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REVIEW

The global prevalence of mental health disorders among runaway and homeless youth: A meta-analysis

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Abstract

A meta-analysis was performed to identify the pooled prevalence of mental health disorders (MHDs) among runaway and homeless youth (RHY). Relevant studies published between December 1, 1985, and October 1, 2023, were identified in the *PubMed, Scopus, Web of Science*, and *Cochrane Library* databases. A preliminary screening of 11,266 papers resulted in the inclusion of 101 studies. The pooled-prevalence estimates were obtained using a random-effects model. The findings showed varying lifetime prevalence rates of MHDs: 47% (conduct disorders and psychological distress), 43% (depression), 34% (major depressive disorders), 33% (post-traumatic stress disorder), 27% (personality disorders), 25% (attention-deficit/hyperactivity disorder), 23% (bipolar disorders), 22% (anxiety), 21% (oppositional defiant disorders), 15% (anorexia), 15% (adjustment disorders), 14% (dysthymia), 11% (schizophrenia), 9% (obsessive–compulsive disorders), and 8% (gambling disorder). The current prevalence rates were: 31% (depression), 23% (major depressive disorder), 23% (anxiety), 21% (post-traumatic stress disorder), 16% (attention-deficit/hyperactivity disorder), 15% (bipolar disorder), 13% (personality disorders), 13% (oppositional defiant disorders), 8% (schizophrenia), and 6% (obsessive–compulsive disorders). Regular screening and the implementation of evidence-based treatments and the promotion of integration and coordination between mental health services for adolescent minors and young adults with other service systems are recommended.

Keywords Mental health disorders · Runaway youth · Homeless youth · Meta-analysis

Abbreviations

ADHD	Attention-deficit/hyperactivity disorder
MHDs	Mental health disorders
NOS	Newcastle–Ottawa Scale
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PTSD	Post-traumatic stress disorder
RHY	Runaway and homeless youth

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Introduction

Mental health disorders (MHDs) among runaway and homeless youth (RHY) have become a major public health issue worldwide [1]. RHY refers to individuals aged 12–24 years who either leave their homes without parental or legal guardian consent [2], lack a permanent dwelling, and reside in public spaces, shelters, with unfamiliar individuals, on the streets, with friends, in transitional housing, or other non-domicile settings [3].

The prevalence of RHY has increased in recent years [4]. Moreover, RHY are more likely to report co-occurring disorders, such as MHDs [5–7], suicidal behaviors [8] and/or substance abuse [9, 10]. They also are more likely to report risky sexual behaviors [11] and experience trauma disorders [1]. While these findings highlight RHY as one of the most

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vulnerable populations globally, RHY culture can serve as a substitute for absent parental support, creating significant challenges for healthcare and human services professionals working with this group [1]. Indeed, RHY often exhibit resistance to traditional methods of assistance, including substance use counseling, HIV prevention programs, and psychotherapy [1].

Youth experience homelessness or run away for various reasons. Some are compelled to leave their homes or voluntarily choose to depart due to family conflicts or dysfunction [12]. Homelessness can also result from inadequate discharge planning and a deficiency of support services for youth transitioning from child welfare or juvenile justice systems [13, 14]. Moreover, familial residential instability, familial poverty, and financial hardships significantly impact the lives of many RHY [15, 16].

Two previous meta-analyses have reported the prevalence of MHDs among homeless children (10–26%) [17], or children and adolescents in the child welfare system (4–27%) [18], but neither focused on RHY. As well as being almost a decade old, these studies: (i) only included homeless children (< 18 years) [17] or children and adolescents in the child welfare system (7–17 years) [18]; (ii) only reported the pooled prevalence rate of some specific MHDs (i.e., they did not report the pooled prevalence rate of psychological distress, major depressive disorders, bipolar disorders, personality disorders, adjustment disorders, or schizophrenia); (iii) did not report the lifetime and current pooled prevalence rate of MHDs; (iv) did not compare two groups of RHY (adolescent minors vs. young adults); and (v) did not conduct any subgroup analyses and sensitivity analyses, or meta-regression to detect sources of heterogeneity [17].

To the best of the present authors' knowledge, there are no previous meta-analyses examining the lifetime and current pooled prevalence rates of a wide range of MHDs among RHY. Consequently, the present study is novel in its aim of estimating the pooled prevalence of MHDs among youth, encompassing both adolescents and young adults. The findings could enhance researchers' understanding of the pooled prevalence rates of various MHDs, assisting practitioners and policymakers in targeting RHY with suitable interventions, developing adapted psychiatric services, providing professional training, and planning further research.

Methods

Registration and protocol

The present systematic review and meta-analysis was conducted based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [19]. The review protocol was registered on PROSPERO (Ref: CRD42023476261).

Search strategy

A thorough search of English-language published papers and abstracts from December 1, 1985, to October 1, 2023, was systematically conducted using the *Scopus, PubMed, Web of Science*, and *Cochrane Library* databases. Additionally, a search on *Google Scholar* was performed to locate any additional relevant studies. The search strategy, employing crucial Boolean operators (AND/OR), was developed and adjusted for diverse databases, utilizing the following initial keywords: "(mental disorders), (psychotic disorders), (mentally ill persons), (homeless youth), (homeless persons), (runaway youth), (adolescent), (young adult), (adult children)". Furthermore, the bibliographies of the published studies included in the meta-analysis were examined to locate the presence of any additional relevant studies. If multiple studies presented findings on the same sample of RHY, the data providing the most comprehensive details regarding the prevalence of MHDs were used in the analysis. The specifics of the search strategy, encompassing the amalgamation of keywords employed across various electronic databases, are outlined in Table 1.

Study eligibility and exclusion criteria

The eligibility criteria used for inclusion were: (a) RHY aged 12–24 years [2, 3]; (b) reporting original prevalence data on RHYs' MHDs, and life-time MHDs including ever having a MHD (at least one time) and current MHDs (defined as having MHDs within the past 30 days); and (c) any type of quantitative empirical study (e.g., cross-sectional, cohort, case–control, mixed-methods, and interventions with baseline data). The study excluded qualitative papers, secondary analyses without primary data, systematic reviews, meta-analyses, and unpublished theses (i.e., those not peer-reviewed, such as PhD theses and Master's theses).

Data extraction process

EndNote X7 software was utilized to eliminate duplicate papers. Subsequently, two authors (BA and JH) independently assessed the titles and abstracts in accordance with the study's inclusion and exclusion criteria. In instances of disagreement between the two reviewers, resolution was sought from a third author (RM). In the subsequent step, the full texts of the studies were examined based on the criteria for eligibility in the study. Two authors (BA and JH) independently conducted the extraction of data for the studies selected for inclusion in the meta-analysis. The extracted information encompassed details such as the study authors,

Table 1 Search strategy

Database	Keywords
Pubmed	#1 (((((((((Mental Disorders [MeSH Terms]) OR (Affective Disorders, Psychotic [MeSH Terms])) OR (Psychotic Disorders [MeSH Terms])) OR (Mentally Ill Persons [MeSH Terms])) OR (Schizophrenia [MeSH Terms])) OR (Depression [MeSH Terms])) OR Depressive Disorder [MeSH Terms]) OR Bipolar and Related Disorders [MeSH Terms]) OR Bipolar Disorder [MeSH Terms]) OR Dysthymic Disorder [MeSH Terms]) OR Depressive Disorder, Major [MeSH Terms]) OR Anxiety [MeSH Terms]) OR Anxiety Disorders [MeSH Terms]) OR Phobia, Social [MeSH Terms]) OR Personality Disorders [MeSH Terms]) OR Antisocial Personality Disorder [MeSH Terms]) OR Borderline Personality Disorder [MeSH Terms]) OR Dependent Personality Disorder [MeSH Terms]) OR Compulsive Personality Disorder [MeSH Terms]) OR Paranoid Personality Disorder [MeSH Terms]) OR Histrionic Personality Disorder [MeSH Terms]) OR Schizoid Personality Disorder [MeSH Terms]) OR Stress Disorders, Post-Traumatic [MeSH Terms]) OR Conduct Disorder [MeSH Terms]) OR Adjustment Disorders [MeSH Terms]) OR Gambling [MeSH Terms]) OR Attention Deficit Disorder with Hyperactivity [MeSH Terms]) OR Psychological Distress [MeSH Terms]) OR Attention Deficit and Disruptive Behavior Disorders [MeSH Terms]) OR Anorexia [MeSH Terms]) OR Anorexia Nervosa [MeSH Terms]) OR Obsessive–Compulsive Disorder [MeSH Terms]) #2 (((Homeless Youth [MeSH Terms]) OR (Homeless persons [MeSH Terms])) OR (Homeless individuals [Title/Abstract])) OR (Homelessness [Title/Abstract]) OR (Ill-Housed Persons [MeSH Terms]) OR (Adult Children [MeSH Terms]) OR (Adolescent [MeSH Terms]) OR (OR (Young Adult [MeSH Terms])) OR Runaway youth [Title/Abstract] OR (Runaway behavior [MeSH Terms]) #3 (((((((((Mental Disorders [MeSH Terms]) OR (Affective Disorders, Psychotic [MeSH Terms])) OR (Psychotic Disorders [MeSH Terms])) OR (Mentally Ill Persons [MeSH Terms])) OR (Schizophrenia [MeSH Terms])) OR (Depression [MeSH Terms])) OR Depressive Disorder [MeSH Terms]) OR Bipolar and Related Disorders [MeSH Terms]) OR Bipolar Disorder [MeSH Terms]) OR Dysthymic Disorder [MeSH Terms]) OR Depressive Disorder, Major [MeSH Terms]) OR Anxiety [MeSH Terms]) OR Anxiety Disorders [MeSH Terms]) OR Phobia, Social [MeSH Terms]) OR Personality Disorders [MeSH Terms]) OR Antisocial Personality Disorder [MeSH Terms]) OR Borderline Personality Disorder [MeSH Terms]) OR Dependent Personality Disorder [MeSH Terms]) OR Compulsive Personality Disorder [MeSH Terms]) OR Paranoid Personality Disorder [MeSH Terms]) OR Histrionic Personality Disorder [MeSH Terms]) OR Schizoid Personality Disorder [MeSH Terms]) OR Stress Disorders, Post-Traumatic [MeSH Terms]) OR Conduct Disorder [MeSH Terms]) OR Adjustment Disorders [MeSH Terms]) OR Gambling [MeSH Terms]) OR Attention Deficit Disorder with Hyperactivity [MeSH Terms]) OR Psychological Distress [MeSH Terms]) OR Attention Deficit and Disruptive Behavior Disorders [MeSH Terms]) OR Anorexia [MeSH Terms]) OR Anorexia Nervosa [MeSH Terms]) OR Obsessive–Compulsive Disorder [MeSH Terms]) AND (((Homeless Youth [MeSH Terms]) OR (Homeless persons [MeSH Terms])) OR (Homeless individuals [Title/Abstract])) OR (Homelessness [Title/Abstract]) OR (Ill-Housed Persons [MeSH Terms]) OR (Adult Children [MeSH Terms]) OR (Adolescent [MeSH Terms]) OR (OR (Young Adult [MeSH Terms])) OR Runaway youth [Title/Abstract] OR (Runaway behavior [MeSH Terms]))

Table 1 (continued)

Database	Keywords
Scopus	#1 (TITLE-ABS-KEY (Mental AND Disorders) OR TITLE-ABS-KEY (Affective AND Disorders, Psychotic) OR TITLE-ABS-KEY (Psychotic AND Disorders) OR TITLE-ABS-KEY (Mentally AND Ill AND Persons) OR TITLE-ABS-KEY (Schizophrenia) OR TITLE-ABS-KEY (Depression) OR TITLE-ABS-KEY (Depressive AND Disorder) OR TITLE-ABS-KEY (Bipolar AND Related AND Disorders) OR TITLE-ABS-KEY (Bipolar AND Disorder) OR TITLE-ABS-KEY (Dysthymic AND Disorder) OR TITLE-ABS-KEY (Depressive AND Disorder AND Major) OR TITLE-ABS-KEY (Anxiety) TITLE-ABS-KEY (Anxiety AND Disorders) OR TITLE-ABS-KEY (Phobia AND Social) OR TITLE-ABS-KEY (Personality AND Disorders) OR TITLE-ABS-KEY (Antisocial AND Personality AND Disorder) OR TITLE-ABS-KEY (Borderline AND Personality AND Disorder) OR TITLE-ABS-KEY (Dependent AND Personality AND Disorder) OR TITLE-ABS-KEY (Compulsive AND Personality AND Disorder) OR TITLE-ABS-KEY (Paranoid AND Personality AND Disorder) OR TITLE-ABS-KEY (Histrionic AND Personality AND Disorder) OR TITLE-ABS-KEY (Schizoid AND Personality AND Disorder) OR TITLE-ABS-KEY (Stress AND Disorders AND Post-Traumatic) OR TITLE-ABS-KEY (Conduct AND Disorder) OR TITLE-ABS-KEY (Adjustment AND Disorders) OR TITLE-ABS-KEY (Gambling) OR TITLE-ABS-KEY (Attention AND Deficit AND Disorder AND Hyperactivity) OR TITLE-ABS-KEY (Psychological AND Distress) OR TITLE-ABS-KEY (Attention AND Deficit AND Disruptive AND Behavior AND Disorders) OR TITLE-ABS-KEY (Anorexia) OR TITLE-ABS-KEY (Anorexia AND Nervosa) OR TITLE-ABS-KEY (Obsessive–Compulsive AND Disorder) #2 (TITLE-ABS-KEY (Homelessness) OR TITLE-ABS-KEY (Homeless AND individuals) OR TITLE-ABS-KEY (Homeless AND persons) OR TITLE-ABS-KEY (Homeless AND Youth) OR TITLE-ABS-KEY (Ill-Housed AND Persons) OR TITLE-ABS-KEY (Adult AND Children) OR TITLE-ABS-KEY (Adolescent) OR TITLE-ABS-KEY (Young AND Adult) OR TITLE-ABS-KEY (Runaway AND youth) OR TITLE-ABS-KEY (Runaway AND behavior) #3 (TITLE-ABS-KEY (Mental AND Disorders) OR TITLE-ABS-KEY (Affective AND Disorders, Psychotic) OR TITLE-ABS-KEY (Psychotic AND Disorders) OR TITLE-ABS-KEY (Mentally AND Ill AND Persons) OR TITLE-ABS-KEY (Schizophrenia) OR TITLE-ABS-KEY (Depression) OR TITLE-ABS-KEY (Depressive AND Disorder) OR TITLE-ABS-KEY (Bipolar AND Related AND Disorders) OR TITLE-ABS-KEY (Bipolar AND Disorder) OR TITLE-ABS-KEY (Dysthymic AND Disorder) OR TITLE-ABS-KEY (Depressive AND Disorder AND Major) OR TITLE-ABS-KEY (Anxiety) TITLE-ABS-KEY (Anxiety AND Disorders) OR TITLE-ABS-KEY (Phobia AND Social) OR TITLE-ABS-KEY (Personality AND Disorders) OR TITLE-ABS-KEY (Antisocial AND Personality AND Disorder) OR TITLE-ABS-KEY (Borderline AND Personality AND Disorder) OR TITLE-ABS-KEY (Dependent AND Personality AND Disorder) OR TITLE-ABS-KEY (Compulsive AND Personality AND Disorder) OR TITLE-ABS-KEY (Paranoid AND Personality AND Disorder) OR TITLE-ABS-KEY (Histrionic AND Personality AND Disorder) OR TITLE-ABS-KEY (Schizoid AND Personality AND Disorder) OR TITLE-ABS-KEY (Stress AND Disorders AND Post-Traumatic) OR TITLE-ABS-KEY (Conduct AND Disorder) OR TITLE-ABS-KEY (Adjustment AND Disorders) OR TITLE-ABS-KEY (Gambling) OR TITLE-ABS-KEY (Attention AND Deficit AND Disorder AND Hyperactivity) OR TITLE-ABS-KEY (Psychological AND Distress) OR TITLE-ABS-KEY (Attention AND Deficit AND Disruptive AND Behavior AND Disorders) OR TITLE-ABS-KEY (Anorexia) OR TITLE-ABS-KEY (Anorexia AND Nervosa) OR TITLE-ABS-KEY (Obsessive–Compulsive AND Disorder) AND (TITLE-ABS-KEY (Homelessness) OR TITLE-ABS-KEY (Homeless AND individuals) OR TITLE-ABS-KEY (Homeless AND persons) OR TITLE-ABS-KEY (Homeless AND Youth) OR TITLE-ABS-KEY (Ill-Housed AND Persons) OR TITLE-ABS-KEY (Adult AND Children) OR TITLE-ABS-KEY (Adolescent) OR TITLE-ABS-KEY (Young AND Adult) OR TITLE-ABS-KEY (Runaway AND youth) OR TITLE-ABS-KEY (Runaway AND behavior)
Web of Knowledge	#1 (((((((((TS = (Mental Disorders)) OR TS = (Affective Disorders, Psychotic)) OR TS = (Psychotic Disorders)) OR TS = (Mentally Ill Persons)) OR TS = (Schizophrenia)) OR TS = (Depression)) OR TS = (Depressive Disorder)) OR TS = (Bipolar and Related Disorders)) OR TS = (Bipolar Disorder)) OR TS = (Dysthymic Disorder) OR TS = (Depressive Disorder, Major) OR TS = (Anxiety) OR TS = (Anxiety Disorders) OR TS = (Phobia, Social) OR TS = (Personality Disorders) OR TS = (Antisocial Personality Disorder) OR TS = (Borderline Personality Disorder) OR TS = (Dependent Personality Disorder) OR TS = (Compulsive Personality Disorder) OR TS = (Paranoid Personality Disorder) OR TS = (Histrionic Personality Disorder) OR TS = (Schizoid Personality Disorder) OR TS = (Stress Disorders, Post-Traumatic) OR TS = (Conduct Disorder) OR TS = (Adjustment Disorders) OR TS = (Gambling) OR TS = (Attention Deficit Disorder with Hyperactivity) OR TS = (Psychological Distress) OR TS = (Attention Deficit and Disruptive Behavior Disorders) OR TS = (Anorexia) OR TS = (Anorexia Nervosa) OR TS = (Obsessive–Compulsive Disorder) #2 TI = (Homelessness OR Homeless individuals OR Homeless persons OR Homeless Youth OR Ill-Housed Persons OR Adult Children OR Adolescent OR Young Adult OR Runaway youth OR Runaway behavior) #3 #1 AND #2

Table 1 (continued)

Database	Keywords
Cochrane	#1MeSH descriptor: [Mental Disorders] explode all trees #2MeSH descriptor: [Affective Disorders, Psychotic] explode all trees #3MeSH descriptor: [Psychotic Disorders] explode all trees #4MeSH descriptor: [Mentally Ill Persons] explode all trees #5MeSH descriptor: [Schizophrenia] explode all trees #6 MeSH descriptor: [Depression] explode all trees #7 MeSH descriptor: [Depressive Disorder] explode all trees #8 MeSH descriptor: [Bipolar and Related Disorders] explode all trees #9 MeSH descriptor: [Bipolar Disorder] explode all trees #10 MeSH descriptor: [Dysthymic Disorder] explode all trees #11 MeSH descriptor: [Depressive Disorder, Major] explode all trees #12 MeSH descriptor: [Anxiety] explode all trees #13 MeSH descriptor: [Anxiety Disorders] explode all trees #14 MeSH descriptor: [Phobia, Social] explode all trees #15 MeSH descriptor: [Personality Disorders] explode all trees #16 MeSH descriptor: [Antisocial Personality Disorder] explode all trees #17 MeSH descriptor: [Borderline Personality Disorder] explode all trees #18 MeSH descriptor: [Dependent Personality Disorder] explode all trees #19 MeSH descriptor: [Compulsive Personality Disorder] explode all trees #20 MeSH descriptor: [Paranoid Personality Disorder] explode all trees #21 MeSH descriptor: [Histrionic Personality Disorder] explode all trees #22 MeSH descriptor: [Schizoid Personality Disorder] explode all trees #23 MeSH descriptor: [Stress Disorders, Post-Traumatic] explode all trees #24 MeSH descriptor: [Conduct Disorder] explode all trees #25 MeSH descriptor: [Adjustment Disorders] explode all trees #26 MeSH descriptor: [Gambling] explode all trees #27 MeSH descriptor: [Attention Deficit Disorder with Hyperactivity] explode all trees #28 MeSH descriptor: [Psychological Distress] explode all trees #29 MeSH descriptor: [Attention Deficit and Disruptive Behavior Disorders] explode all trees #30 MeSH descriptor: [Anorexia] explode all trees #31MeSH descriptor: [Anorexia Nervosa] explode all trees #32 MeSH descriptor: [Obsessive–Compulsive Disorder] explode all trees #33 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 #34 MeSH descriptor: [Homeless Youth] explode all trees #35 MeSH descriptor: [Homeless persons] explode all trees #36(Homeless individuals):ti,ab,kw #37 (Homelessness):ti,ab,kw #38 MeSH descriptor: [Ill-Housed Persons] explode all trees #39 MeSH descriptor: [Adult Children] explode all trees #40 MeSH descriptor: [Adolescent] explode all trees #41 MeSH descriptor: [Adolescent] explode all trees #42 MeSH descriptor: [Young Adult] explode all trees #43 (Runaway youth):ti,ab,kw #44 #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 #45 #33 AND #44

participants' age, publication year, country where the data were collected, study design, sample size, population specifics, quality assessment of studies, and criteria for assessing MHDs. Where necessary, the authors of the selected studies were contacted to obtain additional information. The agreement between the two authors was assessed using Cohen's Kappa statistic. The degree of agreement was categorized into levels such as poor, slight, fair, moderate, substantial, and almost perfect. Corresponding numerical values were assigned as follows: 0, 0.01–0.02, 0.021–0.04, 0.041–0.06, 0.061–0.08, and 0.081–1.00, respectively [20]. Discrepancies between the two authors (comprising less than 10% of the total) were addressed through the intervention of a third author.

Risk of bias of studies

The Newcastle–Ottawa Scale (NOS) [21] was used to evaluate the quality of studies, encompassing three criteria: (i) the selection domain, which includes the representativeness of the exposed group, selection of the non-exposed group, and ascertainment of exposure (three items for cross-sectional studies and four items for cohort studies); (ii) the comparability domain, involving group comparability based on the study design or analysis (one item each for both cross-sectional and cohort studies); and (iii) the exposure/outcome domain, incorporating the assessment of outcome (one item for cross-sectional studies and three items for cohort studies) (Table 2). The studies were classified into four categories: unsatisfactory, satisfactory, good, or very good, with a potential maximum score of 8 for cohort and case–control studies. In assigning scores, studies with a total score of 0–2 were deemed "unsatisfactory," those with scores of 3–4 were labeled "satisfactory," 5–6 were considered "good," and 7–8 were categorized as "very good." In total, 23 studies received a high-quality rating, 41 were rated as good quality, and 37 were rated as satisfactory quality.

Study selection process

Initially, 11,266 papers were found through the four database searches (Fig. 1). After paper duplicates were excluded (n = 6358), the titles and abstracts of 4,908 papers were screened. Of these, 845 were found to be related to the study's aim. After a full text review, 744 studies were excluded. The main reasons for exclusion were as follows: 39 studies did not meet the quality appraisal score (5%), and 705 studies utilized a non-quantitative methodology or did not report parametric measurements such as lifetime prevalence of suicidal behaviors, coefficients or odd ratios of relative risks of determinants of study outcomes (95%). Following these exclusions, 101 studies remained for meta-analysis [6, 22–120].

Data synthesis and statistical analysis

The analysis considered the lifetime or current prevalence of conduct disorders, psychological distress, depression, major depressive disorders, post-traumatic stress disorder (PTSD), personality disorders, attention-deficit/hyperactivity disorder (ADHD), bipolar disorders, anxiety, oppositional defiant disorders, anorexia, adjustment disorders, dysthymia, schizophrenia, obsessive–compulsive disorders, and gambling disorder as MHDs. Any reports of overall prevalence without mentioning the specific time period in the studies were considered as lifetime use for the purposes of the meta-analysis. The pooled-prevalence estimates were obtained using a robust random-effects model [121], which considered the various sampling methods employed in the studies. Additionally, the sources of heterogeneity among studies were evaluated through the application of Cochran's Q and I^2 tests. Subgroup analyses were performed to pinpoint the sources of heterogeneity, considering factors such as participants' age, year of publication, geographical location, quality assessment of studies, diagnosis criteria for MHDs, and sample size. For each subgroup analysis, a minimum of two studies reporting data on the variable of interest was necessary. A sensitivity analysis was performed using Baujat plots to assess the impact of the most significant study on overall heterogeneity and to exclude it during the evaluation of each specific study's effect on the overall estimate. Ultimately, a multivariate meta-regression analysis was undertaken to investigate the primary source of heterogeneity. Statistical significance was defined as a p-value < 0.05, and the meta-analysis was performed using R 3.5.1 with the "meta" package.

Results

Study characteristics

Of 101 studies selected, 90 were from the America region (n = 123,197 participants), one from the African region (n = 227 participants), five from the European region (n = 541 participants), one from the Western pacific region (n = 187 participants) and four from the South-East Asia region (n = 326 participants). The country with the highest number of included studies was the USA, with 82 studies (n = 122,037) (Table 3). Considering country income level, 96 studies were conducted in high-income countries (n = 123,925), four studies were conducted in a lower-middle-income country (n = 532), and one was conducted in an upper-middle income country (n = 21). The study sample size had a mean of 1232 participants, with 21 being the lowest sample size [56] and 76,596 being the largest sample

Table 2 Risk of bias assessment using the Newcastle–Ottawa Scale

Study	Selection (***●)	Comparability (*)	Exposure/outcome (*●●)	Method of assessment	Quality assessment	Quality assessment score
Narendorf et al. (2023)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Burke et al. (2023)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Dunn et al. (2023)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	satisfactory	3
Jain et al. (2022)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Bagley et al. (2021)	***●	*	*●	Newcastle–Ottawa Scale adapted for cohort studies	Very good	7
Hao et al. (2021)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Tucker et al. (2020)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	3
DiGuiseppi et al. (2020)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Narendorf et al. (2020)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Winiarski et al. (2020)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Santa Maria et al. (2020)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Labelle et al. (2020)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Hogan et al. (2020)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Gewirtz O'Brien et al. (2020)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Prock and Kennedy. (2020)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very Good	5
Doré-Gauthier et al. (2019)	**●	*	*●●	Newcastle–Ottawa Scale adapted for cohort studies	Very good	7
Bounds et al. (2019)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Siconolfi et al. (2019)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Tyler et al. (2019)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Narendorf et al. (2018)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Crosby et al. (2018)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Barman-Adhikari et al. (2018)	**		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Pedersen et al. (2018)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Cutuli (2018)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Middleton et al. (2018)	***		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Moore et al. (2017)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4

Table 2 (continued)

Study	Selection (***●)	Comparability (*)	Exposure/outcome (*●●)	Method of assessment	Quality assessment	Quality assessment score
Pagare Bhat et al. (2017)	***	*		Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Harris et al. (2017)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Petering et al. (2017)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very Good	5
Begun et al. (2016)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Ko et al. (2016)	**	*		Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Petering (2016)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very Good	5
Fulginiti et al. (2016)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Kozloff et al. (2016)	***		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Oppong Asante et al. (2015)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Winetrobe et al. (2015)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Ferguson et al. (2015)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Hodgson et al. (2015)	*●	*	*●	Newcastle–Ottawa Scale adapted for cohort studies	Good	5
Rhoades et al. (2015)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Brown et al. (2015)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Narendorf et al. (2015)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Saddichha et al. (2014)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Bender et al. (2014)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Rhoades et al. (2014)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Yohannes et al. (2014)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Hodgson et al. (2014)	**		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Castro et al. (2014)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Thornton et al. (2012)	**	*		Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Ferguson et al. (2012)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Quimby et al. (2012)	***			Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Gupta et al. (2012)	**		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Ferguson et al. (2011)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4

Table 2 (continued)

Study	Selection (***●)	Comparability (*)	Exposure/outcome (*●●)	Method of assessment	Quality assessment	Quality assessment score
Crawford et al. (2011)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Kirst et al. (2011)	***		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Keller et al. (2010)	**●	*	**●	Newcastle–Ottawa Scale adapted for cohort studies	Very good	7
Bender et al. (2010)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Thompson et al. (2010)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very Good	5
Courtney and Zinn (2009)	***	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Very good	5
Merscham et al. (2009)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Nyamathi et al. (2009)	***	*		Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Gwadz et al. (2009)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Solorio et al. (2008)	***	*	*	Newcastle–Ottawa Scale adapted for cohort studies	Good	5
Busen et al. (2008)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Toro et al. (2008)	**	*	*	Newcastle–Ottawa Scale adapted for cohort studies	Satisfactory	4
Kushel et al. (2007)	**		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Whitbeck et al. (2007)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Gwadz et al. (2007)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Techakasem and Kolkijkovin (2006)	**	*		Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Chen et al. (2006)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Solorio et al. (2006)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Taylor et al. (2006)	***	*		Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Johnson et al. (2005)	***		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Robert et al. (2005)	***		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Pottick et al. (2005)	**		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Slesnick and Prestopnik (2005)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Whitbeck et al. (2004)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Slesnick and Tonigan (2004)	***		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Stewart et al. (2004)	*●	*	*●	Newcastle–Ottawa Scale adapted for cohort studies	Good	5

Table 2 (continued)

Study	Selection (***●)	Comparability (*)	Exposure/outcome (*●●)	Method of assessment	Quality assessment	Quality assessment score
Khurana et al. (2004)	**		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Baer et al. (2003)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Auslander et al. (2002)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Rohde et al. (2001)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Embry et al. (2000)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Whitbeck et al. (2000)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Cauce et al. (2000)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Ryan et al. (2000)	**	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Good	4
Yoder (1999)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Sleegers et al. (1998)	***			Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
McCaskill et al. (1998)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Craig and Hodson (1998)	**		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Yates et al. (1998)	**	*		Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Booth and Zhang (1997)	**	*	*	Newcastle–Ottawa Scale adapted for cohort studies	Satisfactory	4
Unger et al. (1997)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Adlaf et al. (1996)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Dadds et al. (1993)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Feitel et al. (1992)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Cohen et al. (1991)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Kurtz et al. (1991)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	4
Warheit and Biafora (1991)	*	*	*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Yates et al. (1991)	**		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Powers et al. (1990)	**		*	Newcastle–Ottawa Scale adapted for cross-sectional studies	Satisfactory	3

*For cross-sectional studies

●For cohort and case–control studies

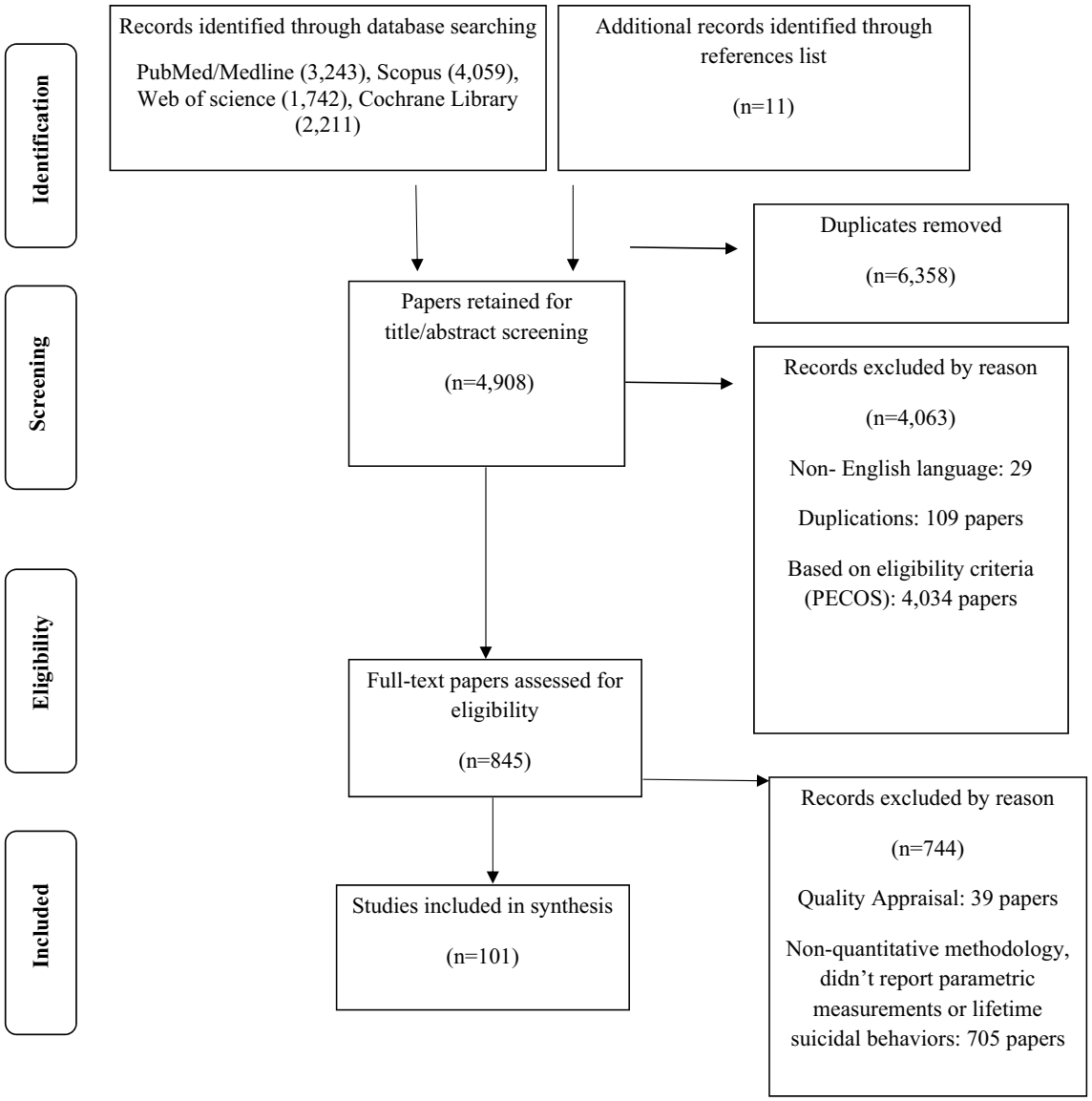

Fig. 1 PRISMA flow diagram

size [71]. Response rates between the studies varied from 35% to 100%. Participants had a mean age of 18.43 years and were more likely to be male (mean 56%), varying from 0% to 100%. Moreover, 47% had adolescent minors as participants (12–17 years old) and 53% had young adults as participants (18–25 years). Almost all studies were cross-sectional (93%). Finally, 57 studies were published between 2010 and 2023 (56%), 73 studies used a standard scale/questionnaire to determine MHDs (72%), with the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) being the most prevalent (22%), followed by the *Mini International Neuropsychiatry Interview* MINI and the *Center for Epidemiological Studies-Depression Scale* (CES-D) (both 19%).

Pooled prevalence of life-time and current MHDs among RHY

The findings showed that lifetime MHDs most frequently reported by RHY were conduct disorders (47%), psychological distress (47%), depression (43%), major depressive disorders (34%), post-traumatic stress disorder (PTSD) (33%), personality disorders (27%), ADHD (25%), bipolar disorders (23%), anxiety (22%), oppositional defiant disorders (21%), anorexia (15%), adjustment disorders (15%), dysthymia (14%), schizophrenia (11%), obsessive–compulsive disorders (9%), and gambling disorder (8%) (Table 4 and Supplementary Files 1–26). In addition, the data showed that

Table 3 Characteristics of the 101 studies identified for review

Authors (year)	Years (y) of data collections (number)	Country	Sample at baseline	Final sample (response rate%)	Study design	Quality assessment	Mean age (yrs)	Type of youth	Male %	Female %	Trans/other %
Narendorf et al. (2023)	2016–17 (2 y)	USA	892	892 (100)	Cross-section	Very good	20.97	Young adult	55	45	
Burke et al. (2023)	2020–1 (2 y)	USA	140	140 (100)	Cross-section	Good	20.9	Young adult	57	42	1
Dunn et al. (2023)	2023 (1y)	USA	114	114 (100)	Cross-section	satisfactory	21.4	Young adult	70	30	
Jain et al. (2022)	2017–18 (2 y)	USA	100	100 (100)	Cross-section	Very good	22	Young adult	67	33	
Bagley et al. (2021)	2016–18 (3 y)	USA	148	148 (100)	Cohort	Very good	21	Young adult	60	40	
Hao et al. (2021)	2017–18 (2 y)	USA	100	100 (100)	Cross-section	Good	21.7	Young adult	67	33	
Tucker et al. (2020)	2020 (1 y)	USA	90	90 (100)	Cross-section	Good	21.9	Young adult	72	28	
DiGuiseppi et al. (2020)	2011–13 (3 y)	USA	1032	1032 (100)	Cross-section	Very good	21.3	Young adult	71	27	2
Narendorf et al. (2020)	2020 (1 y)	USA	1426	1426 (100)	Cross-section	Very good	20.88	Young adult	58	35	7
Winiarski et al. (2020)	2016–18 (3 y)	USA	77	77 (NR)	Cross-section	Very good	19.1	Young adult	60	38	2
Santa Maria et al. (2020)	2014 (1 y)	USA	434	416 (96)	Cross-section	Good	20	Young adult	54	46	
Labelle et al. (2020)	2020 (1 y)	Canada	76	76 (100)	Cross-section	Satisfactory	15.5	Adolescent minor	44	56	
Hogan et al. (2020)	2015 (1 y)	USA	194	68 (35)	Cross-section	Very good	21.24	Young adult	51	44	5
Gewirtz O'Brien et al. (2020)	2016 (1 y)	USA	3368	3368 (100)	Cross-section	Satisfactory	15.5	Adolescent minor	43	57	
Prock and Kennedy. (2020)	2011–18 (8 y)	USA	101	101 (100)	Cross-section	Very Good	17.54	Adolescent minor	51	49	
Doré-Gauthier et al. (2019)	2012–15 (4 y)	Canada	42	42 (100)	Cohort	Very good	23.4	Young adult	93	7	
Bounds et al. (2019)	2008–15 (10 y)	USA	362	151 (42)	Cross-section	Very good	14.84	Adolescent minor	4	96	
Siconolfi et al. (2019)	2017–18 (2 y)	USA	183	183 (100)	Cross-section	Very good	21.73	Young adult	48	52	

Table 3 (continued)

Authors (year)	Years (y) of data collections (number)	Country	Sample at baseline	Final sample (response rate%)	Study design	Quality assessment	Mean age (yrs)	Type of youth	Male %	Female %	Trans/other %
Tyler et al. (2019)	2014–15 (2 y)	USA	150	150 (100)	Cross-section	Good	19.4	Young adult	49	51	
Narendorf et al. (2018)	2014 (1 y)	USA	380	374 (98)	Cross-section	Good	20.7	Young adult	54	41	5
Crosby et al. (2018)	2011–13 (3 y)	USA	937	525 (56)	Cross-section	Very good	21.42	young adult	77	21	2
Barman-Adhikari et al. (2018)	2011–13 (3 y)	USA	911	911 (100)	Cross-section	Satisfactory	21.31	Young adult	74	26	
Pedersen et al. (2018)	2018 (1 y)	USA	278	273 (98)	Cross-section	Very good	21.6	Young adult	71	29	
Cutuli (2018)	2013 (1 y)	USA	1280	1280 (NR)	Cross-section	Good	15	Adolescent minor	52	48	
Middleton et al. (2018)	2016 (1 y)	USA	131	131 (100)	Cross-section	Good	19.65	Young adult	47	48	5
Moore et al. (2017)	2012–13 (2 y)	USA	1169	1169 (100)	Cross-section	Good	16.5	Adolescent minor	74	26	
Pagare Bhat et al. (2017)	2017 (1 y)	India	129	119 (92)	Cross-section	Good	12.7	Adolescent minor	100	0	
Harris et al. (2017)	2011–13 (3 y)	USA	1046	966 (80)	Cross-section	Good	21.09	Young adult	71	29	
Petering et al. (2017)	2012–13 (2 y)	USA	495	495 (100)	Cross-section	Very Good	21.32	Young adult	70	30	
Begun et al. (2016)	2016 (1 y)	USA	601	601 (NR)	Cross-section	Satisfactory	20.5	Young adult	64	36	
Ko et al. (2016)	2016 (1 y)	The Republic of Korea	187	187 (100)	Cross-section	Satisfactory	17.85	Adolescent minor	57	43	
Petering (2016)	2012–13 (2 y)	USA	505	505 (100)	Cross-section	Very Good	21.4	Young adult	72	23	
Fulginiti et al. (2016)	2011–12 (2 y)	USA	406	384 (94)	Cross-section	Good	21.4	Young adult	72	28	
Kozloff et al. (2016)	2009–11 (3 y)	Canada	156	156 (100)	Cross-section	Good	21.5	Young adult	39	61	
Oppong Asante et al. (2015)	2013 (1 y)	Ghana	227	227 (NR)	Cross-section	Good	12.58	Adolescent minor	54	46	
Winetrobe et al. (2015)	2013 (1 y)	USA	125	125 (100)	Cross-section	Very good	21.78	Young adult	71	29	

Table 3 (continued)

Authors (year)	Years (y) of data collections (number)	Country	Sample at baseline	Final sample (response rate%)	Study design	Quality assessment	Mean age (yrs)	Type of youth	Male %	Female %	Trans/other %
Ferguson et al. (2015)	2010–11 (2 y)	USA	601	601 (100)	cross-section	Good	20.1	Young adult	64	36	
Hodgson et al. (2015)	2015 (1 y)	UK	116	90 (74)	Cohort	Good	17.74	Adolescent minor	43	57	
Rhoades et al. (2015)	2012 (1 y)	USA	398	398 (100)	Cross-section	Very good	21.32	Young adult	71	27	2
Brown et al. (2015)	2015 (1 y)	USA	201	201 (100)	Cross-section	Very good	19.9	Young adult	64	36	
Narendorf et al. (2015)	2014 (1 y)	USA	434	416 (96)	Cross-section	Very good	20	Young adult	57	43	
Saddichha et al. (2014)	2014 (1 y)	Canada	82	82 (100)	Cross-section	Good	21.5	Young adult	45	55	
Bender et al. (2014)	2010–11 (2 y)	USA	601	601 (100)	Cross-section	Very good	20.5	Young adult	64	36	
Rhoades et al. (2014)	2012–13 (2 y)	USA	451	435 (96)	Cross-section	Good	21.49	Young adult	69	28	3
Yohannes et al. (2014)	2014 (1 y)	USA	73	73 (100)	Cross-section	Good	20.46	Young adult	51	49	
Hodgson et al. (2014)	2011–12 (2 y)	UK	121	90 (74)	Cross-section	Satisfactory	17.7	Adolescent minor	44	56	
Castro et al. (2014)	2011–12 (2 y)	USA	66	66 (100)	Cross-section	Good	19.3	Young adult	44	56	
Thornton et al. (2012)	2012 (1 y)	Canada	219	219 (100)	Cross-section	Satisfactory	19.15	Young adult	39	61	
Ferguson et al. (2012)	2009 (1 y)	USA	40	36 (90)	Cross-section	Good	21.3	Young adult	69	31	
Quimby et al. (2012)	2012 (1 y)	USA	87	87 (NR)	Cross-section	Satisfactory	20.1	Young adult	58	42	
Gupta et al. (2012)	2012 (1 y)	India	36	36 (100)	Cross-section	Satisfactory	16.02	Adolescent minor	0	100	
Ferguson et al. (2011)	2005–9 (5 y)	USA	238	238 (NR)	Cross-section	Good	20.37	Young adult	64	32	
Crawford et al. (2011)	2011 (1 y)	USA	222	222 (100)	Cross-section	Satisfactory	17.2	Adolescent minor	0	100	
Kirst et al. (2011)	2005–6 (2 y)	Canada	150	150 (100)	Cross-section	Good	18.5	Young adult	50	50	
Keller et al. (2010)	2002 (1 y)	USA	770	732 (95)	Cohort	Very good	17.4	Adolescent minor	48	52	

Table 3 (continued)

Authors (year)	Years (y) of data collections (number)	Country	Sample at baseline	Final sample (response rate%)	Study design	Quality assessment	Mean age (yrs)	Type of youth	Male %	Female %	Trans/other %
Bender et al. (2010)	2005–8 (4 y)	USA	146	146 (100)	Cross-section	Good	20.3	Young adult	67	33	
Thompson et al. (2010)	2005–8 (4 y)	USA	146	146(NR)	Cross-section	Very Good	20.2	Young adult	68	32	
Courtney and Zinn (2009)	1993–2003 (11 y)	USA	14,282	14,282 (100)	Cross-section	Very good	15	Adolescent minor	51	49	
Merscham et al. (2009)	2003–5 (2 y)	USA	182	182 (100)	Cross-section	Satisfactory	20.2	Young adult	58	42	
Nyamathi et al. (2009)	2009 (1 y)	USA	156	156 (100)	Cross-section	Good	18.5	Young adult	74	26	
Gwadz et al. (2009)	2009 (1 y)	USA	80	80 (100)	Cross-section	Good	19.1	Young adult	51	49	
Solorio et al. (2008)	2001–2 (2 y)	USA	261	261 (100)	Cohort	Good	15.5	Adolescent minor	40	60	
Busen et al. (2008)	2008 (1 y)	USA	95	95 (100)	Cross-section	Satisfactory	20.5	Young adult	NR	NR	
Toro et al. (2008)	1992–1994 and 2000–2002 (8 y)	USA	468	468 (100)	Cohort	Satisfactory	15	Adolescent minor	48	52	
Kushel et al. (2007)	2002–3 (2 y)	USA	185	185 (100)	Cross-section	Satisfactory	17.5	Adolescent minor	52	48	
Whitbeck et al. (2007)	2007 (1 y)	USA	455	429 (94)	Cross-section	Good	17.4	Adolescent minor	44	56	
Gwadz et al. (2007)	2000 (1 y)	USA	85	85 (100)	Cross-section	Good	20.4	Young adult	51	49	
Techakasem and Kolkijkovin (2006)	1994–2003 (10 y)	Thailand	21	21 (NR)	Cross-section	Satisfactory	13.76	Adolescent minor	33	67	
Chen et al. (2006)	2006 (1 y)	USA	428	428 (100)	Cross-section	Good	17.4	Adolescent minor	44	56	
Solorio et al. (2006)	2001–2 (2 y)	USA	707	688 (97)	Cross-section	Good	16	Adolescent minor	52	48	
Taylor et al. (2006)	2004–5 (2 y)	UK	150	150 (100)	Cross-section	Good	19.1	Young adult	53	47	
Johnson et al. (2005)	2005 (1 y)	USA	505	455 (90)	Cross-section	Good	17.4	Adolescent minor	44	56	
Robert et al. (2005)	1998–99 (2 y)	Canada	218	218 (100)	Cross-section	Good	15.68	Adolescent minor	61	39	

Table 3 (continued)

Authors (year)	Years (y) of data collections (number)	Country	Sample at baseline	Final sample (response rate%)	Study design	Quality assessment	Mean age (yrs)	Type of youth	Male %	Female %	Trans/other %
Pottick et al. (2005)	1997 (1 y)	USA	76,596	76,596 (NR)	Cross-section	Satisfactory	15	Adolescent minor	60	40	
Slesnick and Prestopnik (2005)	2005 (1 y)	USA	226	226 (100)	Cross-section	Good	15	Adolescent minor	46	54	
Whitbeck et al. (2004)	2004 (1 y)	USA	455	428 (94.3)	Cross-section	Satisfactory	17.4	Adolescent minor	44	56	
Slesnick and Tonigan (2004)	2004 (1 y)	USA	37	37 (100)	Cross-section	Good	15.16	Adolescent minor	49	51	
Stewart et al. (2004)	1995–98 (4 y)	USA	394	374 (95)	Cohort	Good	17.1	Adolescent minor	54	46	
Khurana et al. (2004)	2001 (1 y)	India	150	150 (100)	cross-section	Satisfactory	14	Adolescent minor	100	0	
Baer et al. (2003)	2003 (1 y)	USA	198	198 (100)	Cross-section	Good	17.18	Adolescent minor	55	45	
Auslander et al. (2002)	2002 (1 y)	USA	343	343 (NR)	Cross-section	Satisfactory	16.35	Adolescent minor	45	55	
Rohde et al. (2001)	1994–97 (4 y)	USA	523	523 (NR)	Cross-section	Good	17.8	Adolescent minor	59	41	
Embry et al. (2000)	1981 and 1987 (2 y)	USA	86	83 (96)	Cross-section	Good	15.9	Adolescent minor	54	46	
Whitbeck et al. (2000)	1995–96 (2 y)	USA	602	602 (100)	Cross-section	Satisfactory	17	Adolescent minor	23	77	
Cauce et al. (2000)	2000 (1 y)	USA	364	362 (99)	Cross-section	Satisfactory	16.4	Adolescent minor	58	42	
Ryan et al. (2000)	1991–93 (3 y)	USA	422	329 (78)	Cross-section	Good	16.44	Adolescent minor	58	42	
Yoder (1999)	1999 (1 y)	USA	602	527 (87)	Cross-section	Satisfactory	16	Adolescent minor	40	60	
Sleegers et al. (1998)	1994 (1 y)	Netherlands	53	50 (94)	Cross-section	Satisfactory	18	Young adult	88	12	
McCaskill et al. (1998)	1993–94 (2 y)	USA	118	118 (100)	Cross-section	Satisfactory	14.5	Adolescent minor	NR	NR	
Craig and Hodson (1998)	1993–94 (2 y)	UK	161	161 (100)	Cross-section	Satisfactory	17	Adolescent minor	63	27	
Yates et al. (1998)	1985 (1 y)	USA	110	110 (100)	Cross-section	Satisfactory	18	Young adult	37	63	

Table 3 (continued)

Authors (year)	Years (y) of data collections (number)	Country	Sample at baseline	Final sample (response rate%)	Study design	Quality assessment	Mean age (yrs)	Type of youth	Male %	Female %	Trans/other %
Booth and Zhang (1997)	1997 (1 y)	USA	219	219 (100)	Cohort	Satisfactory	17.4	Adolescent minor	54	46	
Unger et al. (1997)	1994–95 (2 y)	USA	515	432 (84)	Cross-section	Satisfactory	17.5	Adolescent minor	65	35	
Adlaf et al. (1996)	1996 (1 y)	Canada	217	217 (100)	Cross-section	Satisfactory	19.5	Young adult	74	26	
Dadds et al. (1993)	1993 (1 y)	USA	117	117 (100)	Cross-section	Satisfactory	16	Adolescent minor	57	43	
Feitel et al. (1992)	1990–91 (2 y)	USA	169	150 (89)	Cross-section	Satisfactory	18.45	Young adult	65	35	
Cohen et al. (1991)	1988–89 (2 y)	USA	637	637 (100)	Cross-section	Satisfactory	18	Young adult	57	43	
Kurtz et al. (1991)	1985–88 (4 y)	USA	349	349 (NR)	Cross-section	Satisfactory	15.8	Adolescent minor	57	43	
Warheit and Biafora (1991)	1991 (1 y)	USA	100	100 (NR)	Cross-section	Satisfactory	14.5	Adolescent minor	74	26	
Yates et al. (1991)	1988–89 (2 y)	USA	467	467 (100)	Cross-section	Satisfactory	17	Adolescent minor	47	53	
Powers et al. (1990)	1986–87 (2 y)	USA	223	223 (100)	Cross-section	Satisfactory	15.6	Adolescent minor	39	61	

NR = not reported

the current MHDs most frequently reported by RHY were depression (31%), major depressive disorder (23%), anxiety (23%), PTSD (21%), ADHD (16%), bipolar disorder (15%), personality disorders (13%), oppositional defiant disorders (13%), schizophrenia (8%), and obsessive–compulsive disorders (6%).

Subgroup analysis

Several subgroup analyses were conducted to determine the primary factor causing heterogeneity in the pooled odds of MHDs (Supplementary Files 27–105). The factors considered included participants' age, year of study publication, geographical location, quality assessment of studies, diagnostic criteria for MHDs, and sample size. Subgroup analyses detected some source of heterogeneity in some specific MHDs (see next two sections).

Subgroup analyses of pooled prevalence of life-time and current MHDs based on age of participants among RHY

The participants were divided into two groups based on their age, and a subgroup analysis was conducted with those aged: (i) 12–17 years (adolescent minors) and (ii) 18–24 years (young adults) (Table 4 and Supplementary Files 27–41). Results showed that as age increased, the (i) lifetime and current prevalence of depression, bipolar disorder, anxiety and PTSD increased, (ii) lifetime prevalence of schizophrenia and major depressive disorders increased, (iii) lifetime and current prevalence of personality disorders decreased, (iv) lifetime prevalence of ADHD, conduct disorders, and obsessive–compulsive disorders decreased, and (v) current major depressive disorders decreased. The lifetime prevalence of adjustment disorders at these specific ages was stable. The findings also show that externalizing disorders were predominantly prevalent among adolescent minors (except for current major depressive disorders), while internalizing disorders were more prevalent among young adults.

Subgroup analyses of pooled prevalence of life-time and current MHDs based on time of study publication among RHY

The studies were divided into two groups based on the year of publication for each study and a subgroup analysis was conducted by classifying the studies into two different time periods: (i) ≤ 2010 and (ii) > 2010 (Table 4 and Supplementary Files 42–58). This analysis showed several trends: (i) an increase in the lifetime and current prevalence of depression, major depressive disorders, PTSD, and schizophrenia; (ii) an increase in the lifetime prevalence of anxiety, ADHD, personality disorders, conduct disorders, and psychological distress; (iii) an increase in the lifetime prevalence of bipolar disorders; (iv) a decrease in the lifetime prevalence of bipolar disorders, oppositional defiant disorders, and obsessive–compulsive disorders; and (v) no difference in the lifetime prevalence of adjustment disorders over time.

Sensitivity analysis

Sensitivity analysis utilizing Baujat plots was conducted to evaluate influential effects. Effects on the right-hand side of the plots indicate studies with higher levels of heterogeneity (Supplementary Files 106–147). The sensitivity analysis was able to decrease the heterogeneity between studies for lifetime prevalence of anorexia (Cutuli (2018) [83] made the most significant contribution to heterogeneity), dysthymia (Feitel et al. (1992) [88] made the most significant contribution to heterogeneity), gambling disorders (Taylor et al. (2006) [117] made the most significant contribution to heterogeneity), and psychological distress (Narendorf et al. (2020 and 2023) [41, 113] made the most significant contributions to heterogeneity). The test did not detect heterogeneity between studies for other lifetime prevalence of MHDs. The sensitivity analysis reduced the heterogeneity between studies for current prevalence of anxiety and schizophrenia (Middleton et al. (2018] [103] made the most significant contributions to heterogeneity), but was unable to decrease the heterogeneity between studies for other current prevalence of MHDs.

Meta-regression

Multivariate meta-regression analysis was conducted to further investigate the sources of heterogeneity (Table 5). The meta-regression results indicated that the age of participants may contribute to the heterogeneity between the included studies in terms of the lifetime prevalence of depression, conduct disorders, and obsessive–compulsive disorders. Additionally, it was found that the year of study publication may contribute to the heterogeneity between the included studies for (i) the current prevalence of depression and (ii) the lifetime prevalence of anxiety and ADHD. Moreover, diagnostic criteria for MHDs may contribute to the heterogeneity among the included studies on lifetime bipolar and obsessive–compulsive disorders. Finally, the quality assessment of studies may contribute to the heterogeneity among the included studies on the lifetime prevalence of conduct disorders.

Table 4 Pooled prevalence of life-time and current prevalence of mental health disorders, subgroup analyses of pooled prevalence of life-time and current mental health disorders by age of participants, and time of study publication among runaway and homeless youth

Pooled prevalence (95% CI)	Type of mental health disorder	Number of studies	N	Pooled prevalence (95% CI)	Adolescent minors	Young adults	≤2010	>2010
Lifetime pooled prevalence (95% CI)	Depression	50	18,246	43% (37–49%)	34% (25–42%)	48% (41–56%)	40% (30–50%)	45% (38–52%)
	Major depressive disorders	26	7632	34% (28–40%)	26% (19–33%)	39% (30–48%)	31% (23–39%)	36% (26–46%)
	Dysthymia	3	466	14% (0–36%)	NA*	NA*	NA*	NA*
	Anxiety	28	94,239	22% (16–28%)	19% (11–28%)	24% (16–31%)	12% (7–16%)	27% (20–35%)
	Bipolar disorders	23	80,375	23% (16–30%)	19% (4–34%)	24% (16–32%)	30% (16–43%)	20% (12–28%)
	Adjustment disorders	4	76,767	15% (15–15%)	15% (15–15%)	15% (9–21%)	15% (15–15%)	15% (9–21%)
	Conduct disorders	19	96,178	47% (35–59%)	53% (40–65%)	27% (3–50%)	45% (31–58%)	54% (28–81%)
	Schizophrenia	16	18,280	11% (7–16%)	8% (0–16%)	14% (9–18%)	10% (3–17%)	13% (7–18%)
	Oppositional defiant disorders	4	588	21% (9–33%)	NA*	NA*	21% (7–35%)	20% (0–47%)
	Obsessive–compulsive disorders	9	1588	9% (3–15%)	18% (5–30%)	3% (1–4%)	10% (0–21%)	6% (2–10%)
	Personality disorders	10	1381	27% (14–41%)	29% (10–48%)	27% (8–45%)	25% (1–49%)	28% (10–46%)
	Attention-deficit/hyperactivity disorder (ADHD)	17	80,905	25% (17–34%)	26% (8–44%)	25% (16–34%)	16% (6–25%)	31% (19–42%)
	Post-traumatic stress disorder (PTSD)	41	11,966	33% (26–40%)	32% (19–45%)	34% (25–42%)	30% (16–44%)	35% (27–42%)
	Anorexia	3	1596	15% (0–35%)	NA*	NA*	NA*	NA*
	Gambling disorder	3	1352	8% (1–14%)	NA*	NA*	NA*	NA*
	Psychological distress	5	3524	47% (37–57%)	NA*	NA*	NA*	NA*
Current pooled prevalence (95% CI)	Depression	5	1306	31% (18–44%)	22% (12–32%)	46% (41–51%)	22% (12–32%)	46% (41–51%)
	Major depressive disorders	7	1403	23% (15–30%)	24% (11–36%)	22% (14–30%)	19% (13–25%)	33% (13–53%)
	Dysthymia	NA	NA	NA	NA*	NA*	NA*	NA*
	Anxiety	4	411	23% (8–37%)	NA*	NA*	NA*	NA*
	Bipolar disorders	7	3475	15% (3–26%)	10% (0–23%)	19% (0–37%)	13% (1–24%)	18% (0–44%)
	Adjustment disorders	NA	NA	NA	NA*	NA*	NA*	NA*
	Conduct disorders	NA	NA	NA	NA*	NA*	NA*	NA*
	Schizophrenia	4	368	8% (6–11%)	NA*	NA*	8% (4–12%)	9% (5–13%)
	Oppositional defiant disorders	2	271	13% (8–18%)	NA*	NA*	NA*	NA*
	Obsessive–compulsive disorders	2	140	6% (2–11%)	NA*	NA*	NA*	NA*
	Personality disorders	2	221	13% (3–23%)	NA*	NA*	NA*	NA*

Table 4 (continued)

Pooled prevalence (95% CI)	Type of mental health disorder	Number of studies	N	Pooled prevalence (95% CI)	Adolescent minors	Young adults	≤2010	>2010
	Attention-deficit/hyperactivity disorder (ADHD)	S	221	16% (0–42%)	NA*	NA*	NA*	NA*
	Post-traumatic stress disorder (PTSD)	9	3370	21% (15–27%)	19% (10–29%)	22% (14–31%)	7% (12–21%)	25% (14–35%)
	Anorexia	NA	NA	NA	NA*	NA*	NA*	NA*
	Gambling disorder	NA	NA	NA	NA*	NA*	NA*	NA*
	Psychological distress	NA	NA	NA	NA*	NA*	NA*	NA*

*Not applicable

Moderator analysis

Subgroup analyses confirmed that (i) age was a statistically significant moderator for current depression, current major depressive disorders, lifetime adjustment disorders, and lifetime obsessive–compulsive disorders; (ii) year of study publication was a statistically significant moderator for current depression, lifetime adjustment disorders, and current schizophrenia; (iii) geographical location was a statistically significant moderator for current anxiety, current bipolar, lifetime bipolar, and lifetime obsessive–compulsive disorders; (iv) the quality assessment of studies was a statistically significant moderator for current major depressive disorders, lifetime obsessive–compulsive disorders, lifetime personality disorders, current PTSD, and lifetime psychological distress; (v) diagnostic criteria for MHDs were statistically significant moderators for lifetime depression, lifetime adjustment disorders, lifetime schizophrenia, lifetime obsessive–compulsive disorders, and lifetime personality disorders; and (vi) sample size was as a statistically significant moderator for current depression and lifetime obsessive–compulsive disorders.

Multivariate meta-regression analysis found that the year of study publication was a statistically significant moderator for the current pooled prevalence of depression. Additionally, the (i) age of participants was a statistically significant moderator for the lifetime pooled prevalence of depression, conduct disorders, and obsessive–compulsive disorders; (ii) year of study publication was a statistically significant moderator for the lifetime prevalence of anxiety and ADHD; (iii) diagnostic criteria for MHDs were statistically significant moderators for the lifetime prevalence of bipolar and obsessive–compulsive disorders; and (iv) quality assessment of studies was a statistically significant moderator for the lifetime prevalence of conduct disorders. Older age (younger adults) was associated with a higher prevalence of depression, while younger age (adolescent minors) was associated with a higher prevalence of conduct and obsessive–compulsive disorders ($p < 0.05$). Publishing a study after 2010 was associated with a higher prevalence of current depression and lifetime prevalence of anxiety and ADHD ($p < 0.05$). Diagnostic criteria for MHDs other than DSM and MINI were associated with a higher prevalence of lifetime bipolar and obsessive–compulsive disorders ($p < 0.05$). Studies of lower quality were associated with a higher prevalence of conduct disorders ($p < 0.05$).

Discussion

The present meta-analysis estimated the pooled prevalence rates of MHDs among RHY. As far as the present authors are aware, no previous meta-analyses have ever been conducted estimating the pooled prevalence of MHDs among RHY. Findings from the present study indicated that the lifetime pooled prevalence of MHDs among RHY ranged from 8% to 47%, while the current pooled prevalence ranged from 6% to 31%. It was expected that the lifetime pooled prevalence of MHDs among RHY would be higher than the current pooled prevalence rate and this was the case. The prevalence in the present study was higher than the pooled prevalence rate of MHDs in previous meta-analyses among the general population of children and adolescents (13%) [122], homeless children (10–26%) [17], and children and adolescents in the child welfare system (4–27%) [18]. A possible reason for this may be that RHY face several challenges and have multiple health issues [123, 124], leading to a higher rate of MHDs. Additionally, adverse experiences such as maltreatment and serious neglect among RHY [125–127] may contribute to an increased prevalence of MHDs among RHY.

Regarding the most common MHDs among RHY, psychological distress and conduct disorders had the highest lifetime pooled prevalence rates (both 47%), while depression had the highest current pooled prevalence rate (31%).

Table 5 Multivariate meta-regression of the lifetime and current pooled prevalence of mental disorders among runaway and homeless youth (RHY) by age, sample size, publication year, quality assessment of studies, geographic location, and diagnosis criteria

Pooled prevalence	Type of mental health disorder	Covariates	β coefficient	SE [a]	*p*-value	Heterogeneity I^2%	Adj. R^2%[b]
Lifetime pooled prevalence	Depression	*Age of participants*					
		Adolescent minor (reference)	–	–	–		
		Young adults	0.1402	0.06	0.020*		
		Sample size					
		≤ 200 (reference)	–	–	–	85.04	78.38
		> 200	0.0777	0.06	0.196		
		Diagnosis criteria for mental disorders				98.47	13.28
		DISC[c] (reference)	–	–	–		
		DSM[d]	0.1614	0.17	0.343		
		MINI[e]	0.0869	0.18	0.630		
		Other criteria	0.2000	0.14	0.179		
	Major depressive disorders	*Age of participants*				96.62	18.42
		Adolescent minor (reference)	–	–	–		
		Young adults	0.1295	0.08	0.111		
		Geographic location					
		Europe (reference)	–	–	–		
		North America	0.1227	0.10	0.222		
		Diagnosis criteria for mental disorders					
		DISC[c] (reference)	–	–	–		
		DSM[d]	−0.1093	0.11	0.338		
		MINI[e]	−0.0435	0.11	0.709		
		Other criteria	0.0569	0.10	0.593		
	Personality disorders	*Diagnosis criteria for mental disorders*				96.75	0
		DSM[d] (reference)	–	–	–		
		MINI[e]	−0.0395	0.19	0.840		
		Other criteria	−0.2318	0.19	0.236		
	Anxiety	Year of publication of studies				99.67	18.42
		≤ 2010 (reference)	–	–	–		
		> 2020	0.1336	0.06	0.037*		
		Sample size					
		≤ 200 (reference)	–	–	–		
		> 200	−0.0387	0.07	0.602		
	PTSD	*Diagnosis criteria for mental disorders*				98.75	1
		DISC[c] (reference)	–	–	–		
		DSM[d]	−0.0922	0.16	0.568		

Table 5 (continued)

Pooled prevalence	Type of mental health disorder	Covariates	β coefficient	SE [a]	*p*-value	Heterogeneity I^2%	Adj. R^2%[b]
		MINI[e]	−0.1037	0.13	0.428		
		Other criteria	0.0296	0.11	0.803		
		Quality assessment of studies					
		Very good	0.0067	0.08	0.935		
		Good (reference)	–	–	–		
		Satisfactory	−0.1122	0.09	0.239		
	Conduct disorders	*Age of participants*				0	100
		Adolescent minor (reference)	–	–	–		
		Young adults	0.2644	0.04	0.001**		
		Quality assessment of studies					
		Very good	0.0337	0.05	0.522		
		Good (reference)	–	–	–		
		Satisfactory	0.1598	0.04	0.001**		
	Schizophrenia	*Age of participants*				98.51	2.89
		Adolescent minor (reference)	–	–	–		
		Young adults	0.0518	0.04	0.260		
		Geographic location					
		Europe (reference)	–	–	–		
		North America	0.0369	0.05	0.527		
	ADHD	*Year of publication of studies*				85.16	82.15
		≤ 2010 (reference)	–	–	–		
		> 2020	0.2274	0.06	0.001**		
		Sample size					
		≤ 200 (reference)	–	–	–		
		> 200	−0.0782	0.06	0.227		
	Bipolar disorders	*Geographic location*				97.27	32.23
		North America	0.1399	0.08	0.115		
		Europe (reference)	–	–	–		
		Diagnosis criteria for mental disorders					
		DSM[d] (reference)	–	–	–		
		MINI[e]	0.0073	0.07	0.920		
		Other criteria	0.1705	0.07	0.021*		
	Obsessive–compulsive disorders	*Age of participants*				0	100
		Adolescent minor (reference)	–	–	–		
		Young adults	−0.2697	0.04	0.001**		
		Diagnosis criteria for mental disorders					

Table 5 (continued)

Pooled prevalence	Type of mental health disorder	Covariates	β coefficient	SE [a]	*p*-value	Heterogeneity I^2%	Adj. R^2%[b]
		DISC[c] (reference)	–	–	–		
		DSM[d]	0.1878	0.03	0.001**		
		MINI[e]	0.2362	0.03	0.001**		
		Other criteria	0.1799	0.02	0.001**		
		Geographic location					
		North America	−0.0078	0.01	0.635		
		Europe (reference)	–	–	–		
		Sample size					
		≤ 200 (reference)	–	–	–		
		> 200	0.0142	0.04	0.730		
Current pooled prevalence	Depression	*Year of publication of studies*					
		≤ 2010 (reference)	–	–	–		
		> 2020	0.2403	0.06	0.001**	85.04	78.38
	PTSD	*Year of publication of studies*				94.08	0
		≤ 2010 (reference)	–	–	–		
		> 2020	0.0226	0.09	0.812		
		Quality assessment of studies					
		Satisfactory	−0.0669	0.10	0.512		
		Good	0.0352	0.09	0.709		
		Very good (reference)	–	–	–		
	Bipolar disorders	*Geographic location*				92.15	24.87
		North America	0.1172	0.07	0.109		
		Europe (reference)	–	–	–		

[a] *SE* Standard error

[b] *Adj.*R^2 Adjusted R squared

[c] *Center for Epidemiological Studies Depression Scale*

[d] *Diagnostic and Statistical Manual of Mental Disorders*

[e] *Mini International Neuropsychiatric Interview*

*$p < 0.05$

**$p < 0.01$

These rates are higher than those reported in previous meta-analyses among children and adolescents in the child welfare system or general population of children and adolescents for conduct disorders (6%-20%) [18, 122] and depression (3%–18%) [18, 122]. To the best of the present authors' knowledge, no previous study has reported the pooled prevalence rate of psychological distress among RHY.

The elevated prevalence of psychological distress among RHY can be attributed to various factors. Firstly, as indicated by prior studies, psychological distress is associated with several adverse behaviors, including substance abuse, conduct problems, and engaging in sexual risk behavior [6, 7, 9–11], behaviors that may all be present among RHY. Secondly, this heightened psychological distress might stem from a lack of self-determination within the RHY population [128]. Lastly, the intricate dynamics of loneliness and social support may contribute to this phenomenon [129]. While 'close' relationships can offer some degree of support, they simultaneously expose individuals to potential victimization and challenging interactions with other distressed RHY [130].

According to previous studies, RHY are more likely to have conduct disorders than peers who reside in stable housing [25, 77]. Research also indicates that conduct disorder diagnoses are typically feasible until the age of 18 years, with a noticeable decline in prevalence among young adults

aged 18 to 25 years [131, 132]. This could be due to the fact that aggression and impulsivity can have negative effects on RHYs' abilities to reside in housing and shelter systems, reducing access to mental health support and potentially increasing the odds that they will experience homelessness [133]. Another explanation could be the fact that the presence of conduct disorder heightens the likelihood of initiating substance use by the age of 15 years, particularly illicit substances, with this risk persisting until 18 years of age [132]. Moreover, the probability of initiating cocaine, amphetamines, inhalants, and club drugs remains notably elevated up to the age of 21 years [134].

Also, RHY may experience a high level of neighborhood violence, have violent and criminal peers, and be involved with gangs [4]. For everyone, whether housed or not, adolescence may be a challenging period characterized by self-doubt and low self-esteem [123]. RHY may experience various forms of physical and sexual abuse, leading to diminished self-worth [135]. Additionally, facing abuse in the streets, from passers-by or the police, contributes to a reduction in their self-image, potentially leading to increased depression [135].

Examining other MHDs as reported in previous meta-analyses, the prevalence rates were notably higher among RHY. More specifically, 22% had anxiety, 25% had ADHD, 21% exhibited oppositional defiant disorders, and 33% had PTSD, each of these much higher the rates observed among the general population of children and adolescents (6.5% for anxiety, 3.4% for ADHD) [122]. Additionally, the rates in the present study were higher than those found among children and adolescents within the child welfare system (18% for anxiety, 12% for oppositional defiant disorders, 11% for ADHD, and 4% for PTSD) [18].

Another important finding was the increasing prevalence of MHDs over time. However, there is no previous study reporting the prevalence of MHDs among RHY over time. According to a previous meta-analysis, there had been a minor increase of MHDs between the 1980s and the 2000s among the general adolescent population [136]. There have been noticeable indications of parallel trends among the general adolescent population, including a rise in symptoms related to MHDs [137]. Furthermore, there has been an increase in the utilization of health services for the diagnosis and treatment of both psychosomatic health complaints and MHDs in high-income countries [138]. These trends broadly align with the findings from the present review. However, it is important to note that not all findings were equally consistent.

Another novel finding of the present study was that internalizing disorders (e.g., anxiety disorders, depression, PTSD) were more prevalent among young adults, while externalizing disorders (e.g., conduct disorders, ADHD) were more prevalent among adolescent minors. This finding is in line with previous studies with US and Swedish adolescents [139, 140] which reported that there is a trend of increasing internalizing symptoms and decreasing externalizing symptoms among general adolescents. One possible explanation for this finding could be that young adults with MHDs may engage in substance use concurrently [141], experience family conflicts [142] and increased violence [143] and/or have limited access to therapeutic and supportive care in the community [144], leading to an increase in internalizing symptoms among this cohort. Moreover, internalizing symptoms, linked to adverse social and health outcomes in young adults [145], hold clinical significance. Given that these symptoms can progress to psychiatric disorders among a subset of young adults [146], clinicians should be vigilant about the rising prevalence of internalizing symptoms among young adults. Finally, the trend of the rise in internalizing symptoms and the decline in externalizing symptoms suggests a shift more closely associated with the natural evolution of psychiatric disorders rather than homelessness.

Finally, the current meta-analysis identified several sources of heterogeneity between studies through meta-regression and moderator analysis. Similar levels of heterogeneity have been observed in previous meta-analyses conducted within the general adolescent population [122]. Heightened heterogeneity can be influenced by several factors, including country variations, mean age, sample size, year of publication, diagnostic criteria, and the quality assessment of studies. These aspects may contribute to methodological challenges and should be considered in future studies. In the present study, there was a lower estimate of the lifetime pooled prevalence of major depressive disorders and obsessive–compulsive disorders with increasing age. This finding is unexpected, as an inverse relationship was anticipated. This should be examined in future studies. It was also found that studies published after 2010 were associated with a higher prevalence of current depression, as well as lifetime prevalence of anxiety and ADHD. This association could be due to increased numbers of studies carried out post-2010, leading to more comprehensive assessments of MHDs among RHY. There were also variations in the diagnostic criteria which could have led to discrepancies in the prevalence rates, aligning with findings from prior meta-analyses [18, 122]. In an older study examining two prominent nosological systems, the DSM-IV-TR consistently categorized a higher number of children and adolescents as having an anxiety disorder compared to the ICD-10 [147]. Moreover, it was observed that studies of lower quality exhibited a higher prevalence of conduct disorders. This highlights the importance of acknowledging that studies with lower quality may yield elevated prevalence rates compared to those with higher quality data. This

consideration should be taken into account in future epidemiological studies.

Limitations

The present meta-analysis has several limitations that should be noted. First, nine-tenths of the studies were carried out in the US and Canada (89%), and the distribution of MHDs was unequally dispersed across the 101 included studies. Therefore, the authors were unable to create a distribution map for each MHD in each country or continent. Second, almost all studies (95%) were conducted in high-income countries, and the findings may not be generalizable to other countries. Third, there was inconsistency in defining MHDs across various studies. For instance, some studies relied on self-reporting rather than adhering to standardized criteria. Fourth, some studies did not specify the duration (whether it was lifetime or current) of MHDs. Fifth, in some studies, the type of MHD was not specified (i.e., they reported MHDs without specifying the particular type of MHD. Therefore, these studies were excluded from the analysis. Sixth, several important pieces of data were not available from studies (e.g., age at the first episode of homelessness or runaway, co-occurring disorders such as substance use, and receiving treatment). Therefore, these trends could not be investigated with these crucial covariates. For example, according to a study from 2005 to 2018, only one-fifth of adolescents received MHD treatment [148], and receiving treatment might affect MHD trends. Finally, excluded from consideration were gray literature sources such as dissertations, research and committee reports, government reports, conference papers, ongoing research, manuscripts, and unpublished studies. The decision to exclude these sources was based on the research team's inability to adequately assess their quality and the fact that they had not been peer-reviewed.

Conclusion

The present study is the first meta-analysis to estimate the lifetime and current pooled prevalence rate of MHDs among RHY. Several innovative subgroup analyses, such as trends of MHDs over time and comparisons of MHDs among adolescent minors vs. young adults, were conducted. Additionally, to the best of the authors' knowledge, the present study is the first to perform meta-regression and moderator analysis to detect potential contributing factors to the heterogeneity of studies on the lifetime and current pooled prevalence rate of MHDs among RHY. The findings suggest that RHY had significantly higher prevalence of MHDs compared to other high-risk populations reviewed. Regular screening and the implementation of evidence-based treatments, and the promotion of integration and coordination between mental health services for adolescent minors and young adults with other service systems are recommended.

Based on the present results, externalizing symptoms were observed among adolescent minors, while internalizing symptoms were evident among young adults. Tailoring mental health services based on the type of symptoms and age is crucial, because adolescent minors and young adults may require distinct interventions for internalizing and/or externalizing symptoms. Future research should investigate the causal factors driving the observed difference between internalizing and externalizing symptom trends among adolescent minors and young adults. Moreover, it is imperative to formulate and implement effective brief and low-intensity psychological interventions [149, 150], including cognitive-behavioral therapy [151], for mitigating internalizing disorders among young adults. Additionally, it is recommended to incorporate selective parent training, family support, and school-based programs [152] for addressing and reducing externalizing disorders among adolescent minors.

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Declarations

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Ethics approval and consent to participate The present study was an analysis of preexisting literature and did not use human participants.

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