality and moderate risk of bias, and a study with a score of 0–4 stars has low quality and high risk of bias.

Data analysis and data visualization

A classical meta-analysis based on the random-effects model was used, with the assumption that actual effects will vary over time [45]. We used the general inverse variance method with the logit transformed [PLO] proportions [46], and the DerSimonian-Laird method was used to estimate and adjust for the between-study variance in effects [47]. Random-effects modelling was used because it assumes that, in using different measures (e.g., EAT and SCOFF; Table 1), different sets of studies are estimating different, yet conceptually related, effects. For each study the pooled prevalence and the 95% confidence interval are reported.

A forest plot was used to display data [48]. It is a disadvantage that forest plots may display only confidence intervals at a significance level, such as $p < 0.05$. Confidence intervals should also be used to determine whether a research effect is substantial and therefore results are reproducible, so drapery plots were also used [49] and analysis of the p curve was also reported [50]. The drapery plot depicts the p value function as curves that provide the prediction range for a single future study for all individual studies and pooled values in a meta-analysis [49].

To further strengthen the results of the classical meta-analysis, Bayesian meta-analysis was also conducted and reported. Meta-analysis using Bayesian methods has three principal advantages over many classical methods [51]. First, they account for the imprecision of the between-study variance estimates [51]. Second, Bayesian methods take into account “priors”, that is, what is previously known on the topic [52]. Finally, Bayesian methods include external evidence, such as information about the effects of interventions or likely differences between studies [51, 52].

Our prior distribution focused on eating disorder prevalence in the absence of screen-based estimates and was proposed to be $\mu = 10\%$, $\tau = 2\%$, and $\eta = 5\%$ according to previous global estimates [53, 54]. The large eta was postulated in our review due to the amount of "error" that could be obtained using a screen-based self-reported tool, as indicated by on our comprehensive review of the clinical measures commonly used (Table 1).

Bayesian meta-analysis uses the Bayesian hierarchical model, which relies on the same basic assumptions underpinning the conventional random-effects model [55]. The difference is that in the Bayesian model the prior distribution (informative, weakly informative, or uninformative) is assumed for μ and τ^2. The prior distribution describes the uncertainty surrounding a particular effect measure within a meta-analysis, such as the odds ratio or the mean difference [55]. Uncertainty may be attributable to the researchers' subjective beliefs about the size of the effect or to sources of evidence excluded from the meta-analysis. Quantity uncertainty is reflected by the width of the prior distribution [56]. It is possible to use a non-informative prior when there is little or no available information, such that all values are equally likely [56]. A credible interval (CrI) in Bayesian statistics is a range of values where an unobserved parameter value is likely to occur [57]. In our analyses we reported the [95% CrI].

We assessed between-study heterogeneity using the I^2 statistic; a value between 75 and 100% represents a high degree of heterogeneity [52]. We also evaluated heterogeneity using Cochran's Q statistics [58], and tau^2 (τ^2) and tau (τ) [52]. The H statistic [59] is the square root of the following: Cochran's χ^2 heterogeneity statistic divided by the degree of freedom [52]. To visualize heterogeneity we used a simple form of the Galbraith radial plot [60] in which the inverse of standard errors (horizontal axis) is plotted against observed effect sizes or outcomes standardized by their corresponding standard errors (vertical axis). On the right-hand side of a full-scale Galbraith plot, an arc shows the corresponding effect sizes or outcomes [61, 62].

Meta-analysis' validity and robustness may be compromised by the inclusion of outliers. Whenever the study's confidence interval does not align with the pooled effect's confidence interval, the study is classified as an outlier and can be addressed by the sensitivity analysis [63]. Therefore, using a Jackknife sensitivity analysis, we eliminated one study at a time to make sure we did not have any inordinate influence from any single study [64]. This analysis involves repeating the main meta-analysis as many times as the number of studies included, discarding one different study each time [64].

A publication bias occurs when the odds of research being published are influenced by its findings [65]. To investigate publication bias, funnel plots were employed as a preliminary visual tool [66]. To correct for funnel plot asymmetry owing to probable publication bias, the trim and fill approach [67] was used to generate adjusted point estimates. To conduct a more rigorous analysis of publication bias, Peters' correlations [68] and Egger's regression [66] were also utilized as gold standards.

Subgroup meta-analyses were used to investigate heterogeneous outcomes and to answer specific queries regarding distinct populations or study characteristics [69]. Subgroup analyses were performed on categorical variables including country, culture (Western vs. non-Western), and some of the clinical measures/scales used in various studies. To investigate the effect of time as a confounder the studies were clustered into 5-year intervals: 1985–1989, 1990–1994, 1995–1999, 2001–2004, 2005–2009, 2010–2014, 2015–2019, and 2020 onwards. The subgroup meta-analyses addressed any subgroup of five studies or more, and all results are reported graphically using forest plots.

Meta-regressions are, in essence, regression models in which the values of one or more explanatory factors are used to predict the outcome variable [70]. A meta-regression analysis' regression coefficient will indicate how the outcome variable changes as the explanatory variable (the possible moderator/effect modifier/confounding variable) is increased by one unit [70]. A term for the interaction between age, sex and BMI was tested. In statistically significant meta-regression models effect size was reported using R^2, and percent of variance explained of 1–8%, 9–24% and ≥ 25% were regarded as small, medium and large effect size, respectively [71].

R software for statistical computing was used to analyze all data [72]. The packages 'meta' [73] and 'metafor' [74] were used to perform all classical meta-analytics. Package 'bayesmeta' was used to perform Bayesian random-effects meta-analysis [75]. Using the package 'robvis', risk-of-bias plots were generated for quality assessment [76]. For all investigations, a summary plot (weighted) was generated to show the proportion of information inside each judgment for each domain [76]. Summary of all studies' risk of bias assessments. The risk of bias in each domain, as well as the overall risk, is depicted by a traffic light plot.

Results

Descriptive

The initial literature search, conducted during September to October 2021, yielded 1523 studies, of which 89 independent studies [7, 30, 77–163] (across all times and measures, $K = 105$ data points for analyses; N of participants = 149,629) met the inclusion and exclusion criteria.

Table 2 Selected descriptive results of the studies included in this systematic review and meta-analysis of disordered eating among university students

S.No.	Study label	Citation	Country	Study characteristics	Sample characteristics	Quality score
1	Abdul Manaf (2016)	[77]	Malaysia	Cross-sectional design. Sample Size *N* = 206. ED Measure: EAT-26	%Female = 100%, Age = 19.5 years, BMI = 22.2 kg/m^2	7
2	Abo Ali (2020)	[78]	Egypt	Cross-sectional design. Sample Size *N* = 615. ED Measure: EAT-26	%Female = 67.2%, Age = 21 years, BMI = 22 kg/m^2	8
3	Akdevelioglu (2010)	[79]	Turkey	Cross-sectional design. Sample Size *N* = 577. ED Measure: EAT-40	%Female = 70%, Age = 21.2 years, BMI = 21.2 kg/m^2	5
4	Al Banna (2021)	[80]	Bangladesh	Cross-sectional design. Sample Size *N* = 365. ED Measure: EAT-26	%Female = 49.6%, Age = 21.1 years, BMI = 22.2 kg/m^2	8
5	Albrahim (2019)	[81]	Saudi Arabia	Cross-sectional design. Sample Size *N* = 396. ED Measure: EAT-26	%Female = 100%, Age = 20.1 years, BMI = 23.2 kg/m^2	6
6	Alcaraz-Ibáñez (2019)	[82]	Spain	Cross-sectional design. Sample Size *N* = 545. ED Measure: SCOFF	%Female = 46%, Age = 21.4 years, BMI = 23 kg/m^2	7
7	Alhazmi (2019)	[83]	Saudi Arabia	Cross-sectional design. Sample Size *N* = 342. ED Measure: EAT-26	%Female = 50%, Age = 21.2 years, BMI = 22.2 kg/m^2	7
8	Alkazemi (2018)	[84]	Kuwait	Cross-sectional design. Sample Size *N* = 1147. ED Measure: EAT-26	%Female = 100%, Age = 20.5 years, BMI = 23.9 kg/m^2	7
9	AlShebali (2020)	[85]	Saudi Arabia	Cross-sectional design. Sample Size *N* = 503. ED Measure: EDE-Q	%Female = 100%, Age = 19.8 years, BMI = 23.4 kg/m^2	7
10	Alwosaifer (2016)	[86]	Saudi Arabia	Cross-sectional design. Sample Size *N* = 656. ED Measure: EAT-26	%Female = 100%, Age = 18.7 years, BMI = 22.2 kg/m^2	7
11	Azzouzi (2019)	[87]	Morocco	Cross-sectional design. Sample Size *N* = 710. ED Measure: SCOFF	%Female = 65.1%, Age = 21.3 years, BMI = 22.9 kg/m^2	7
12	Badrasawi (2019)	[88]	Palestine	Cross-sectional design. Sample Size *N* = 154. ED Measure: BEDS-7	%Female = 100%, Age = 19.6 years, BMI = 22.2 kg/m^2	7
13	Barayan (2018)	[89]	Saudi Arabia	Cross-sectional design. Sample Size *N* = 319. ED Measure: EDE-Q	%Female = 100%, Age = 21.2 years, BMI = 22 kg/m^2	5
14	Barry (2021)	[90]	United States	Cross-sectional design. Sample Size *N* = 804. ED Measure: SCOFF	%Female = 50.4%, Age = 21.2 years, BMI = 22.2 kg/m^2	8
15	Benítez (2019)	[91]	Spain	Cross-sectional design. Sample Size *N* = 600. ED Measure: EDI	%Female = 59.5%, Age = 20.8 years, BMI = 22.2 kg/m^2	7
16	Bizri (2020)	[92]	Lebanon	Cross-sectional design. Sample Size *N* = 131. **ED Measures**: EAT-26; SCOFF	%Female = 53.4%, Age = 23 years, BMI = 22.2 kg/m^2	7
17	Bo (2014)	[93]	Italy	Cross-sectional design. Sample Size *N* = 440. **ED Measures**: EAT-26; SCOFF	%Female = 54%, Age = 19.8 years, BMI = 16.9 kg/m^2	7
18	Bosi (2016)	[94]	Brazil	Cross-sectional design. Sample Size *N* = 202. ED Measure: EAT-26	%Female = 100%, Age = 21.8 years, BMI = 22.2 kg/m^2	7

Table 2 (continued)

S.No.	Study label	Citation	Country	Study characteristics	Sample characteristics	Quality score
19	Brumboiu (2018)	[95]	Romania	Cross-sectional design. Sample Size *N* = 222. ED Measure: SCOFF	%Female = 82%, Age = 21.5 years, BMI = 21.3 kg/m^2	7
20	Carriedo (2020)	[96]	Mexico	Cross-sectional design. Sample Size *N* = 911. ED Measure: EDE-Q	%Female = 65.4%, Age = 21 years, BMI = 22.6 kg/m^2	7
21	Castejón (2020)	[97]	Spain	Cross-sectional design. Sample Size *N* = 604. ED Measure: EDI	%Female = 65.9%, Age = 22.5 years, BMI = 22.2 kg/m^2	6
22	Chammas (2017)	[98]	Lebanon	Cross-sectional design. Sample Size *N* = 457. ED Measure: SCOFF	%Female = 37%, Age = 21.3 years, BMI = 22.2 kg/m^2	6
23	Chan (2020)	[99]	Malaysia	Cross-sectional design. Sample Size *N* = 1017. ED Measure: EAT-26	%Female = 51%, Age = 20.7 years, BMI = 22 kg/m^2	8
24	Chaudhari (2017)	[100]	India	Cross-sectional design. Sample Size *N* = 193. ED Measure: EDE-Q	%Female = 60.6%, Age = 23.4 years, BMI = 24.5 kg/m^2	7
25	Christensen (2021)	[101]	United States	Cohort design. Sample Size *N* = 579. ED Measure: EDDS	%Female = 76.3%, Age = 21.8 years, BMI = 25.1 kg/m^2	7
26	Compte (2015)	[102]	Argentina	Cross-sectional design. Sample Size *N* = 472. ED Measure: EAT-26	%Female = 0%, Age = 21.2 years, BMI = 24.8 kg/m^2	7
27	Damiri (2021)	[103]	Palestine	Cross-sectional design. Sample Size *N* = 1047. **ED Measures**: EAT-26; SCOFF	%Female = 61.3%, Age = 20.2 years, BMI = 23.3 kg/m^2	8
28	Din (2019)	[104]	Pakistan	Cross-sectional design. Sample Size *N* = 672. ED Measure: EAT-26	%Female = 56%, Age = 21.7 years, BMI = 22.1 kg/m^2	7
29	Ebrahim (2019)	[105]	Kuwait	Cross-sectional design. Sample Size *N* = 400. ED Measure: EAT-26	%Female = 0%, Age = 21.9 years, BMI = 25.8 kg/m^2	7
30	Erol (2019)	[106]	Turkey	Cross-sectional design. Sample Size *N* = 298. ED Measure: EAT-40	%Female = 70%, Age = 21.3 years, BMI = 22.2 kg/m^2	7
31	Falvey (2021)	[107]	Multi	Cross-sectional design. Sample Size *N* = 77,193. ED Measure: SCOFF	%Female = 65.9%, Age = 23.1 years, BMI = 24.4 kg/m^2	7
32	Farchakh (2019)	[30]	Lebanon	Cross-sectional design. Sample Size *N* = 627. **ED Measures**: ORTO-15; EAT-26	%Female = 50.4%, Age = 21.8 years, BMI = 23.4 kg/m^2	8
33	Fatima (2018)	[108]	Saudi Arabia	Cross-sectional design. Sample Size *N* = 120. ED Measure: EAT-26	%Female = 100%, Age = 21.2 years, BMI = 22.2 kg/m^2	8
34	Gramaglia (2019)	[109]	Multi	Cross-sectional design. Sample Size *N* = 664. **ED Measures**: EAT-26; ORTO-15	%Female = 70%, Age = 24 years, BMI = 22.2 kg/m^2	7
35	Greenleaf (2009)	[110]	United States	Cross-sectional design. Sample Size *N* = 204. ED Measure: QEDD	%Female = 100%, Age = 20.2 years, BMI = 23.1 kg/m^2	7
36	Havemann (2011)	[111]	South Africa	Cross-sectional design. Sample Size *N* = 26. ED Measure: EAT-26	%Female = 100%, Age = 19 years, BMI = 23.2 kg/m^2	4
37	Herzog (1985)	[112]	United States	Cross-sectional design. Sample Size *N* = 121. ED Measure: SD	%Female = 100%, Age = 25.1 years, BMI = 22 kg/m^2	5

Table 2 (continued)

S.No.	Study label	Citation	Country	Study characteristics	Sample characteristics	Quality score
38	Iyer (2021)	[113]	India	Cross-sectional design. Sample Size $N=332$. ED Measure: EAT-26	%Female = 56.3%, Age = 22.3 years, BMI = 22 kg/m^2	7
39	Jamali (2020)	[114]	Pakistan	Cross-sectional design. Sample Size $N=407$. **ED Measures**: EAT-26; SCOFF	%Female = 36.9%, Age = 19.9 years, BMI = 20.8 kg/m^2	7
40	Jennings (2006)	[115]	Australia	Cross-sectional design. Sample Size $N=240$. ED Measure: EAT-26	%Female = 100%, Age = 19.3 years, BMI = 21.2 kg/m^2	4
41	Joja (2012)	[116]	Germany	Case–control design. Sample Size $N=110$. ED Measure: EDI	%Female = 100%, Age = 20.3 years, BMI = 21.5 kg/m^2	8
42	Kiss-Toth (2018)	[117]	Multi	Cross-sectional design. Sample Size $N=1965$. ED Measure: SCOFF	%Female = 70%, Age = 21.2 years, BMI = 22.2 kg/m^2	6
43	Ko (2015)	[118]	Vietnam	Cross-sectional design. Sample Size $N=203$. ED Measure: SCOFF	%Female = 100%, Age = 18.8 years, BMI = 19 kg/m^2	7
44	Koushiou (2019)	[119]	Greece	Cross-sectional design. Sample Size $N=334$. ED Measure: WCS; EDDS	%Female = 90%, Age = 20.7 years, BMI = 22.2 kg/m^2	7
45	Kutlu (2013)	[120]	Turkey	Cross-sectional design. Sample Size $N=262$. ED Measure: EAT-40	%Female = 59.5%, Age = 21.7 years, BMI = 21.5 kg/m^2	7
46	Ladner (2019)	[121]	France	Cross-sectional design. Sample Size $N=3076$. ED Measure: SCOFF	%Female = 69%, Age = 21.2 years, BMI = 22.2 kg/m^2	7
47	Le Grange (1998)	[122]	South Africa	Cross-sectional design. Sample Size $N=1402$. ED Measure: EAT-40	%Female = 75%, Age = 19.2 years, BMI = 22 kg/m^2	6
48	Lee (2015)	[123]	Korea	Cross-sectional design. Sample Size $N=199$. ED Measure: DEBQ	%Female = 52.3%, Age = 29.2 years, BMI = 22 kg/m^2	7
49	Liao (2013)	[124]	China	Cohort design (**two data points**). Sample Size $N=487$. ED Measure: EAT-26	%Female = 63%, Age = 20.5 years, BMI = 20.2 kg/m^2	7
50	Mancilla-Diaz (2007)	[125]	Mexico	Cross-sectional design. Sample Size $N=1402$. ED Measure: EAT-40	%Female = 100%, Age = 19.2 years, BMI = 22.4 kg/m^2	7
51	Marciano (1988)	[126]	Canada	Cross-sectional design. Sample Size $N=994$. ED Measure: EAT-26	%Female = 84.5%, Age = 20.4 years, BMI = 22.2 kg/m^2	6
52	Mazzaia (2018)	[127]	Brazil	Cross-sectional design. Sample Size $N=120$. ED Measure: EAT-26	%Female = 84.2%, Age = 21.9 years, BMI = 23.3 kg/m^2	7
53	Mealha (2013)	[7]	Portugal	Cross-sectional design. Sample Size $N=189$. **ED Measures**: EAT-26; EDI	%Female = 100%, Age = 20.3 years, BMI = 21.2 kg/m^2	6
54	Momeni (2020)	[128]	Iran	Cross-sectional design. Sample Size $N=385$. ED Measure: EAT-26	%Female = 47%, Age = 21.8 years, BMI = 22.4 kg/m^2	7
55	Ngan (2017)	[129]	Malaysia	Cross-sectional design. Sample Size $N=263$. ED Measure: EAT-26	%Female = 65%, Age = 22.8 years, BMI = 22 kg/m^2	5
56	Nichols (2009)	[130]	West Indies	Cross-sectional design. Sample Size $N=383$. ED Measure: EAT-26	%Female = 48%, Age = 21.2 years, BMI = 22.2 kg/m^2	6

Table 2 (continued)

S.No.	Study label	Citation	Country	Study characteristics	Sample characteristics	Quality score
57	Padmanabhan (2017)	[131]	United Arab Emirates	Cross-sectional design. Sample Size $N=156$. ED Measure: EAT-26	%Female = 52.6%, Age = 23.3 years, BMI = 22.2 kg/m^2	5
58	Parra-Fernández (2019)	[132]	Spain	Cross-sectional design. Sample Size $N=492$. ED Measure: EDI	%Female = 70%, Age = 20 years, BMI = 22.6 kg/m^2	7
59	Parreño-Madrigal (2020)	[133]	Spain	Cross-sectional design. Sample Size $N=481$. ED Measure: SCOFF	%Female = 72.6%, Age = 20.1 years, BMI = 22.4 kg/m^2	8
60	Pereira (2011)	[134]	Brazil	Cross-sectional design. Sample Size $N=214$. ED Measure: EAT-26	%Female = 100%, Age = 21 years, BMI = 21.1 kg/m^2	7
61	Pitanupong (2017)	[135]	Thailand	Cross-sectional design. Sample Size $N=885$. ED Measure: EAT-26	%Female = 56%, Age = 20.8 years, BMI = 21.2 kg/m^2	7
62	Plichta (2019)	[136]	Poland	Cross-sectional design. Sample Size $N=1120$. ED Measure: ORTO-15	%Female = 70.4%, Age = 21.4 years, BMI = 22 kg/m^2	7
63	Polanco (2020)	[137]	Mexico	Cross-sectional design. Sample Size $N=90$. ED Measure: EAT-26	%Female = 66.4%, Age = 20 years, BMI = 22 kg/m^2	6
64	Radwan (2018)	[138]	United Arab Emirates	Cross-sectional design. Sample Size $N=662$. ED Measure: EAT-26	%Female = 61.4%, Age = 20.4 years, BMI = 24.1 kg/m^2	7
65	Ramaiah (2015)	[139]	India	Cross-sectional design. Sample Size $N=172$. ED Measure: EAT-26	%Female = 65%, Age = 21 years, BMI = 21.6 kg/m^2	7
66	Rasman (2018)	[140]	Malaysia	Cross-sectional design. Sample Size $N=279$. ED Measure: SCOFF	%Female = 75.3%, Age = 21.9 years, BMI = 22.5 kg/m^2	8
67	Rathner (1994)	[141]	Austria	Cross-sectional design. Sample Size $N=379$. **ED Measures**: EDI; ANIS	%Female = 40.9%, Age = 22 years, BMI = 21 kg/m^2	7
68	Reyes-Rodríguez (2011)	[142]	Puerto Rico	Cross-sectional design. Sample Size $N=709$. ED Measure: EAT-26	%Female = 0%, Age = 18.3 years, BMI = 24.4 kg/m^2	5
69	Roshandel (2012)	[143]	Iran	Cross-sectional design. Sample Size $N=400$. ED Measure: EAT-26	%Female = 100%, Age = 22.1 years, BMI = 21.2 kg/m^2	7
70	Rostad (2021)	[144]	Norway	Cross-sectional design. Sample Size $N=1044$. ED Measure: EDS	%Female = 70.9%, Age = 21.2 years, BMI = 22.8 kg/m^2	8
71	Safer (2020)	[145]	Tunisia	Cross-sectional design. Sample Size $N=974$. ED Measure: SCOFF	%Female = 69.9%, Age = 22.8 years, BMI = 22.2 kg/m^2	7
72	Saleh (2018)	[146]	Palestine	Cross-sectional design. Sample Size $N=2001$. **ED Measures**: EAT-26; SCOFF	%Female = 100%, Age = 19.5 years, BMI = 21.7 kg/m^2	7
73	Sepúlveda (2007)	[147]	Spain	Cross-sectional design. Sample Size $N=2551$. ED Measure: EDI	%Female = 67.9%, Age = 21 years, BMI = 22 kg/m^2	8
74	Sharifian (2021)	[148]	Finland	Cross-sectional design. Sample Size $N=3110$. ED Measure: SCOFF	%Female = 52.6%, Age = 21.2 years, BMI = 22.2 kg/m^2	7
75	Sharma (2019)	[149]	India	Cross-sectional design. Sample Size $N=370$. ED Measure: EAT-26	%Female = 42.4%, Age = 20.3 years, BMI = 22 kg/m^2	8

Table 2 (continued)

S.No.	Study label	Citation	Country	Study characteristics	Sample characteristics	Quality score
76	Shashank (2016)	[150]	India	Cross-sectional design. Sample Size *N* = 134. **ED Measures**: EAT-26; SCOFF	%Female = 100%, Age = 21.4 years, BMI = 22.4 kg/m^2	8
77	Spillebout (2019)	[151]	France	Cross-sectional design. Sample Size *N* = 731. ED Measure: SCOFF	%Female = 69.9%, Age = 20 years, BMI = 22.1 kg/m^2	7
78	Taha (2018)	[152]	Saudi Arabia	Cross-sectional design. Sample Size *N* = 1200. ED Measure: EAT-26, SCOFF	%Female = 100%, Age = 21 years, BMI = 22.2 kg/m^2	7
79	Tavolacci (2015)	[153]	France	Cross-sectional design. Sample Size *N* = 3457. ED Measure: SCOFF	%Female = 63.6%, Age = 20.5 years, BMI = 21.4 kg/m^2	7
80	Tavolacci (2018)	[154]	France	Cross-sectional design. Sample Size *N* = 1225. ED Measure: SCOFF	%Female = 61%, Age = 21.6 years, BMI = 22 kg/m^2	7
81	Tavolacci (2020)	[155]	France	Cross-sectional design. Sample Size *N* = 1493. ED Measure: SCOFF	%Female = 63.4%, Age = 20.1 years, BMI = 22.2 kg/m^2	7
82	Thangaraju (2020)	[156]	India	Cross-sectional design. Sample Size *N* = 199. ED Measure: EDE-Q	%Female = 100%, Age = 20.4 years, BMI = 23.8 kg/m^2	7
83	Tury (2020)	[157]	Hungary	Cohort design (**two data points**). Sample Size *N* = 538. **ED Measures**: ANIS; EDI	%Female = 53.9%, Age = 21.4 years, BMI = 21.4 kg/m^2	7
84	Uriegas (2021)	[158]	United States	Cross-sectional design. Sample Size *N* = 150. ED Measure: EDI	%Female = 56%, Age = 19.9 years, BMI = 25.2 kg/m^2	7
85	Uzun (2006)	[159]	Turkey	Cross-sectional design. Sample Size *N* = 414. ED Measure: EAT-40	%Female = 100%, Age = 19.9 years, BMI = 22.2 kg/m^2	6
86	Weigel (2016)	[160]	Germany	Cross-sectional design. Sample Size *N* = 304. ED Measure: EDI	%Female = 58.2%, Age = 22.6 years, BMI = 20.1 kg/m^2	7
87	Yoneda (2020)	[161]	Japan	Cross-sectional design. Sample Size *N* = 469. ED Measure: EAT-26	%Female = 100%, Age = 19.9 years, BMI = 20.7 kg/m^2	7
88	Yu (2015)	[162]	China	Cross-sectional design. Sample Size *N* = 1328. ED Measure: EAT-26	%Female = 64.2%, Age = 21.2 years, BMI = 22.2 kg/m^2	6
89	Zhou (2020)	[163]	United States	RCT design. Sample Size N = 130. ED Measure: EDE-Q	%Female = 100%, Age = 20.8 years, BMI = 24.4 kg/m^2	7

FEDS feeding and eating disorders. Quality score was computed based on Newcastle–Ottawa quality assessment scale total score for cross-sectional studies

EAT-26 Eating Attitudes Test-26, *EAT-40* Eating Attitudes Test-40, *SCOFF* Sick, Control, One Stone, Fat, Food, *EDE-Q* Eating Disorder Examination- Questionnaire, *BEDS-7* Binge Eating Disorder Screener-7, *ORTO-15* ORTO-15, *QEDD* Questionnaire for Eating Disorder Diagnoses, *EDDS* The Eating Disorder Diagnostic Scale, *SD* Self-developed, *WCS* The Weight Concern Scale, *DEBQ* Dutch Eating Behavior Questionnaire, *EDI* Eating Disorder Inventory-I/II, *ORTO-11* ORTO-11, *ANIS* Anorexia Nervosa Inventory for Self-Rating

Details of the studies included are shown in Table 2. Of the 89 studies only two (2.2%) were grey literature: [117] and [121]. They were of a similar quality compared to the published studies.

Most of the studies analyzed were cross-sectional (95%), although a few used cohorts (3%) or other methodology (2%), and 11% presented data collected during the COVID-19 pandemic. Furthermore, the Eating Attitudes Test-26 (EAT-26) and Sick, Control, One Stone, Fat, Food (SCOFF) measures were the most common scales, making up 64% of total studies (see Table 3). The mean percentage of participants self-identifying as female was approximately

Table 3 A meta-analysis of disordered eating among university students

Analysis	K	N	Random effects model		Heterogeneity						Confounders			Publication bias	
			Pooled results [95% CI or CrI]	Figure	I^{2a}	τ	τ^{2b}	H[c]	Q	Cochran's Q P value[d]	Age	Sex	BMI	Egger's test[e]	Peter's test
Prevalence of studies	105	145,629	19.7% [17.9%; 21.6%]	Figure 4	98.2	0.6	0.34	7.39	5696.85	0.001	0.49	0.04	0.001	0.90	0.06
Bayesian analysis	105	145,629	Odds 0.24 [0.20; 30]	Figure 5	98%	0.9	–	–	–	–	–	–	–	–	
Prevalence by country															
Saudi Arabia	8	4736	21.2% [14.1%; 30.5%]	Figure 12	97.7%	0.70	0.48	–	307.42	0.001	–	–	–	NS	NS
India	7	1534	18.1% [14.7%; 22.0%]		70.1%	0.27	0.076	–	20.05		–	–	–	NS	NS
United states of America	6	1988	37.1% [26.3%; 49.5%]		95.8%	0.61	0.37	–	117.83		–	–	–	NS	NS
Spain	6	5235	31.7% [20.4%; 45.6%]		98.8%	0.73	0.53	–	404.30		–	–	–	NS	NS
Palestine	5	6250	32.8% [26.2%; 40.2%]		96.8%	0.35	0.13	–	124.57		–	–	–	NS	NS
Lebanon	5	1966	33.2% [15.9%; 56.7%]		98.8%	1.09	1.19	–	338.83		–	–	–	NS	NS
France	5	9982	21.0% [18.7%; 23.6%]		88.4%	0.16	0.025	–	34.52		–	–	–	NS	NS
Prevalence by culture (Western)															
No	55	29,363	20.9% [17.8%; 24.4%]	Figure 13	97.9%	0.74	0.55	–	2711.00	0.001	–	–	–	NS	NS
Yes	50	115,966	18.4% [16.4%; 20.6%]		97.8%	0.51	0.26	–	2264.44		–	–	–	NS	NS
Prevalence by measure															
EAT-26	45	23,821	17.0% [13.9%; 20.3%]	Figure 14	97.6%	0.75	0.56	–	1905.43	0.001	–	–	–	NS	NS
SCOFF	22	100,638	27.6% [24.1%; 31.5%]		98.4%	0.44	0.19	–	1413.76		–	–	–	NS	NS
EDI	10	6394	16.9% [9.6%; 28.2%]		98.8%	1.04	1.08	–	729.14		–	–	–	NS	NS
EAT-40	6	4355	10.6% [7.4%; 14.9%]		93.3%	0.45	0.21	–	75.17		–	–	–	NS	NS
EDE-Q	6	2255	18.1% [8.3%; 35.0%]		97.8%	1.09	1.20	–	223.88		–	–	–	NS	NS
Prevalence by Timeframe/Year															
2020 Onwards	31	97,625	20.8% [17.6%; 24.5%]	Figure 15	98. 4%	0.58	0.34	–	1869.51	0.001	–	–	–	NS	NS
2015–2019	50	35,006	23.8% [20.7%; 27.2%]		97.9%	0.63	0.39	–	2376.86		–	–	–	NS	NS
2010–2014	11	3256	13.0% [8.4%; 19.7%]		94.6%	0.77	0.60	–	222.67		–	–	–	NS	NS
2005–2009	8	6167	10.6% [7.3%; 15.1%]		95.7%	0.56	0.31	–	164.13		–	–	–	NS	NS

K Represents the number of included studies, N Represents the number of included samples

[a] I^2 statistic referred to the percentage of variation across samples due to heterogeneity rather than chance

[b] τ^2 Describe the extent of variation among the effects observed in different samples (between-sample variance)

[c] H Describes confidence intervals of heterogeneity

[d] Significant differences between samples in meta-analysis

[e] Detects publication bias in meta-analyses

[f] Represents the correlation between effect sizes and sample variation

70% [95% CI = 66–75%], while, as expected, the average respondent's age was 21 years old [95% CI = 20–22; range 18–29 years), with a median sample mean BMI of 22 kg/m^2 [95% CI = 21–24]; range 17–26 kg/m^2).

The studies represented samples from 40 countries and territories, and the majority (54%) of studies reported data from non-Western countries. The countries and territories were: Argentina, Australia, Austria, Bangladesh, Brazil, Canada, China, Egypt, Finland, France, Germany, Greece, Hungary, India, Iran, Italy, Japan, Kuwait, Lebanon, Malaysia, Mexico, Morocco, Norway, Pakistan, Palestine, Poland, Portugal, Puerto Rico, Republic of Korea, Romania, Saudi Arabia, South Africa, Spain, Thailand, Tunisia, Turkey, United Arab Emirates, United States, Vietnam, and West Indies.

Seven countries accounted for 42% of the studies qualifying for this meta-analysis: Saudi Arabia (8%), United States of America (7%), Spain (7%), India (7%), France (5%), Malaysia (4%), and Turkey (4%).

Quality assessment of included studies

Figure 2 presents summary plots for the quality and risk of bias of the studies qualifying for this meta-analysis. The overall risk of bias in this sample of studies was moderate, as the categorization of bias was low (17%), moderate (81%), and high (2%). Figure 3 provides a summary of all studies' risk of bias assessments the risk of bias in each domain, as well as the overall risk, is depicted by a traffic light plot.

Meta-analysis of the overall prevalence of disordered eating

Figure 4 presents the raw prevalence data for each study and the results of the basic meta-analysis. The prevalence of SBDE among university students ($k = 108$, $N = 146{,}210$) using random-effects meta-analysis was ($K = 105$, $N = 145{,}629$) was [95% CI] = 19.7% [17.9%; 21.6%], $I^2 = 98.2\%$, τ [95% CI] = 0.6 [0.64; 0.94], τ^2 [95% CI] = 0.34 [0.41; 0.88], H [95% CI] = 7.39 [7.1; 7.7], Cochran's Q p-value = 0.001. Bayesian meta-analysis, shown in Fig. 5, yielded disordered eating odds of 0.24 95% CrI [0.20, 0.30], $\tau = 92\%$. An odd estimate of 0.24 equals an SBSE prevalence of to approximately 1: 4 or more simply 24–25%.

There is no publication bias in our data, as evidenced by visual examination of the funnel (Fig. 6) and Galbraith radial plots (Fig. 7), as well as Egger's regression test at 0.90 and Peter's test at 0.05. The Jackknife sensitivity analysis showed that excluding one study at a time from this meta-analysis did not affect the prevalence of SBDE in university students by more than 0.5% (Fig. 8), suggesting that our weighted prevalence findings are robust and relatively insensitive to outliers. Another indication that the results from all studies are reproducible is seen in a drapery plot based on p values (Fig. 9), which eliminates the need to rely on the $p < 0.05$ significance threshold when interpreting the results of any given study.

Confounder analyses

Age, BMI, and sex

Meta-regression analysis (Figs. 10 and 11) showed that BMI and sex are statistical confounders, $p = 0.001$ and $p = 0.04$, respectively, for the prevalence of SBDE in university students. As the mean BMI of the sample increased, or as the percentage of the sample that was female increased, so did the weighted prevalence of SDBE. The effect size was large for BMI ($R^2 = \sim 0.50$), but small for the proportion of the sample that was female ($R^2 = \sim 20$). There was no statistically significant relationship between mean age of the sample and level of disordered eating ($p = 0.49$; see Table 3). The study concerned university college students; thus, it is highly unlikely that age could have any impact on the estimates because of the small age range.

The interaction term between age, sex and BMI yielded a statistically significant result, $p = 0.01$, but the interaction was not explored further because the effect size was negligible, $R^2 = 0.10$.

Country and culture

Figure 12 shows the weighted prevalence levels as a function of country in which the data were collected. These varied tremendously, and, as noted above, the number of studies (k)

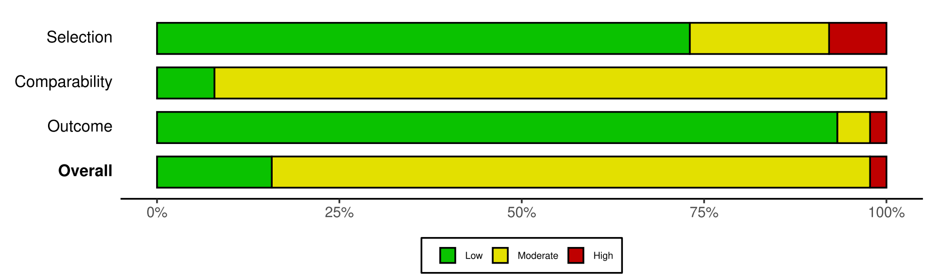


Fig. 2 Summary plot of the assessment of the risk of bias

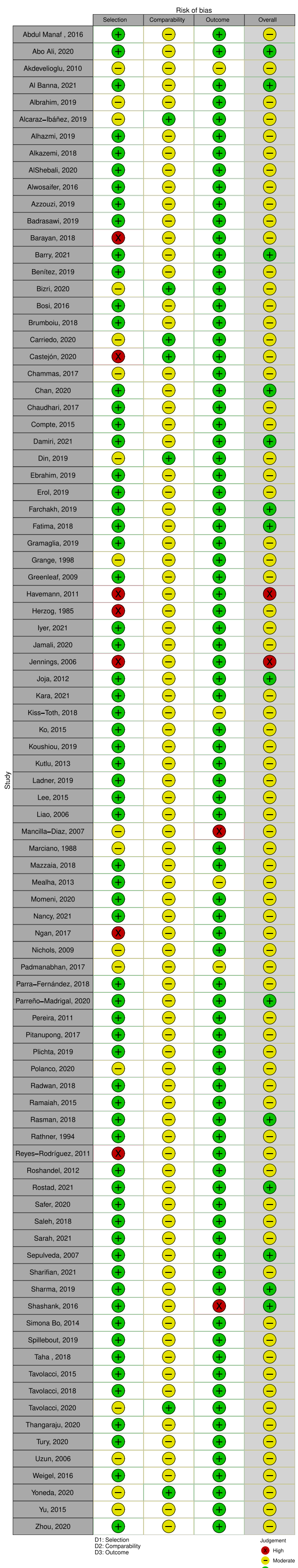


Fig. 3 Traffic light plot of the assessment of the risk of bias

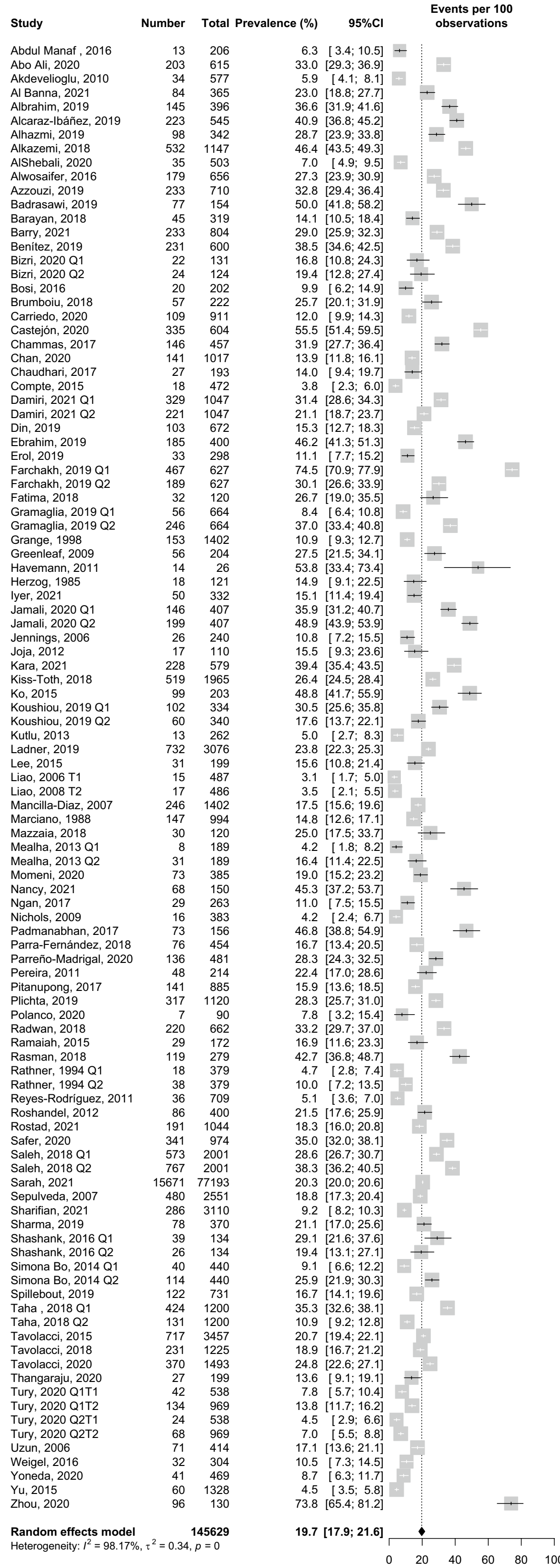
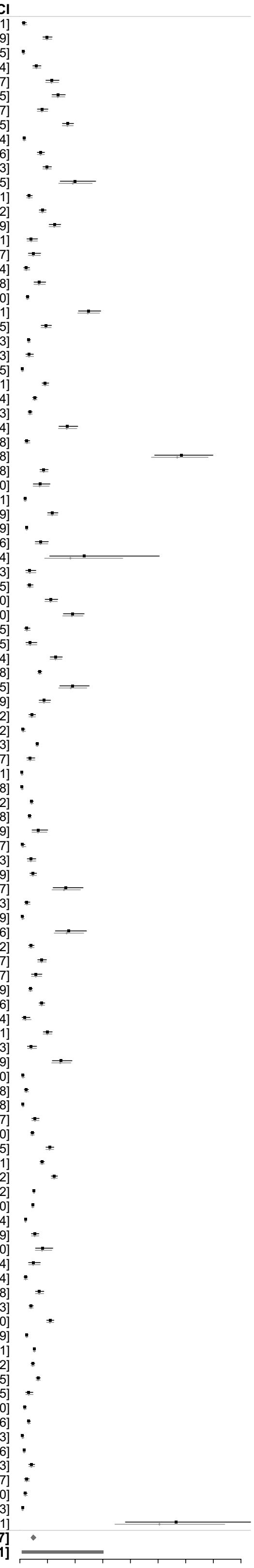


Fig. 4 Classical random-effects meta-analysis of disordered eating in university students

Fig. 5 Bayesian meta-analysis of disordered eating in university students

■ quoted estimate ✦ shrinkage estimate

study	estimate	95% CI
Abdul Manaf , 2016	0.0674	[0.0384, 0.1181]
Abo Ali, 2020	0.4927	[0.4165, 0.5829]
Akdevelioglu, 2010	0.0626	[0.0443, 0.0885]
Al Banna, 2021	0.2989	[0.2343, 0.3814]
Albrahim, 2019	0.5777	[0.4709, 0.7087]
Alcaraz-Ibáñez, 2019	0.6925	[0.5838, 0.8215]
Alhazmi, 2019	0.4016	[0.3177, 0.5077]
Alkazemi, 2018	0.8650	[0.7703, 0.9715]
AlShebali, 2020	0.0748	[0.0530, 0.1054]
Alwosaifer, 2016	0.3753	[0.3160, 0.4456]
Azzouzi, 2019	0.4885	[0.4176, 0.5713]
Badrasawi, 2019	1.0000	[0.7291, 1.3715]
Barayan, 2018	0.1642	[0.1198, 0.2251]
Barry, 2021	0.4081	[0.3504, 0.4752]
Benítez, 2019	0.6260	[0.5311, 0.7379]
Bizri, 2020 Q1	0.2018	[0.1277, 0.3191]
Bizri, 2020 Q2	0.2400	[0.1537, 0.3747]
Bosi, 2016	0.1099	[0.0693, 0.1744]
Brumboiu, 2018	0.3455	[0.2556, 0.4668]
Carriedo, 2020	0.1359	[0.1113, 0.1660]
Castejón, 2020	1.2454	[1.0607, 1.4621]
Chammas, 2017	0.4695	[0.3857, 0.5715]
Chan, 2020	0.1610	[0.1347, 0.1923]
Chaudhari, 2017	0.1627	[0.1083, 0.2443]
Compte, 2015	0.0396	[0.0248, 0.0635]
Damiri, 2021 Q1	0.4582	[0.4022, 0.5221]
Damiri, 2021 Q2	0.2676	[0.2306, 0.3104]
Din, 2019	0.1810	[0.1467, 0.2233]
Ebrahim, 2019	0.8605	[0.7069, 1.0474]
Erol, 2019	0.1245	[0.0867, 0.1788]
Farchakh, 2019 Q1	2.9187	[2.4391, 3.4928]
Farchakh, 2019 Q2	0.4315	[0.3638, 0.5118]
Fatima, 2018	0.3636	[0.2426, 0.5450]
Gramaglia, 2019 Q1	0.0921	[0.0701, 0.1211]
Gramaglia, 2019 Q2	0.5885	[0.5028, 0.6889]
Grange, 1998	0.1225	[0.1036, 0.1449]
Greenleaf, 2009	0.3784	[0.2782, 0.5146]
Havemann, 2011	1.1667	[0.5396, 2.5224]
Herzog, 1985	0.1748	[0.1059, 0.2883]
Iyer, 2021	0.1773	[0.1313, 0.2395]
Jamali, 2020 Q1	0.5594	[0.4568, 0.6850]
Jamali, 2020 Q2	0.9567	[0.7877, 1.1620]
Jennings, 2006	0.1215	[0.0809, 0.1825]
Joja, 2012	0.1828	[0.1090, 0.3065]
Kara, 2021	0.6496	[0.5498, 0.7674]
Kiss-Toth, 2018	0.3589	[0.3247, 0.3968]
Ko, 2015	0.9519	[0.7229, 1.2535]
Koushiou, 2019 Q1	0.4397	[0.3483, 0.5549]
Koushiou, 2019 Q2	0.2143	[0.1621, 0.2832]
Kutlu, 2013	0.0522	[0.0299, 0.0912]
Ladner, 2019	0.3123	[0.2874, 0.3393]
Lee, 2015	0.1845	[0.1258, 0.2707]
Liao, 2006 T1	0.0318	[0.0190, 0.0531]
Liao, 2008 T2	0.0362	[0.0223, 0.0588]
Mancilla-Diaz, 2007	0.2128	[0.1854, 0.2442]
Marciano, 1988	0.1736	[0.1457, 0.2068]
Mazzaia, 2018	0.3333	[0.2205, 0.5039]
Mealha, 2013 Q1	0.0442	[0.0218, 0.0897]
Mealha, 2013 Q2	0.1962	[0.1335, 0.2883]
Momeni, 2020	0.2340	[0.1813, 0.3019]
Nancy, 2021	0.8293	[0.6013, 1.1437]
Ngan, 2017	0.1239	[0.0843, 0.1823]
Nichols, 2009	0.0436	[0.0264, 0.0719]
Padmanabhan, 2017	0.8795	[0.6422, 1.2046]
Parra-Fernández, 2018	0.2011	[0.1572, 0.2572]
Parreño-Madrigal, 2020	0.3942	[0.3232, 0.4807]
Pereira, 2011	0.2892	[0.2097, 0.3987]
Pitanupong, 2017	0.1895	[0.1583, 0.2269]
Plichta, 2019	0.3948	[0.3466, 0.4496]
Polanco, 2020	0.0843	[0.0390, 0.1824]
Radwan, 2018	0.4977	[0.4234, 0.5851]
Ramaiah, 2015	0.2028	[0.1361, 0.3023]
Rasman, 2018	0.7437	[0.5867, 0.9429]
Rathner, 1994 Q1	0.0499	[0.0311, 0.0800]
Rathner, 1994 Q2	0.1114	[0.0797, 0.1558]
Reyes-Rodríguez, 2011	0.0535	[0.0383, 0.0748]
Roshandel, 2012	0.2739	[0.2158, 0.3477]
Rostad, 2021	0.2239	[0.1914, 0.2620]
Safer, 2020	0.5387	[0.4723, 0.6145]
Saleh, 2018 Q1	0.4013	[0.3642, 0.4421]
Saleh, 2018 Q2	0.6216	[0.5680, 0.6802]
Sarah, 2021	0.2547	[0.2503, 0.2592]
Sepulveda, 2007	0.2318	[0.2099, 0.2560]
Sharifian, 2021	0.1013	[0.0897, 0.1144]
Sharma, 2019	0.2671	[0.2081, 0.3429]
Shashank, 2016 Q1	0.4105	[0.2828, 0.5960]
Shashank, 2016 Q2	0.2407	[0.1569, 0.3694]
Simona Bo, 2014 Q1	0.1000	[0.0723, 0.1384]
Simona Bo, 2014 Q2	0.3497	[0.2825, 0.4328]
Spillebout, 2019	0.2003	[0.1649, 0.2433]
Taha , 2018 Q1	0.5464	[0.4854, 0.6150]
Taha, 2018 Q2	0.1225	[0.1022, 0.1469]
Tavolacci, 2015	0.2617	[0.2410, 0.2841]
Tavolacci, 2018	0.2324	[0.2014, 0.2682]
Tavolacci, 2020	0.3295	[0.2930, 0.3705]
Thangaraju, 2020	0.1570	[0.1046, 0.2355]
Tury, 2020 Q1T1	0.0847	[0.0618, 0.1160]
Tury, 2020 Q1T2	0.1605	[0.1337, 0.1926]
Tury, 2020 Q2T1	0.0467	[0.0310, 0.0703]
Tury, 2020 Q2T2	0.0755	[0.0590, 0.0966]
Uzun, 2006	0.2070	[0.1603, 0.2673]
Weigel, 2016	0.1176	[0.0816, 0.1697]
Yoneda, 2020	0.0958	[0.0695, 0.1320]
Yu, 2015	0.0473	[0.0365, 0.0613]
Zhou, 2020	2.8235	[1.9095, 4.1751]
mean	**0.2420**	**[0.2020, 0.2897]**
prediction	**0.2420**	**[0.0388, 1.5071]**



Heterogeneity (tau): 0.92 [0.79, 1.06]

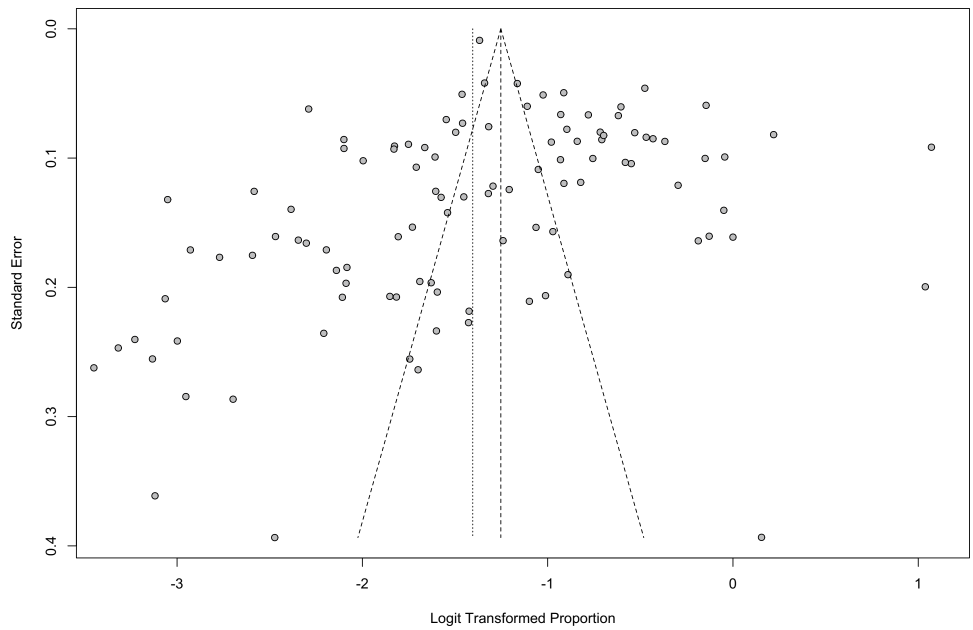


Fig. 6 Funnel plot of disordered eating in university students

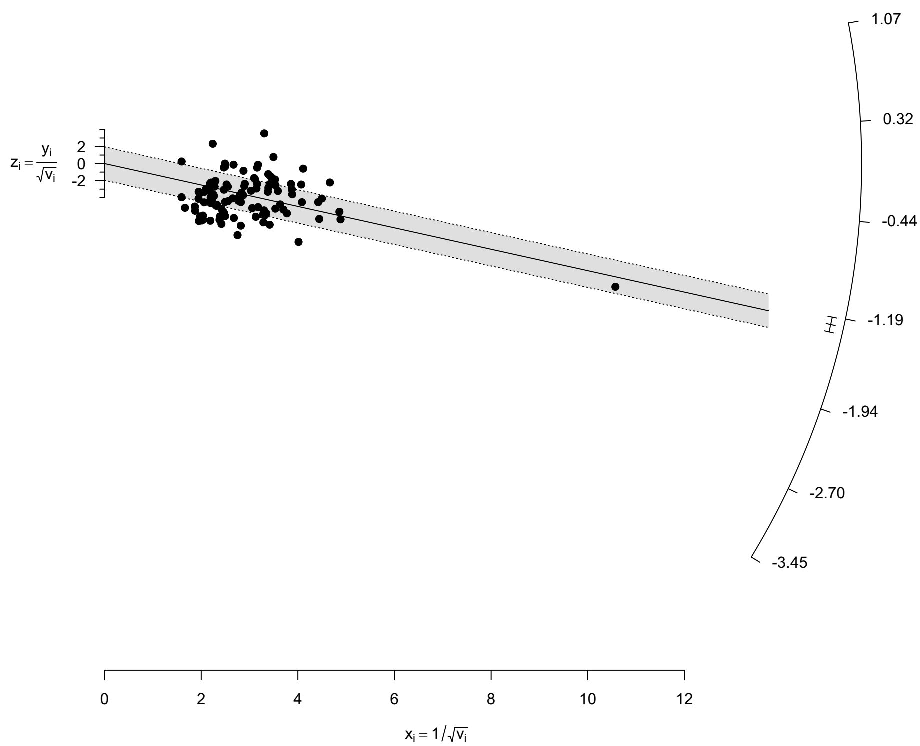
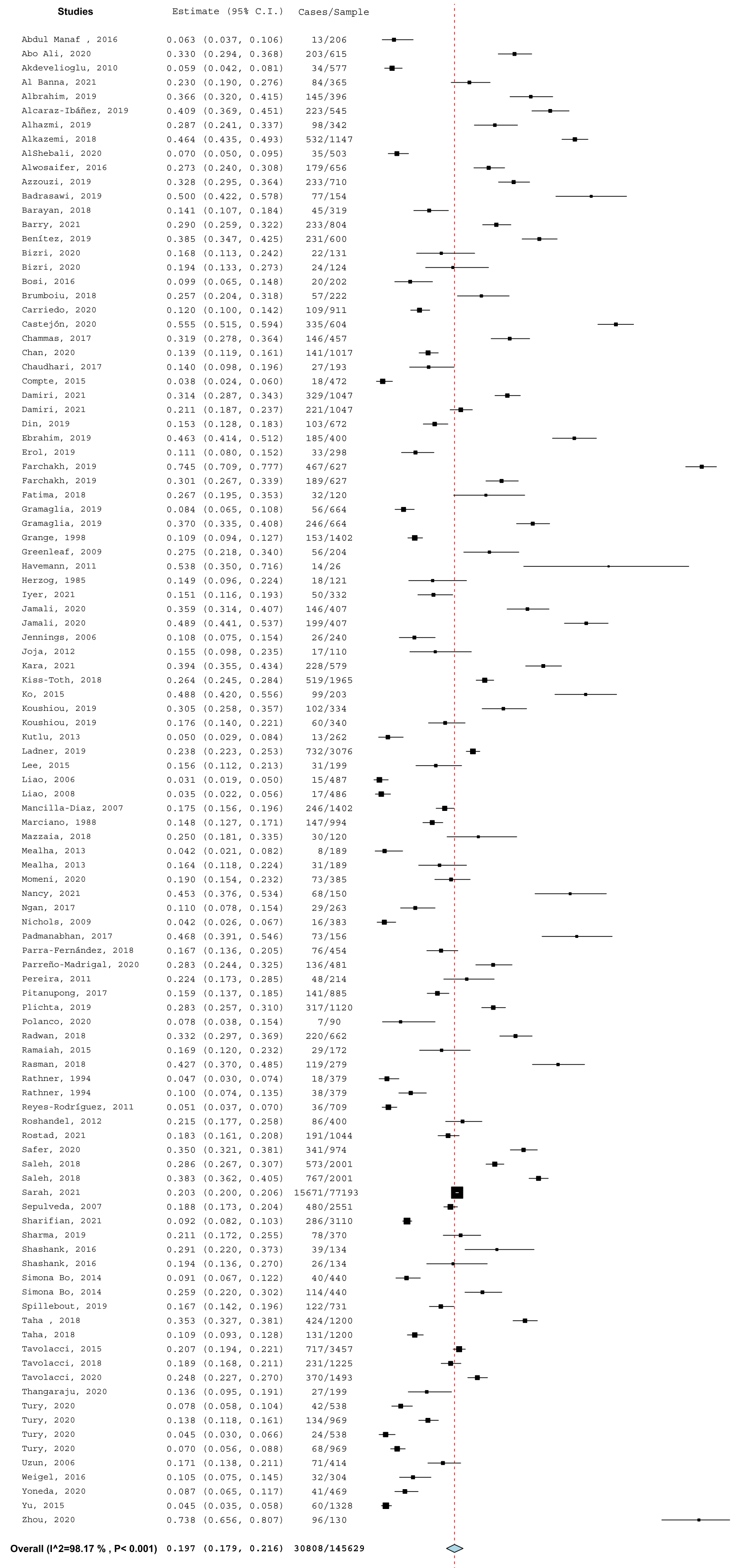


Fig. 7 Galbraith radial plot of disordered eating in university students

was very low for many countries. Lebanon ($k=1$, $N=627$) reported the highest SBDE prevalence of 74.5% [70.1; 77.8], while Argentina ($k=1$, $N=472$) and China ($k=3$, $N=2{,}301$) reported the lowest percentages of 3.8 [2.4; 6.0], and 4.0 [3.2; 5.0], respectively. A subgroup meta-analysis, conducted for the eight countries with at least 5 studies (see Table 3), yielded evidence of statistically significant heterogeneity ($p=0.001$) in the prevalence of SBDE. Visual inspection of Table 3 suggests that, at the very least, a greater percentage of university students in the USA are reporting SBDE than their counterparts in India (which has a low heterogeneity index), France, and Saudi Arabia. The difference between different countries was statistically significant, $p=0.001$.

Table 3 shows that non-Western countries ($k=55$, $N=29{,}663$) have a slightly higher weighted mean prevalence of SBDE, 20.9% [17.8; 24.5], than Western countries

Fig. 8 Sensitivity plot of disordered eating in university students



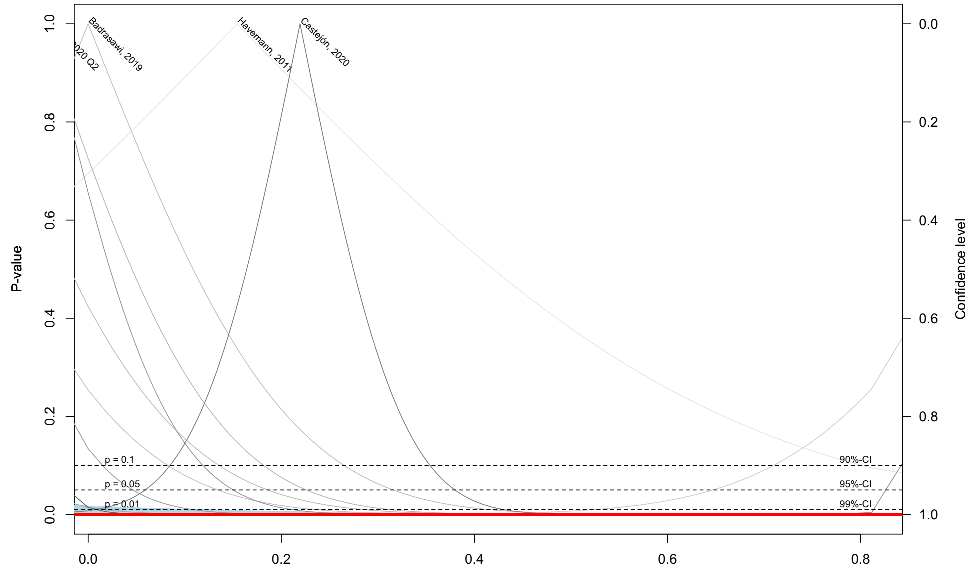


Fig. 9 Drapery plot of disordered eating in university students

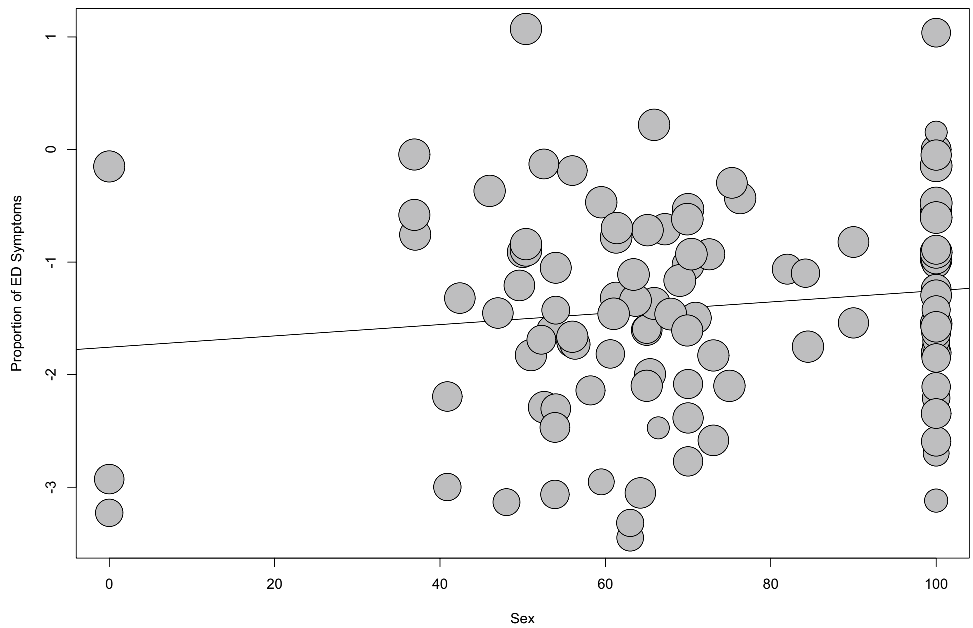


Fig. 10 Meta-regression between sex and disordered eating in university students

(k = 50, N = 115,966), 18.4% [16.4; 20.6], but the difference is not statistically significant (p = 0.52; see Fig. 13).

Measure of screen-based disordered eating

There was significant heterogeneity across the various measures (Table 3) used by the sample of this studies in this meta-analysis, I^2 = 98.2%, τ^2 = 0.36, p = 0.001 (Fig. 14). Considering the measures as 15 categories, the BEDS-7 (k = 1, N = 154) yielded the highest SBDE prevalence at 50.0% [42.2; 57.8], while the EDE-Q (k = 1, N = 503) yielded the lowest prevalence at 7.0% [5.04; 9.54]. In descending order, the prevalence of SBDE for the measures used in at least 5 studies were SCOFF (k = 22, N = 100,638) = 27.6% [24.1; 31.5], EAT-26 (k = 45, N = 23,821) = 16.9% [13.9; 20.3], EDE-Q (k = 6, N = 2255) = 18.1% [8.4; 35.0], EDI (k = 10, N = 6,394) = 16.9% [9.6; 28.2], EAT-40 (k = 6, N = 4355) = 10.6% [7.5; 14.9].

Timeframe/years

Ninety-three percent of the studies were published after 2009, while 23% were published in 2020, 2021, or 2022. No studies meeting the inclusion and exclusion criteria were published between 1995 and 2004. Results of subgroup meta-analysis showed a statistically significant (p = 0.001)

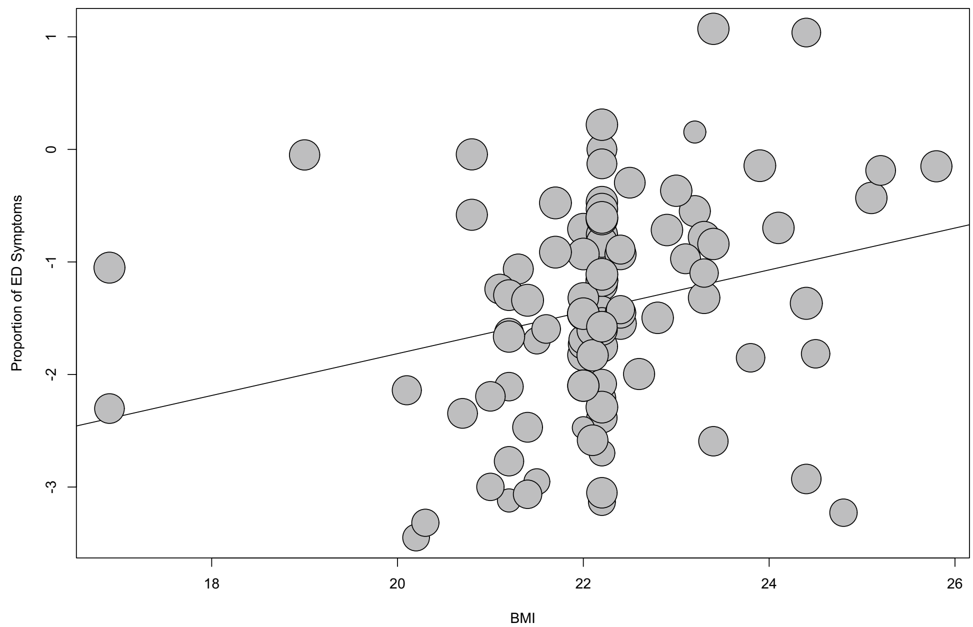


Fig. 11 Meta-regression between BMI and disordered eating in university students

increase in the prevalence of SBDE among university students (see Fig. 15). Specifically, there appears to be an increase between 2005–2014 and 2015–2022; for the categories 2005–2009, 2010–2014, 2015–2019 and 2020 onwards the weighted pooled prevalence of screen-based disordered eating was 10.6% [07.3; 15.1], 13.0% [8.3; 19.8], 23.8% [20.7; 27.2] and 20.8% [17.6; 24.5], respectively. To further illustrate the effect of year on the prevalence of SBDE among university students, a meta-regression showed that time of publication is a statistically significant predictor ($p = 0.001$) of increased prevalence rate of SBDE among university students (see Fig. 16).

Discussion

This meta-analysis of 89 studies (total $N = 145{,}629$) from 40 countries suggests that the prevalence of screen-based disordered eating among university undergraduate students is 19.7%. We also found that increasing BMI is a strong statistical confounder, while female sex is a statistically significant but weak confounder. Age, which typically does not vary a great deal for undergraduates, had an insignificant effect. Non-Western countries have a slightly higher risk prevalence of screen-based disordered eating (20.9%) compared to Western countries (18.4%), but the difference is not statistically significant. Although slight asymmetry to the right was apparent in the funnel plot, using Egger's regression test we ruled out significant heterogeneity.

The overall screen-based prevalence rate of disordered eating (nearly 20%) is approximately twice the global prevalence of eating disorders estimates of around (approximately 10) [53, 54]. This is perhaps due to the margin of error of screen-based measurement tools combined with the fact that disordered eating focuses on the presence of individual symptoms while an eating disorder focuses on meeting a group of symptoms for a minimum period of time to meet established diagnostic criteria. However, a figure of 15–20% is also what would be expected if a number of those sometimes co-occurring symptoms were normally distributed within the populations that have been studied to date.

At 19.7%, our overall prevalence rate of screen-based disordered eating corresponds with perfectly Levine and Smolak's (2021) conclusion based on their narrative review [12]. Furthermore our results are consistent with the findings of the two studies with the largest sample sizes: 20.3% and 20.7% in the studies by Falvey, Hahn, Anderson, Lipson, and Sonneville (2021; $N = 77{,}193$) and Tavolacci et al. (2015; $N = 3457$), respectively [107, 153]. We acknowledge that further research is needed, because the prevalence may be lower. If we assume that the sensitivity of measures such as the EAT-26 and the SCOFF is around 85% [6], this means that at least 15% of 20%, or at least 3%, have disordered eating beliefs, anxieties, and behaviors that are correlated with a wide variety of health problems and that put them at risk for a possible eating disorder [12, 164]. However, regardless of the psychometrics of the screening measures, epidemiological studies indicate that it is highly unlikely that $20-3\% = 17\%$, that is, 1 in 6, university undergraduates have a diagnosable but not yet diagnosed eating disorder. If we place the point prevalence of *DSM*-5-defined eating disorders at a conservative estimate of 8–10% [8], then our meta-analytic findings suggest, again conservatively, that

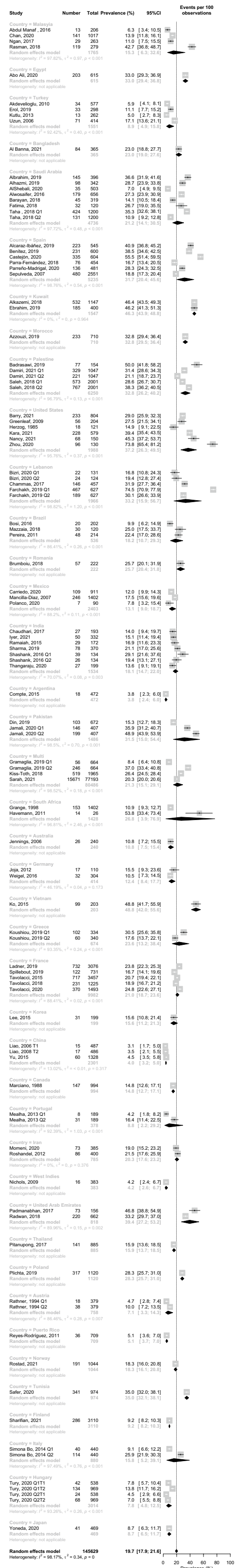


Fig. 12 Subgroup meta-analysis by Country

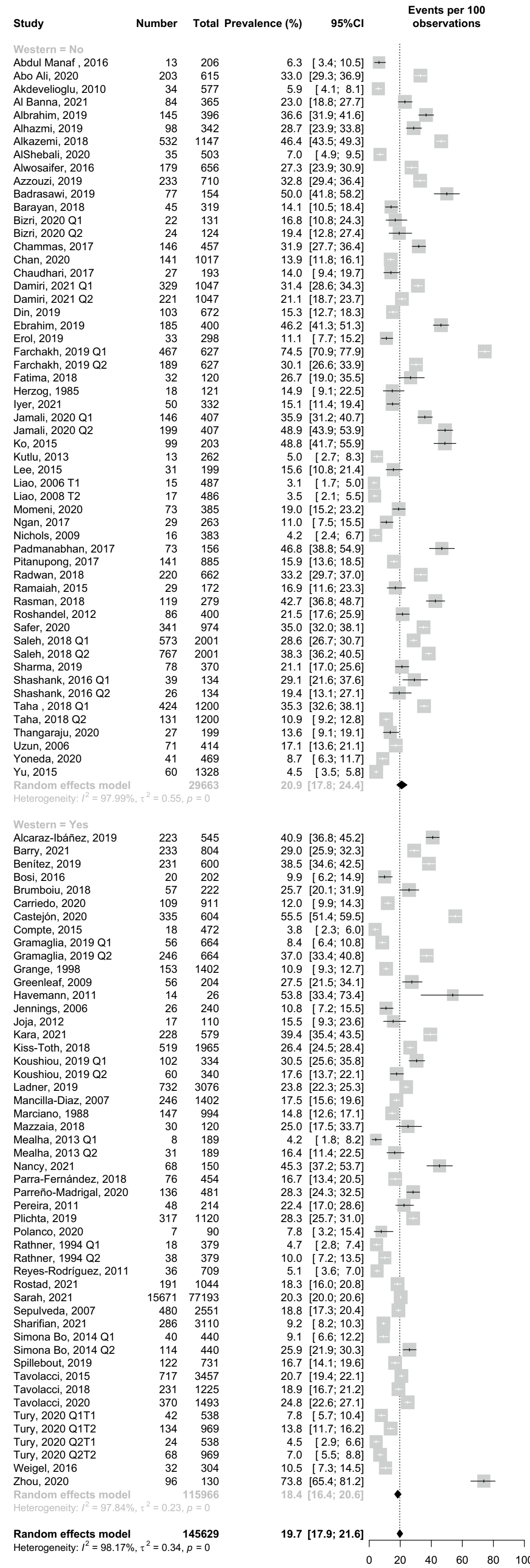


Fig. 13 Subgroup meta-analysis by Culture.

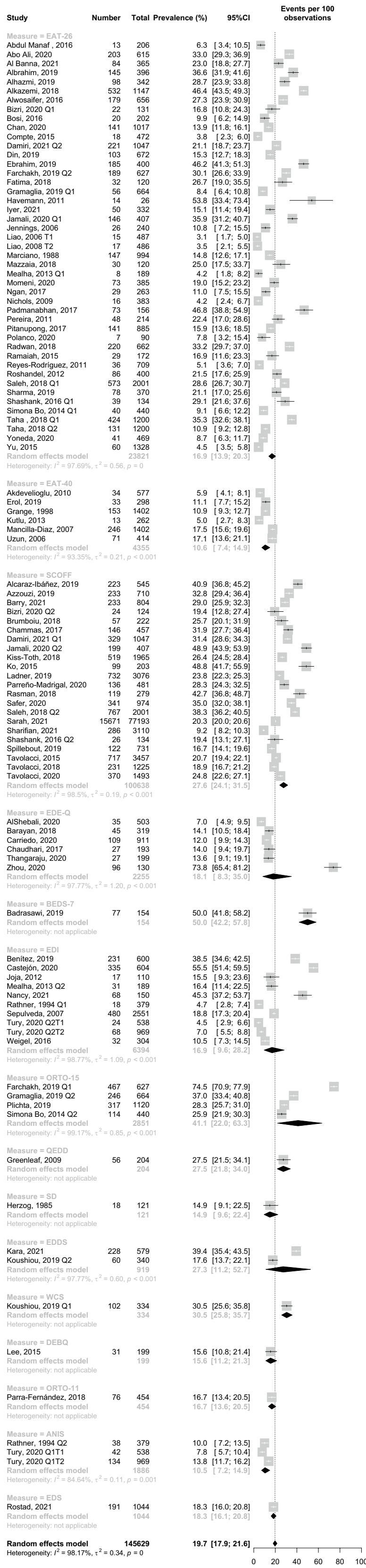


Fig. 14 Subgroup meta-analysis by disordered eating measure

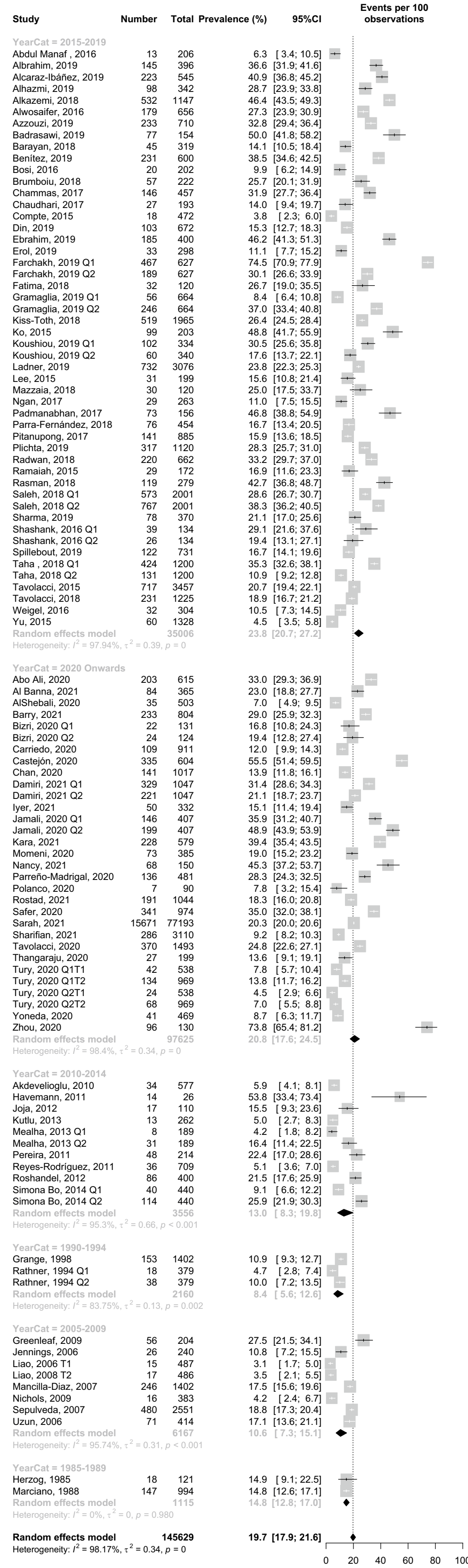


Fig. 15 Subgroup meta-analysis by Timeframe/Year

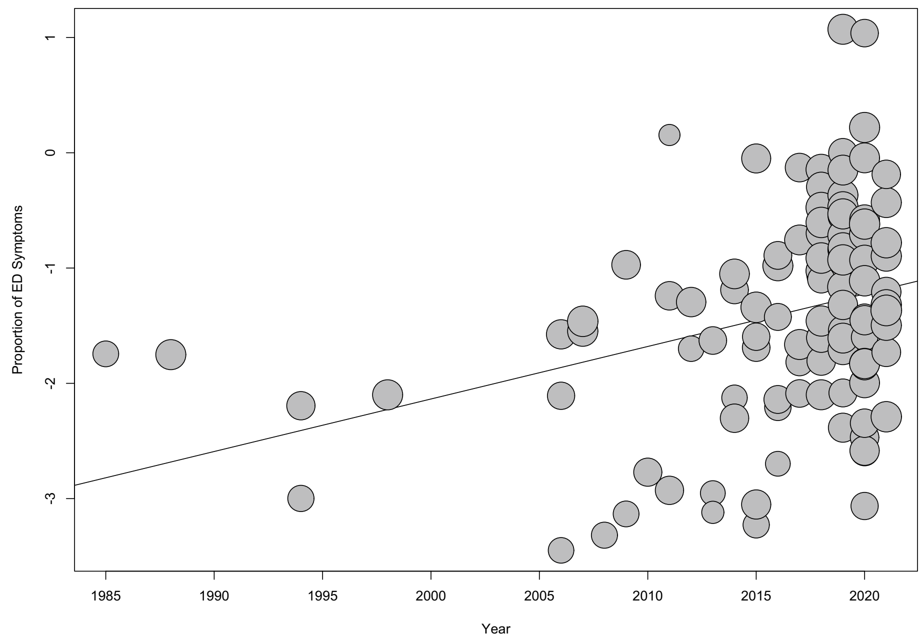


Fig. 16 Meta-regression between year and disordered eating in university students

10–12%, or at least 1 in 9, of university undergraduates meet our criteria for disordered eating.

The statistic of 1 in 9, let alone 1 in 5—or possibly 1 in 4, based on the Bayesian estimate—undergraduates scoring above the at-risk cut-off on various validated measures that screen for eating disorders and represent disordered eating deserves the attention of researchers, clinicians, public health officials, and mental health advocates for two reasons. First the rationale for, and validity data in support of, the instruments used to measure screen-based (at-risk) disordered eating strongly suggests that there are a meaningful number of university undergraduates who have an eating disorder that is currently undiagnosed and presumably untreated. Although this has been pointed out by many researchers and clinicians, it remains alarming [32] because early detection and treatment have been shown to decrease symptoms to a greater extent and improve the chance of recovery [165].

This aspect of our findings is supported by a very recent study that sought to determine whether established disparities in ED prevalence and receiving mental healthcare for marginalized groups within this population have widened or narrowed over time for different cognitive and behavioral ED symptoms, current probable EDs, lifetime ED diagnoses, and mental healthcare use among college students across the United States [166]. This study found that between 2013 and 2020 there were non-linear increases in ED symptoms and mental health care among young adults in the United States. Moreover, consistent with the data from this meta-analysis, young adults in the United States with higher BMIs had more ED burden with time, as did bisexuals, homosexual, lesbian, or queer people [166].

There has been a strong sense among clinicians in some parts of the world (e.g., the USA and Canada) that "the problem of eating disorders and disordered eating" has been worsened by the COVID-19 pandemic. In a recent study of five cross-sectional samples of French university students, surveyed at 3-year intervals between 2009 and 2021, Tavolacci et al. (2021) found that the prevalence of screen-based disordered eating for the female and male samples remained fairly stable at 26%-31% and 7–13%, respectively, between 2009 and 2018. However, for both females and males the prevalence increased dramatically (+ 20% and + 18%, respectively) between 2018 and 2021, perhaps reflecting the stressors of the COVID-19 pandemic.

Our global data, which incorporates a set of studies of French undergraduates by Tavolacci et al. (2015, 2018, 2020), paints a different picture. We also found evidence of stability—in our study, between 2005 and 2014—but the increase we noted was in the period 2015–2022. Moreover, we found a slight decrease in the weighted pooled prevalence of screen-based disordered eating from the pre-COVID period of 2015–2019 (23.8%) to the post-COVID period (2020 onwards; 20.8%). Our data are consistent with several other recent reviews [167, 168] in suggesting that a COVID-19 effect is accurate in some places and for some vulnerable people—and, in particular, people who already have an eating disorder—but *not* in general. Future research and meta-analytic reviews are needed to clarify the moderating and mediating variables at work here.

Over the past 10 years the prevalence and seriousness of disordered eating and eating disorders in males has received considerable attention [169]. Nevertheless, our confounder analysis indicated that, as the preponderance of females in a sample of university undergraduates increased, to a small but significant degree so did the prevalence of screen-based disordered eating. This finding, in the context of the very significant sex difference seen in, for example, the Tavolacci et al. (2021) samples, is a reminder that, while males certainly have disordered eating and eating disorders, as do those who do not identify as either female or female, there is still something about the construction, policing, and sociopolitical status of femininity that places females, including female undergraduate students, across the globe at greater risk for screen-based disordered eating, as well as eating disorders [170]. Further research, including meta-analysis, should continue to investigate risk and protective factors that moderate and mediate this disparity.

As noted previously, our confounder analyses also found that, even though the range was narrow, the greater the mean BMI of the sample, the higher the prevalence of screen-based disordered eating. Burnette et al. (2018) reported a similar finding for a sample of U.S. female undergraduate students, but not male undergraduates [28]. Our finding is also consistent with cross-sectional and longitudinal epidemiological studies of U.S. adolescents and emerging adults showing that greater levels of disordered eating and poor psychosocial health among overweight youth [171–173]. In this regard Yoon et al. (2020) reported that BMI and disordered eating behaviors rose in a correlated fashion across 15 years of 4 follow-ups of a community sample that was 11 through 18 at baseline [174].

In some cultures at least, it is likely that there is a reciprocal relationship between disordered eating and body mass gain which is mediated by internalized weight stigma and a dieting mentality, and shaped by other sociocultural factors that promote the well-established risk factors of body dissatisfaction and weight and shape concerns [174]. However, further cross-cultural research on the confounders and mediators of the relationship between BMI and screen-based disordered eating is necessary to test particular path models that acknowledge cultural variability. For example, a recent survey of Chinese female undergraduates found that the relationship between body shame and scores on a dietary restraint measure was stronger for those with lower BMI scores [175]. Moreover, a recent meta-analysis of the relationship between disordered eating and use of social networking sites found that there was a small positive relationship for university students, but regardless of sample that relationship was weaker for those with higher BMIs [176].

We did not find the age was associated with disordered eating. This is in line with the results of a study of 680 U.S. female undergraduate students who were screened to eliminate those who would probably qualify to an eating disorder diagnosis. This study found a trivial, nonsignificant association of 0.05 between age and scores on a semi-structured interview assessing screen-based disordered eating [177].

It is possible that the truncated range of the mean sample ages accounts for this null finding. Further research on the relationship between age in undergraduates and postbaccalaureate (e.g., graduate, medical, law students) and screen-based disordered eating is needed. Preliminary epidemiological data from a community sample in Cyprus indicates that a higher percentage of both men (12.3%) and women (23.2%) in the 25–45 age range met or exceeded the EAT-26 cut-off score of 20 than their counterparts in the 12–18 and 46–60 ranges [178]. Of course, age is embedded in the transition from older adolescence to emerging adulthood that is a foundation for the interest in screen-based disordered eating in undergraduates, so longitudinal designs beginning in early or mid-adolescence (see, e.g., Project EAT; Yoon et al., 2020) are needed.

Although our confounder analysis did not find a general difference in screen-based disordered eating between Western and non-Western countries, broad sociocultural factors are likely to be relevant to developmental phenomena, so cross-cultural replications will also be necessary. In this regard a cross-sectional study of over 3,200 males and females in South Korea, using the same EAT-26 cut-off score we did in our meta-analysis, found that the prevalence of disordered eating varied only between 6.7% and 7.2% for age categories 10–12, 13–14, 15–17, and older in 900 undergraduates ages 18 through 24 [179]. Yet, a previous meta-analysis by our team [33] of over 3200 pre-medical undergraduate students from Brazil, China, India, Malaysia, Pakistan, and the UK found that the prevalence of EAT-26-based disordered eating in females was moderated by higher BMI and older age, whereas this was not the case for males.

One strength of our meta-analysis with undergraduates in general is that nearly two thirds of the individual studies used the EAT-26 and SCOFF screening measures. The EAT-26 measure is well validated in a variety of clinical and non-clinical populations from different cultural backgrounds [180]. Likewise, the SCOFF measure appears to be a very practical, highly effective screening tool for detecting risk for eating disorders [181]. In contrast, we recommend against further use of the EAT-40 in studies of screen-based disordered eating, due to a very low sensitivity that results in a large rate of false-negatives [182], which probably accounts for the fact that in our meta-analysis the six studies (published between 1998 and 2019) using the EAT-40 yielded a prevalence of disordered eating (10.62%), half that of the remaining studies.

Study strengths and limitations

To our knowledge this is the first meta-analysis of the prevalence of screen-based disordered eating in the population of university undergraduate students across the world. Other strengths are the large sample size (135,454 participants from 91 studies) and the categorization of event rates using cut-off scores from well-validated measures of FEDs. Nevertheless, the findings should be interpreted with consideration of several limitations. First, the self-report nature of the data from the studies included may be confounded by shame and/or social desirability, and diluting the power of anonymity and leading to underreporting of ED symptomatology. Second, most of the studies considered by this meta-analysis had a cross-sectional design, so that the direction of the causality remains unclear. Third, we exclusively examined English Language articles, which may have led to omission of some relevant non-English articles. Finally, another limitation is inherent in one of the strengths: the inevitable heterogeneity of the numerous studies selected.

Conclusion and implications

The pooled prevalence of screen-based disordered eating in university undergraduate students in 40 countries appears to be 20%. As a number of studies eliminated people with ongoing eating disorders from their sample, this finding supports many previous studies indicating that far too many students have an eating disorder and are not accessing accurate diagnosis and available treatment (see, e.g., Falvey et al., 2021). Moreover, as probably only a 10–15% of that 20% have a diagnosable eating disorder, our data indicate that a large percentage of undergraduates are struggling with disordered eating as a biopsychosocial health problem. It is important to develop means of identifying these students and offering them original or culturally appropriate versions of the Body Project [183] or other effective preventive interventions for high-risk undergraduate students [12]. Finally, our review indicates that prospective studies, using sensitive and specific screening measures such as the EAT-26 and the SCOFF, are urgently needed to illuminate the interactions between the risk factors and to use the information to construct or improve prevention programs for students with disordered eating attitudes and behaviors.

What is already known on this subject?

- Individuals with eating disorders have disordered eating attitudes and behaviors, but not everyone who engages in disordered eating has, or will be diagnosed with, an eating disorder. The difference is in the frequency and severity of the behaviors, as well as the amount of distress they cause the person.
- Previous research has reported that university students have a higher prevalence of disordered eating than the general population, indicating that more research is needed.

What does this study add?

- About 20% of university students exhibit a high level of screen-based disordered eating behavior and can be classified 'at risk' of developing a clinical eating disorder.
- Results of Bayesian analyses confirm the results of a prevalence-based approach. This is the first time Bayesian statistics are used to compute odds of disordered eating.
- Strong evidence suggests that screen- based disordered eating is increasing among university students in recent years; thus, planning access for preventive interventions and for supporting those who need outreach and treatment is urgently needed.

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Declaration

Conflict of interest The authors have not disclosed any competing interests.

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