Facultad de Estudios Superiores
IZTACALA

REVISTA MEXICANA DE TRASTORNOS ALIMENTARIOS

MEXICAN JOURNAL OF EATING DISORDERS

REVISIÓN

Eating disorders in twins: a scoping review

Trastornos de la conducta alimentaria en gemelos: una revisión de alcance

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Recibido: 2024-01-31
Revisado: 2024-06-24
Aceptado: 2024-11-06

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Funding: This study was not financially supported.

Conflict of interest: None of the researchers who participated in the writing of this protocol declare any related conflict of interest.

Abstract. Evidence suggests that eating disorders (EDs) are multifactorial, with a complex interplay between genetics and environment. Twin studies have indicated a significant genetic contribution, but non-shared environmental factors also contribute to the variability in their etiology. A scoping review was conducted, finding 32 articles from different databases (PUBMED, EMBASE, and BVS) on twins, with the aim of reviewing the literature that includes information on this interaction in the onset and persistence of ED.The findings revealed that the manifestation of EDs emerges from the interplay between genetic predispositions and environmental influences. Psychosocial factors such as child abuse, family environment, peer pressure, and exposure to sociocultural dynamics that idealize thinness influence the risk of development. Moreover, adverse environmental conditions increase the risk in individuals with genetic predispositions. However, the current literature on EDs in twin populations requires

further depth. Most studies focus on underrepresented samples, so research on more diverse cohorts is needed to understand the dynamics of ED diagnosis more precisely. In conclusion, EDs are the product of a complex interplay between genetics and environment. Further research is needed to unravel these dynamics and develop more effective prevention and treatment strategies.

Keywords: eating disorders; twins; genetics; environmental; review

Resumen. La evidencia apunta a una naturaleza multifactorial en los trastornos alimentarios (TA), donde la genética interactúa de forma compleja con el entorno. Estudios en gemelos indican un papel determinante de la genética, aunque factores ambientales no compartidos contribuyen a la variabilidad en su etiología. Esta revisión de alcance, en la que se incluyeron 32 artículos sobre poblaciones de gemelos, busca arrojar luz sobre esta interacción en la aparición y persistencia de los TA. Los resultados revelan que la manifestación de los TA surge de la interrelación entre predisposiciones genéticas e influencias ambientales. Factores psicosociales como abuso infantil, percepción del entorno familiar, presión de grupo y exposición a distintas dinámicas socioculturales influyen en el riesgo de desarrollo. Además, condiciones ambientales adversas potencian este riesgo en individuos con predisposición genética. Sin embargo, la literatura actual sobre TA en poblaciones de gemelos requiere mayor profundidad. En su mayoría, se centra en muestras poco diversas, por lo que se necesitan estudios en cohortes más variadas para comprender con mayor precisión la dinámica del diagnóstico de los TA.

Palabras clave: trastornos de conducta alimentaria; gemelos; genética; ambiente; revisión

Introduction

Eating disorders (ED) are a wide range of mental health disorders distinguished by abnormal eating or weight-control behaviors. They tend to be classified according to the thoughts, feelings and irrational actions carried by the individual, which affect their physical and psychosocial functionality (Gomez-Restrepo et al., 2018; Treasure et al., 2020). ED are disabling and expensive for health systems, presenting high rates of comorbidities and mortality (Galmiche et al., 2019). The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013) includes 6 main disorders, anorexia nervosa (AN), bulimia nervosa (BN), binge eating disorder, rumination, pica, and avoidant/restrictive food intake disorder (Treasure et al., 2020). It is estimated that the global prevalence of ED for women is 8%, and for men is 2% (Galmiche et al., 2019). AN and BN are the most common, however, they have the highest mortality rates amongst mental health disorders (Gomez-Restrepo et al., 2018).

Twins are conceived within the same uterus simultaneously. They can be monozygotic, which means that the two embryos come from the same zygote and have the same genetic load, or dizygotic, meaning that they originate from two independent zygotes and develop into two genetically different embryos. This last group is the most common of twin pregnancies, constituting 70% of all twin pregnancies (de Paepe, 2020). In recent years, twin births have been increasing mainly due to assisted reproductive technology and older maternal age, constituting 3% of all births (Martin et al., 2012). However, twin pregnancies account for 15% of infant deaths, which corresponds to a mortality rate that is 4 times higher compared to singleton pregnancies (Cunningham et al., 2021).

ED development has a genetic factor shown in twin concordance and family aggregation studies. Studies show that first-degree relatives of individuals who have

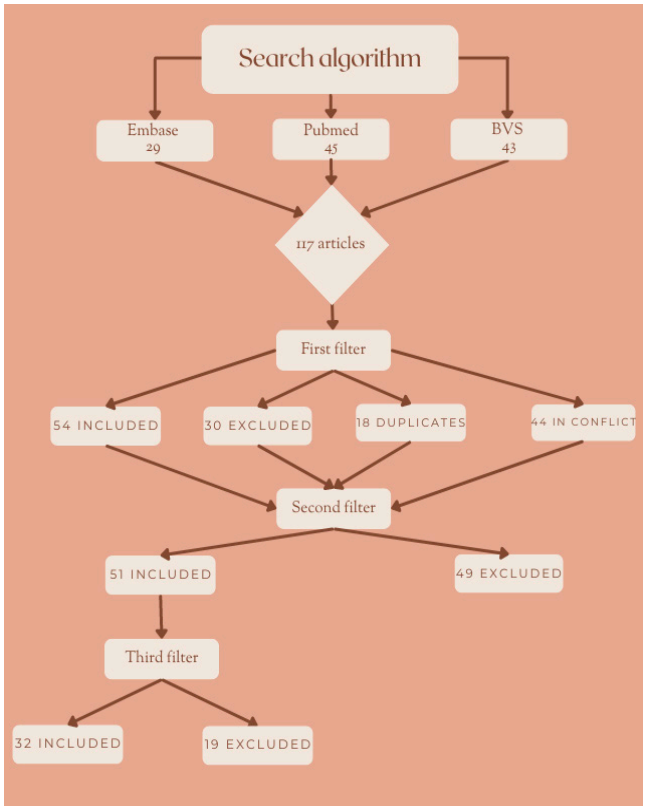
ED are more vulnerable to presenting ED or affective disorders such as depression or anxiety. Monozygotic twins of those who have ED also have higher rates of these disorders, compared to dizygotic twins (Gomez-Restrepo et al., 2018). Additionally, it has been identified that these genetic factors predispose up to 33-84% of the presence of AN, 28-33% of BN and 41-57% of binge eating disorder (Donato et al., 2022).

Twin studies suggest that about 17-46% of the variance in anorexia and bulimia can be explained by non-shared environmental factors. There are not many studies, but the few that explored this topic conclude that events such as relationships with parents, experiences with friends or life events can differentially trigger the possibility of a twin developing ED or not (Klump, Wonderlich, et al., 2002a; Anaya, C. et al, 2022). Other environmental factors associated with the development of ED include both neighborhood disadvantage and an unfavorable family socioeconomic status (Mikhail et al. 2023). Likewise, it has been described that people diagnosed with ED report their mothers as less caring and more overprotective compared to their siblings (Wade, el al. 2001). It has also been found that several prenatal and birth exposures could be associated with the development of ED (Ozsvar, et al. 2023). However, more information is required on the environmental factors associated with the presentation of these disorders to determine if there are ways of prevention in patients who have associated genetic factors. Therefore, this study's aim is to review the existing literature evaluating twin populations and the influence environmental and genetic variables have on the diagnosis and maintenance of ED.

Methods

This scoping review adhered to the guidelines established by the JBI methodology for scoping reviews (Peters Micah DJ et al., 2020). Initially, we conducted a preliminary search of Medline, Embase, SciELO, LiLAC and PsycArticles. The terminology found in the titles and abstracts of pertinent articles, as well as the index terms used to characterize these articles, served as the foundation for constructing a search strategy. The terms used when searching the selected databases were: 'eating disorders', 'twins' and 'environment'; only including full-text articles available online and published in English or Spanish. The reference lists of all included sources of evidence were scrutinized for potential additional studies. All identified citations were screened by all the members of the study team independently, assessing against the inclusion criteria, and any disagreements during the selection process were discussed to reach consensus. Reasons for exclusion of sources in full text that did not meet the inclusion criteria were recorded. The results of the search and the study inclusion process were presented based on the recommendations made by the PRISMA extension for scoping review (see Figure 1). The inclusion and exclusion criteria are detailed below. An extraction form was developed to gather data from each article that met inclusion criteria, which included: (1) country where the data was collected, (2) year of publication, (3) study design, (4) primary study focus, and (5) findings.

Figure 1: Search Algorithm



Selection criteria

1. Participants: Studies that evaluate ED in twin populations.
2. Focus of article: Environmental variables that influence the diagnosis and/or maintenance of the eating disorder. Studies that only reported genetic influence on ED were excluded.
3. Article types: Experimental, analytical and descriptive observational, reviews. Case reports were excluded.
4. Language: Articles written or translated to English or Spanish
5. Year of publication: No filters were applied.

Ethics and dissemination

This study is considered research without risk for subjects in accordance with the proposed methodology and the regulations in force in our country, specifically the resolution 8430 of 1993.This article does not include any studies with human participants performed by any of the authors. Informed consent was not obtained as no primary data was collected from participants by the authors.

Results

During the literature review process, an extensive search was conducted across various databases, including Embase, PubMed, and the Virtual Health Library (see Appendices 1, 2 and 3). This initial search yielded a total of 117 articles, which underwent a preliminary analysis using the Rayyn.ai software (Khabsa et al., 2015). In this phase, 18 duplicates were detected and removed, reducing the dataset to 99 articles for subsequent evaluation.

In the next stage, a group of six researchers conducted a more detailed analysis of titles and abstracts available online. As a result of this initial filter, 25 articles were included, while 30 were excluded. However, conflicts arose concerning 44 articles during this process.

To address these discrepancies, a committee comprising five researchers, including a psychiatrist, two psychiatry residents, a medical doctor, and two medical students, convened to perform a second filter. During this phase, abstracts were re-evaluated, leading to the inclusion of 51 articles and the exclusion of 49.

Subsequently, the 51 selected articles underwent thorough reading by two different researchers, who conducted a third filter. In this instance, it was decided to include 32 articles and exclude 19. Exclusions encompassed case reports, duplicates with different titles, and others not meeting the inclusion criteria are detailed in Table 1.

Excluded

Specifically, exclusions involved the article by Baker et al. (Baker, Johnson, et al., 2018), focusing on substance use, as it did not assess environmental factors but rather emphasized genetic aspects. Likewise, the Spanish duplicate of an English article by Pilar Arribas et al. (Arribas et al., 2018a) was eliminated. Baker et al. (Baker, Brosof, et al., 2018) this was excluded as it evaluated the pursuit of thinness and body dissatisfaction as isolated dimensions in relation to the symptoms of eating disorders, rather than as part of a comprehensive diagnostic spectrum of ED. The article by Luis *Rojo-Moreno et al.* (Rojo-Moreno et al., 2017) was excluded for duplication and its failure to address the diagnosis of the targeted ED.

Furthermore, the article by *O'Connor, Shannon M. and Klump, Kelly L. et al* (O'Connor, Klump, et al., 2016). was excluded as it solely focused on body image perceptions. The longitudinal study by *Slane et al.* (Slane et al., 2014) was dismissed for not correlating symptoms with environmental factors, failing to meet the inclusion criteria.

Regarding the twin study *by Klump et al.* (Klump et al., 2009), it was excluded for not effectively comparing twins but rather functioning as an adoption study. Other excluded articles, such as those by *Keski-Rahkonen et al.* (Keski-Rahkonen et al., 2005), Wade et al. (Wade, Bulik, et al., 2001), *Couvy-Duchesne et al.* (Couvy-Duchesne et al., 2018), Ferguson et al. (Ferguson et al., 2012), *Tracey D. Wade, and Susan A. Treloar et al.* (Wade et al., 2009), *Wilksch et al.* (Wilksch & Wade, 2009), T D Wade, S *Treloar and N G Martin* (Wade

Table 1: Excluded articles

Number	References	Title	Country	Year	Reasons to excluded
1	Arribas, Pilar et al.	Cambios en la influencia genética y ambiental en los trastornos de la alimentación entre niñas en estadio pre y post menarquia. Un estudio gemelar	Spain	2018	Duplicates
2	Baker et al.	Illicit Drug Use, Cigarette Smoking, and Eating Disorder Symptoms: Associations in an Adolescent Twin Sample.	Sweden	2018	This study does not assess the environmental impact.
3	Baker, Jessica H. et al.	Associations Between Alcohol Involvement and Drive for Thinness and Body Dissatisfaction in Adolescent Twins: A Bivariate Twin Study.	Sweden	2018	This study does not assess the outcome of interest [outcome]. Instead, it focuses on motivations for thinness and dissatisfaction with body image.
4	Baptiste Couvy-Duchesne et al	Nineteen and Up study (19Up): understanding pathways to mental health disorders in young Australian twins.	Australia	2018	This study does not assess the outcome of interest [outcome].
5	Christopher J Ferguson et al	The influence of heritability, neuroticism, maternal warmth and media use on disordered eating behaviors: a prospective analysis of twins.	USA	2012	This study does not assess the outcome of interest [outcome].
6	H Sulestrowska et al	Twin rivalry as an important factor in the development of anorexia nervosa in a 14 year old girl	Poland	1995	This study was excluded because it was a case report written in Polish and not available online.
7	Keski-Rahkonen, Anna et al.	Body dissatisfaction and drive for thinness in young adult twins.	Finland	2005	The study was excluded because it did not examine other factors that may contribute to eating disorders.
8	Klump, Kelly L et al.	Genetic and environmental influences on disordered eating: An adoption study.	USA	2009	This adoption study used a database of twins, but did not compare the twin population.
9	O'Connor S. et al	Understanding familial resemblance in eating pathology during pre-early puberty: Results from a Nuclear Twin Family model	USA	2019	Duplicate
10	O'Connor, Shannon M. and Klump, Kelly L. et al	Does parental divorce moderate the heritability of body dissatisfaction? An extension of previous gene-environment interaction effects.	USA	2016	This study does not assess the outcome of interest [outcome].
11	Rojo-Moreno, Luis et al.	Genetic and environmental influences on psychological traits and eating attitudes in a sample of Spanish schoolchildren.	Spain	2017	The article was excluded because it did not assess the diagnosis of eating disorders, but only the symptoms of eating disorders. It did not evaluate the outcome we want
12	Rojo-Moreno, Luis et al	Influencias genéticas y ambientales en rasgos psicológicos y actitudes alimentarias en una población escolar española	Spain	2017	Duplicate
13	Root T et al	Shared and unique genetic and environmental influences on binge eating and night eating: a Swedish twin study.	Sweden	2010	This study does not assess the outcome of interest [outcome].
14	Slane, Jennifer D et al	Developmental trajectories of disordered eating from early adolescence to young adulthood: a longitudinal study.	USA	2014	This study evaluates the longitudinal course of symptoms without considering environmental factors..

Table 1: Continue

Number	References	Title	Country	Year	Reasons to excluded
15	Suisman, Jessica L et al.	Parental divorce and disordered eating: an investigation of a gene-environment interaction.	USA (Michigan and Minnesota)	2011	This study was excluded because it did not provide quantitative data.
16	T D Wade 1, S Treloar, N G Martin	Shared and unique risk factors between lifetime purging and objective binge eating: a twin study.	Australia	2008	This study does not assess the outcome of interest [outcome].
17	Tracey D. Wade, and Susan A. Treloar et al.	An examination of the overlap between genetic and environmental risk factors for intentional weight loss and overeating.	Australia	2009	This study does not assess the outcome of interest [outcome].
18	Wade, T D et al.	The influence of genetic and environmental factors in estimations of current body size, desired body size, and body dissatisfaction.	USA	2001	This study does not assess the outcome of interest [outcome].
19	Wilksch, S M et al.	An investigation of temperament endophenotype candidates for early emergence of the core cognitive component of eating disorders.	Australia	2009	This study does not evaluate the outcome of eating disorders, but rather 7 temperament variables associated with body image concerns.

et al., 2008), did not meet the criteria for the diagnosis of ED, assessing only associated symptomatology. The article by *Suisman et al.* (Suisman et al., 2011) was excluded from the review because it only reported the percentages found in each population. This is not considered an analysis of the data.

Finally, the article by *H. Sulestrowska et al.* (Sulestrowska, 1995) was excluded as it constituted a case report, was entirely inaccessible online, and was written in Polish.

Included:

The included articles amounted to 32 after going through the three described filters. These were thoroughly read by two or more researchers and summarized in Table 2. Some of the most significant findings will be mentioned below.

General:

Within the highlighted studies, Qi et al.'s research emphasizes a robust genetic correlation between bulimia and alcohol consumption, underscoring a unique gene-environment interaction (Qi et al., 2023). Fairweather-Schmidt et al. delve into correlations in binge eating symptoms and ED, highlighting additive genetic contributions and the crucial role of non-shared environmental influences (Fairweather-Schmidt & Wade, 2020). Waszczuk et al. demonstrate a significant increase in symptoms related to thinness pursuit, with strong genetic influences and a moderate environmental contribution to bulimic symptoms (Waszczuk et al., 2019). Kelly L Klump and Stephen Wonderlich's work underscores that 17%-46% of the variability in AN and BN is attributed to non-shared environmental factors, indicating unique contributions to continuous eating pathology (Klump, Wonderlich, et al., 2002b). In O'Connor et al.'s study, 32.1% of variability in disordered eating is identified as shared environmental influences, with 13.7% genetic and 54.1% non-shared, excluding evidence of specific familial influences (O'Connor et al., 2019). This analysis is enriched by the inclusion of O'Connor et al.'s study, (O'Connor, Burt, et al., 2016) suggesting that adolescents predisposed to genetic or environmental factors for ED tend to self-select into weight-conscious peer groups, and the association between exposure to these groups and ED significantly decreases when shared genetic and environmental influences are controlled. These findings consolidate the

Table 2. Summary of included articles

#	References	Title	Country	Year	Study type	Study focus	Results
1	Anaya, C. et al	An investigation of associations between parenting and binge eating across pubertal development in pre-adolescent and adolescent female participants	United States	2022	Transversal	Examine whether interactions between puberty and parenting are associated with higher levels of binge-eating symptoms during/after puberty in female youth	- Lower parental care, increased parental overprotection, and higher parent-child conflict were associated with elevated binge eating -Although parenting is significantly associated with binge eating scores, associations are similar across pubertal development and across the race/ethnicities examined. - There were significant correlations between parenting measures and binge eating. -Lower levels of parental care and higher levels of both parental overprotection and parent–child conflict were significantly associated with higher levels of binge eating. Likewise, in terms of the PBI parenting styles, groups characterized by nonoptimal styles of parenting generally reported significantly higher binge-eating scores than the optimal parenting group
2	Arribas, Pilar et al.	Changes in genetic and environmental influences on disordered eating between pre-menarche and postmenarche girls. A twin study.	Spain	2018	Transversal	Evaluate changes during puberty which could have genetic and environmental influences on disordered eating attitudes and behaviors	- BMI intra-class correlations suggested a higher heritability among pre-menarche subjects, compared to subjects at the post-menarche stage. - The intra-class correlations suggested no genetic influence among the total ChEAT score for individuals at the pre-menarche stage, whereas for the post-menarche individuals, sources of variance show a very high heritability - The four EDI subscales showed moderate heritability estimates at the post-menarche stage group
3	Baker, Jessica H and Maes, Hermine H. et al	Genetic risk factors for disordered eating in adolescent males and females.	Sweden	2009	Transversal	Answer the following questions: (a) Are there quantitative and qualitative sex differences in the genetic risk factors for aspects of body dissatisfaction, drive for thinness, and bulimia; (b) is there a single latent factor underlying these three facets of disordered eating; and (c) are there sex differences in the genetic and environmental risk factors on this latent factor?	- Heritabilities were estimated at 61% and 20% for Drive for Thinness, 16% and 33% for Bulimia, and 57% and 40% for Body Dissatisfaction for females and males, respectively. However, it is important to note the 95% confidence intervals for genetic effects in males for Drive for Thinness and Bulimia include zero. - Common genetic factors account for 36% of the variance in Drive for Thinness scores for females and 32% in males, 7% of the variance in Bulimia scores for females and 1% in males, and 27% of the variance in Body Dissatisfaction scores in females and 21% in males. - Common shared and unique environmental factors also account for more of the variance in females than in males for all subscales.
4	Bulik CM, et al.	Characteristics of monozygotic twins discordant for bulimia nervosa.	United States	2001	Longitudinal	Explore differences between female MZ twins who were reared together who are discordant for BN in order to identify environmental factors that may be associated with development of the disorder.	- The affected twins were at significantly increased risk for lifetime generalized anxiety disorder in both the broadly defined and narrowly defined comparisons. Seventy-five percent of the affected twins reported the onset of GAD to precede or to be concurrent with the onset of BN. - In the broadly defined groups, affected twins scored significantly lower on mastery, self-esteem, and locus of control. In the narrowly defined groups, the affected twins scored significantly lower on mastery, optimism, and self-esteem. - The affected twins reported more discord in their families than the broadly or narrowly defined unaffected co-twins. - In the broadly defined unaffected comparison, there were no differences between the unaffected twins' self-report on parental relationships and their perceptions of the parental relationship with their co-twin. - The affected twins recalled their mothers and fathers as being more warm toward them than toward their unaffected co-twin.

Table 2. Continued

#	References	Title	Country	Year	Study type	Study focus	Results
5	Capusan AJ,et al	Genetic and environmental aspects in the association between attention-deficit hyperactivity disorder symptoms and binge-eating behavior in adults: a twin study.	Sweden	2017	Cross sectional	Investigate the association between attention-deficit hyperactivity disorder (ADHD), binge eating behavior, binge-eating disorder (BED), and bulimia nervosa (BN) in an adult twin population, and to determine the extent to which ADHD symptoms and binge-eating behavior share genetic and environmental factors.	- ADHD symptoms significantly increased risk for binge-eating behavior and DSM-5 binge-eating behavior. - Both BED and BN were significantly more common in adults with ADHD symptoms - Univariate analysis showed moderate heritability for ADHD and high heritability for binge-eating behavior - The genetic correlation (for binge eating and ADHD) was estimated at 0.28 and the non-shared environmental correlation at 0.10. - Shared genetic factors explained 91% of the covariance between ADHD and binge-eating behavior. Non-shared environmental effects (E) accounted for the remaining 9%. - Correlations between binge eating behavior and both HI (hiperactive/impulsive) (0.18, 95% CI 0.12–0.24) and IN (inattentive) (0.18, 95% CI 0.13–0.24) symptoms were similar - For binge-eating behavior, heritability was estimated as 65%
6	Fairweather-Schmidt et al.	Common genetic architecture and environmental risk factors underpin the anxiety-disordered eating relationship: Findings from an adolescent twin cohort.	Australia	2020	Longitudinal	Use twin modeling to expose whether a shared genetic liability underpins comorbidity between anxiety and disordered eating.	- MZ correlations (rCASI: 0.43;rEDE: 0.53) are greater than DZ (rCASI:0.23,rEDE: 0.10), suggesting additive genetic factors contribute to the association between CASI and EDE - Nonshared environmental variances were pivotal in the expression of independent CASI(58%) and EDE (37%) phenotypes, but an additional 11% was contributed by CASI to EDE
7	Harrell ZA, et al	Predictors of alcohol problems in college women: the role of depressive symptoms, disordered eating, and family history of alcoholism.	United States	2009	Cross sectional	Investigate the direct and moderating effects of FHA on the relationships between alcohol problems, disordered eating, and depressive symptoms.	- The correlations between the disordered eating variables and depression were moderate. - There were no significant main effects of disordered eating or FHA in either model. However, there was a significant interaction between FHA and disordered eating in the model for overall disordered eating showing that higher levels of disordered eating were associated with more alcohol problems for women with a positive FHA. (Higher MEBS total score was associated with family history of alcoholism)
8	K S Kendler et al	The genetic epidemiology of bulimia nervosa	United States	1991	Observational transversal	Clarify, from both an epidemiologic and genetic perspective, the major risk factors for bulimia nervosa and to understand the relationship between narrowly defined bulimia and bulimia-like syndromes.	Lifetime prevalence and risk for narrowly defined bulimia were 2.8% and 4.2%, respectively. Including bulimia-like syndromes increased these estimates to 5.7% and 8.0%, respectively. Significant comorbidity was found between bulimia and anorexia nervosa, alcoholism, panic disorder, generalized anxiety disorder, phobia, and major depression. Proband- wise concordance for narrowly defined bulimia was 22.9% in monozygotic and 8.7% in dizygotic twins. The best-fitting model indicated that familial aggregation was due solely to genetic factors with a heritability of liability of 55%.
9	Kelly L Klump 1, Stephen Wonderlich et al	Does environment matter? A review of nonshared environment and eating disorders	United States	2002	Review	Review studies highlighting the importance of nonshared factors for the development of eating disorders and suggest areas for future research.	- Twin studies suggest that approximately 17%-46% of the variance in both anorexia nervosa (AN) and bulimia nervosa (BN) can be accounted for by nonshared environmental factors. - Estimates have indicated that24%-42% of the variance in AN , 17%-46% of the variance in BN , and 28%-68% of the variance in continuous measures of eating pathology can be accounted for by nonshared environmental factors

Table 2. Continued

#	References	Title	Country	Year	Study type	Study focus	Results
10	Kendler KS et al	Childhood sexual abuse and adult psychiatric and substance use disorders in women: an epidemiological and cotwin control analysis.	Sweden	2000	Transversal	What is the diagnostic specificity and cause of the association between childhood sexual abuse and adul psychiatric disorders?	- Self-reported CSA with intercourse was positively associated with all disorders, the highest ORs being seen with bulimia (OR 3.3 CI 1.37-7.96) and alcohol (OR 4.01 CI 2.33-6.91) and other drug dependence (OR 5.7 CI 3.04-10.69). - The ORs were modest and often nonsignificant with nongenital CSA and increased with genital CSA and especially intercourse - A similar pattern of findings was seen with CSA as reported by the cotwin, although many ORs were smaller. - In twin pairs discordant for CSA, the exposed twin was at consistently higher risk of illness.
11	Kendler KS, et al	Dimensions of religiosity and their relationship to lifetime psychiatric and substance use disorders.	United States	2003	Cross sectional	Clarify the dimensions of religiosity and the relationships of these dimensions to risk for lifetime psychiatric and substance use disorders.	Dimension-specific analysis only in association with bulimia nervosa: - General religiosity: OR: 0.97, not statistically significant. - Social religiosity: OR: 0.98, not statistically significant. - Involved god: OR: 0.93, not statistically significant. - Forgiveness: OR: 0.83, not statistically significant. - God as judge: OR: 0.89, not statistically significant. - Unvengefulness: OR: 0.53 (higher levels associated with lower risk of bulimia nervosa). - Thankfulness: OR: 0.60 (higher levels associated with lower risk of bulimia nervosa).
12	Klump, Kelly L; Burt, S Alexandra et al	Changes in genetic and environmental influences on disordered eating across adolescence: a longitudinal twin study.	United States	2007	Longitudinal cohort analysis.	Examine longitudinal changes in genetic and environmental influences on disordered eating across early, mid, and late adolescence.	- Although genetic factors accounted for a negligible proportion (6%) of variance at age 11 years, genes increased in importance and accounted for roughly half of the variance (46%) in disordered eating at ages 14 and 18 years. Shared environmental influences decreased substantially across these same ages.
13	Klump, Kelly L; McGue, Matt et al.	Genetic relationships between personality and eating attitudes and behaviors.	United States	2002	Transversal	(a) examine phenotypic associations between personality characteristics and disordered eating attitudes and behaviors such as body dissatisfaction, weight preoccupation, binge eating, and the use of compensatory behaviors; (b) determine the extent to which genetic or environmental factors underlie relationships; and (c) examine whether common genes and environmental factors account for the total variance in disordered eating or whether there are genetic and environmental influences on eating pathology that are independent of those for personality.	- Elevated scores of negative affectivity in individuals with AN and BN are consistent with clinical studies, and significant correlations were found between Negative Emotionality in the Multidimensional Personality Questionnaire (MPQ) and various scales in the Minnesota Eating Behavior Survey (M-EDI). Similar associations were observed with positive emotionality, suggesting that individuals with eating disorders may exhibit reduced levels of positive affect and optimism. - Bivariate estimates, genetic correlations, and nonshared environmental correlations suggest that relationships between M-EDI scales and MPQ factors are primarily mediated through shared genes, and that 2–22% of the proportion of the total heritability of M-EDI scales is attributable to the genetic component shared with MPQ factors. Common nonshared environmental influences were negligible for most MPQ and M-EDI score relationships, with the exception of Negative Emotionality and Total Score relationship and the Negative Emotionality and Binge Eating relationship, where 40–51% of the variance was attributable to the common nonshared environmental factors.

Table 2. Continued

#	References	Title	Country	Year	Study type	Study focus	Results
14	Korotana, Laurel M., et al	Reciprocal Associations Between Eating Pathology and Parent-Daughter Relationships Across Adolescence: A Monozygotic Twin Differences Study.	Australia	2018	Prospective	Examine longitudinal, bidirectional associations between eating pathology and perceptions of the parent-daughter relationship across adolescence using a methodologically rigorous research design that overcame several methodological challenges that have limited previous study conclusions.	- Consistent negative associations were observed between overall levels of eating pathology at middle adolescence and daughters' later perceptions of various aspects of the father-daughter relationship at late adolescence. - Negative associations were observed between eating pathology and daughters' later perceptions of mother regard and involvement.
15	Mikhail M.E., et al	Context matters: Neighborhood disadvantage is associated with increased disordered eating and earlier activation of genetic influences in girls.	United States	2021	Transversal	Examine whether phenotypic and etiologic associations between neighborhood disadvantage and disordered eating differed across this critical developmental stage.	- Neighborhood disadvantage was significantly correlated with MTP-ED scores at the bivariate level ($r = .09$, $p < .001$) - Associations remained significant after controlling for puberty and race/ethnicity in the MLM ($\beta = .07$, $p = .003$) - Girls at more advanced pubertal stages exhibited greater disordered eating symptoms ($\beta = .32$, $p < .001$)
16	Munn-Chernoff, M. A., et al	Shared genetic risk between eating disorder- and substance-use-related phenotypes: Evidence from genome-wide association studies.	United States	2021	Review	Estimate SNP-based rgs between eating disorder and substance use-related phenotypes based upon summary statistics from the largest published eating disorder GWAS and existing GWAS encompassing a range of substance use-related phenotypes.	- The overall SNP-based heritability for the eating disorder phenotypes ranged from 0.1992 to 0.3911, whereas the corresponding heritabilities for the substance use-related phenotypes ranged from 0.0273 to 0.3548 - For the remainder of the results, we focus on previously unexplored associations of interest in this study—correlations between eating disorder and substance use-related phenotypes. For these associations, the genetic covariance intercepts ranged from −0.0252 to 0.0113, indicating some sample overlap (or low-level confounding) existed
17	Mikhail et al.	Disadvantage and disordered eating in boys: Examining phenotypic and genotype × environment associations across development	United States	2023	Transversal	Examine phenotypic and genotype x environment (GxE) effects of disadvantage in boys	- Both familial and neighborhood disadvantage were associated with significantly greater genetic influences on disordered eating in boys in early adrenarche, and significantly greater phenotypic disorder eating symptoms during late adrenarche - Boys living in disadvantaged environments may be at elevated risk for disordered eating, particularly if they have underlying genetic vulnerabilities - In the model including BMI percentile as a covariate, the association between neighborhood disadvantage and disordered eating was significant for boys in late adrenarche but not in early adrenarche. Similarly, when controlling for BMI, family SES was significantly associated with disordered eating for boys in late adrenarche, but not in early adrenarche. Results were similar in models not including BMI as a covariate.
18	O'Connor et al.	Differences in genetic and environmental influences on body weight and shape concerns across pubertal development in females.	United States	2020	Transversal	Examine differences in genetic and environmental effects on a range of body weight and shape concerns Pisotón Emotional Education Program	- Higher mean scores were found in mid-late puberty than pre-early puberty for overall disordered eating, body dissatisfaction, weight/shape concerns, and weight preoccupation. - The full model for MEBS total score showed mainly linear increases in genetic and non-shared environmental effects across pubertal development - There were minimal differences in shared environmental influences.

Table 2. Continued

#	References	Title	Country	Year	Study type	Study focus	Results
19	O'Connor SM, et al.	Elucidating factors underlying parent-offspring similarity in eating pathology in pre- and early puberty: Exploring the possibility of passive gene-environment correlation.	United States	2019	Cross sectional	Explore the potential role of passive rGE while also modeling genetic and environmental main effects, as well as explored whether the shared environmental influences demonstrated in classical twin studies were attributed to sibling-specific or family-specific environmental influences	- Variance in overall disordered eating was primarily attributed to environmental influences, specifically sibling-specific shared environment (32.1%) and non-shared environmental influences (54.1%). Variance attributable to additive genetic influence was much lower (13.7%). - Family-specific influences (F) were not included in the best fitting models and thus, passive rGE was not indicated.
20	O'Connor, Shannon M. and Burt, S. Alexandra et al.	What drives the association between weight-conscious peer groups and disordered eating? Disentangling genetic and environmental selection from pure socialization effects.	United States	2016	Transversal	Explore socialization versus selection effects in associations between weight conscious peer groups and disordered eating in pre-adolescent and young adolescent female twins	- Teen girls who exhibit more disordered eating appear to select into weight conscious peer groups rather than socialization within these peer groups leading to increased disordered eating. The pattern was observed in multiple disordered eating construct and multiple measures of peer group exposure. - A range of disordered eating attitudes and behaviors and exposure to weight conscious peer groups was present in our sample. A total of 3.9% of twins scored above the clinical cut-off for the MEBS Total Score. Significant positive associations were found between all disordered eating and peer group scores. - When genetic and shared environmental influences were controlled for using the co-twin control method, the association between exposure to weight conscious peer groups and disordered eating was either eliminated or significantly reduced. Aggregating findings across all studies then, it is possible that genetic and/or shared environmental selection effects may drive who one chooses to affiliate with initially, and then socialization may work to increase the similarity within a particular peer group.
21	Qi, B. et al.	Differential genetic associations between dimensions of eating disorders and alcohol involvement in late adolescent twins.	Sweden	2023	Transversal	Provide additional evidence on sex-specific etiology of the comorbidity between eating disorders and alcohol use disorders	- The strongest genetic correlation (ra) emerged between EDI bulimia and AUDIT-P, the proportion of genetic variance of one trait that was shared with the other trait was 0.21. - The proportion of total variance accounted for by nonshared environmental effects was higher in 18 year old girls than 16 and 17 year old girls, therefore, some nonshared environ-mental factors might play limited roles in this association in late adolescents.
22	Racine, S. E. Et al.	Eating disorder-specific risk factors moderate the relationship between negative urgency and binge eating: A behavioral genetic investigation.	United States	2017	Transversal	Examine whether appearance pressures, thin-ideal internalization, body dissatisfaction, and dietary restraint moderate phenotypic and etiologic (i.e., genetic and environmental) associations between negative urgency and binge eating in adolescent and young adult female twins.	- Twin moderation models revealed that genetic, but not environmental, sharing between negative urgency and binge eating was enhanced at higher levels of these eating disorder-specific variables.- Appearance pressures, thin-ideal internalization, and body dissatisfaction strengthened phenotypic and genetic associations between negative urgency (NU) and binge eating (BE), with a greater proportion of genetic influences shared between NU and BE at higher levels of the risk factors. Dietary restraint did not emerge as a moderator of the relationship. - The heritability of negative urgency was estimated at 39%, with the remaining variance due to the non-shared environment (61%). With regards to the etiologic nature of the negative urgency-binge eating association, the genetic correlation was large and significant (ra = .72) with a smaller, yet significant, non-shared environmental correlation (re = .31).

Table 2. Continued

#	References	Title	Country	Year	Study type	Study focus	Results
23	Rutherford, J et al.	Genetic influences on eating attitudes in a normal female twin population.	United States	1993	Transversal	Determine the genetic influences on eating attitudes	- The heritability value of 41 % applies to the total EAT score and gives little information. - The dieting factor of the EAT appeared to be significantly heritable, with a value of 42%. - The body dissatisfaction subscale of the EDI had the highest subscale heritability of 52% with the drive for thinness subscale estimated as 44%.
24	Sipilä, Pyry et al.	"Holy anorexia"- relevant or relic? Religiosity and anorexia nervosa among Finnish women.	Finland	2017	Retrospective cohort	Study in a nationwide setting whether personal or family religiosity is associated with lifetime anorexia nervosa among women in adolescence and early adulthood.	- Found no evidence that either higher personal or parental religiosity is significantly associated with lifetime anorexia nervosa in our population-based Finnish twin cohort. - Eating Disorder Inventory 2, Bulimia and Drive for Thinness were not correlated with religiosity in early adulthood, and Body Dissatisfaction had rather a negative than a positive correlation with religiosity - Neither high religiosity of mothers nor high religiosity of fathers predicted lifetime DSM-5 anorexia nervosa among their daughters. Mothers were more religious than fathers. Religiosity in adolescence was not associated with lifetime DSM-5 anorexia nervosa. The odds ratios for lifetime DSM-5 anorexia nervosa for the most religious decile were 0.62 and 0.36 in Datasets A and B, respectively. Personal religiosity in early adulthood (age 22–27 years) had a J-shaped association with lifetime DSM-5 anorexia nervosa, but this find- ing was not statistically significant, even when adjusted for education.
25	Spanos, Alexia et al	A longitudinal investigation of the relationship between disordered eating attitudes and behaviors and parent-child conflict: a monozygotic twin differences design.	United States	2010	Longitudinal cohort study	Research via a prospective longitudinal MZ twin differences design, examining parent-child conflict as a nonshared environmental influence on disordered eating attitudes and behaviors.	- The study suggests that parent-child conflict may be influenced by, rather than influencing, disordered eating attitudes and behaviors in twins. - Specifically, within age, differential parent– child conflict was associated with differences in disordered eating, such that the twin reporting higher levels of conflict also tended to report more disordered eating than her cotwin (rs .16). Across age, associations were again contrary to expectations. Twin differences in earlier parent– child conflict were not significantly associated with later disordered eating (e.g.,rs .10). Instead, disordered eating attitudes and behaviors at ages 11 and 14 years were significantly and positively associated with twin differences in conflict at age 17 years (rs .16 –.27). This finding tentatively suggests parent–child conflict may be a consequence of disordered eating rather than a nonshared environmental risk factor. - In contrast to within-age relationships, most cross-lagged (across-age) associations (rs =-.10 –.13) were nonsignificant and notably smaller than their respective Pearson correlations
26	Wade, T. D., et al	Investigation of quality of the parental relationship as a risk factor for subclinical bulimia nervosa.	Australia	2001	Transversal	Investigate the relationship between offspring pyschopathology and the parental relationship using a population-based twin registry that contained 766 complete twin pairs.	- Poorer quality of the marital relationship predicted the presence of subclinical bulimia nervosa (SBN) using both mother's (odds ratio [OR] = 0.83, 95% confidence interval [CI]: 0.71–0.97) and father's (OR = 0.78, 95% CI: 0.62–0.97) reports. It also predicted the presence of generalized anxiety disorder (GAD) and alcohol dependence. SBN was still strongly predicted by the marital relationship when parental psychopathology was included as a covariate.

Table 2. Continued

#	References	Title	Country	Year	Study type	Study focus	Results
27	Wade, T. D., et al	A transdiagnostic approach to understanding eating disorders	Australia	2006	Prospective, 3 wave study	Investigate the utility of a dimensional conceptual-ization of eating disorders, namely the number of LEDBs, defined for this purpose as objective binge eating, self-induced vomiting, laxative misuse, diuretic misuse, fasting, and low body weight	- High EAT scorers had a history of a significantly higher weight than low scorers; there was no difference in the lowest ever adult weight. - This reduced model gives what we must take as the best heritability estimate, i.e. a value of 41%. The heritability value of 41 % applies to the total EAT score and gives little information about which aspects of the EAT score are heritable. - The dieting factor of the EAT appeared to be significantly heritable, with a value of 42%. - The body dissatisfaction subscale of the EDI had the highest subscale heritability of 52% with the drive for thinness subscale estimated as 44%. - The bulimia subscales of the EAT and the EDI bulimia subscale had lower heritabilities (26 and 28 % respectively). - The BMI heritability estimate was 64%
28	Wade, T. D., et al	A comparison of early family life events amongst monozygotic twin women with lifetime anorexia nervosa, bulimia nervosa, or major depression	Australia	2007	Case control designs	Investigate the differential profile of early family life events associated with lifetime anorexia nervosa (AN), bulimia nervosa (BN), and major depression (MD).	- Paternal care and control (overprotection) were specifically associated with eating disorders, unlike maternal factors. Increased paternal control was uniquely linked to AN, highlighting a potentially distinctive role of fathers in the development of AN. - Retroactive correlates such as comments about the amount eaten or appearance made by family members during childhood were identified as relevant to both AN and BN. These comments were retrospective correlates for MD as well but were uniquely associated with eating disorders. - Contrary to previous studies, women with BN reported higher parental expectations compared to those with AN. Women with MD reported higher levels of parental expectations than controls but lower expectations than women with BN. -Unaffected AN twins reported issues related to parental conflict and criticism that were not reported by their affected cotwin, suggesting potential differences in familial perception.
29	Wade, T. D., et al	A comparison of family functioning, temperament, and childhood conditions in monozygotic twin pairs discordant for lifetime bulimia nervosa	Australia	2001	Case control	Investigate differences between twins in nine pairs of female monozygotic twins in the Australian Twin Registry who were discordant for lifetime bulimia nervosa.	- The affected twins reported their mothers as being significantly less caring (t(df=8):-2.68)) and significantly more overprotective (t(df=8): 2.04) in the first 16 years of their lives. - The affected twins had significantly lower self-esteem than their nonaffected co-twins (t(df=8): -2.14)) - The affected twins displayed higher levels of impulsivity , exploratory excitability, extravagance, and disorderliness. (t(df=8): 1.68))
30	Wade T, et al.	The structure of genetic and environmental risk factors for three measures of disordered eating.	Australia	1999	Longitudinal study	Explore the genetic and environmental risk factors for both the behaviours and attitudes characteristic of disordered eating.	- The MZ correlations being more than double of the DZ correlations , suggests the presence of genetic factors influencing the development of disordered eating. - Over the 7 year span between Waves 1 and 3, there is still a considerable amount (66%) of shared genetic risk factors between these two waves. The environmental correlation between the two measures is lower, at 18%. - Investigators considered the common pathway structure as the most parsimonious description of the model structure, therefore, The latent variable (liability to disordered eating) has a broad heritability (A) of 59% and the non-shared environmental influences (E) account for 41%.

Table 2. Continued

#	References	Title	Country	Year	Study type	Study focus	Results
31	Waszczuk et al.	Etiological influences on continuity and co-occurrence of eating disorders symptoms across adolescence and emerging adulthood.	Norway	2019	Prospective, 3 wave study	Investigate the continuity and change of etiological influences on drive for thinness, bulimia and body dissatisfaction symptoms	- There was a moderate main effect of time on drive for thinness symptoms and body dissatisfaction (increasing across development), bulimia symptoms did not increase significantly over time - There was a larger concurrent association between drive for thinness and body dissatisfaction symptoms (r = 0.83–0.84) than between bulimia and the other two eating disorders symptoms (r = 0.46–0.59) - Both drive for thinness and body dissatisfaction were characterized by large genetic influences (A = 0.56–61 and 0.65–0.58, respectively), with remaining variance explained by non-shared environmental effects. Bulimia symptoms were under significantly lower, moderate genetic influences (A = 0.31–0.49)
32	Magel, C. A. et al.	Shifting goalposts: widening discrepancies between girls' actual and ideal bodies predict disordered eating from preadolescence to adulthood	United States	2024	Longitudinal and prospective study	The study focuses on examining how girls' perceptions of their actual and ideal body sizes change over time, as well as the discrepancies between these perceptions, and how these discrepancies relate to subsequent disordered eating behaviors and attitudes.	The results of the study revealed that both perceived body sizes and body mass indices (BMI) increased from ages 10 to 33, while ideal body sizes remained relatively stable. These perceptions and discrepancies were found to be stronger predictors of disordered eating behaviors and attitudes than body dissatisfaction measured by self-report questionnaires. These findings highlight the critical role of body size perceptions and discrepancies between actual and ideal sizes in the development of disordered eating behaviors from preadolescence to adulthood.

updated understanding of ED and underscore the need to address complex gene-environment interactions in future research and therapeutic approaches.

Social and Family Environment:

Mikhail et al.'s study underscores how unfavorable environments, both familial and neighborhood, increase the risk of developing ED in children, especially when there are underlying genetic vulnerabilities (Mikhail et al., 2023). Body mass index (BMI), family socioeconomic status and neighborhood disadvantage emerge as key modulators of these associations, even after controlling for puberty and ethnicity. Anaya et al. delve into parental upbringing, revealing a significant association between lower levels of parental care and higher binge episodes in twins, emphasizing the importance of assessing family dynamics in understanding ED (Anaya et al., 2022). Mikhail et al. found significant correlation between neighborhood disadvantage and scores of eating disorder symptoms (Mikhail et al., 2021a). Tracey D Wade et al. establish the specific influence of paternal care and control on ED, particularly AN, revealing that elevated paternal control is uniquely linked to AN (Wade et al., 2007). Additionally, retrospective correlates relevant to AN and BN are identified. S A Treloar et al.'s study reveals that twins affected by ED report significantly lower maternal care and higher overprotection during childhood, along with traits like impulsivity, suggesting a complex interplay of factors in the etiology of ED (Wade, Treloar, et al., 2001). K S Kendler et al. highlights the prevalence of bulimia and associated risk factors, including low paternal attention, weight fluctuation, and low self-esteem, with estimated heritability at 55% (Kendler et al., 1991). Laurel M. Korotana et al. reveals consistent negative associations between adolescent eating pathology and later perceptions of father-daughter relationships, as well as negative associations with mother-daughter relationship perceptions (Korotana et al., 2018). T D Wade and C M Bulik et al. add a unique perspective by describing how poor marital relationship quality predicts the presence of subclinical BN (SBN) and other

disorders, emphasizing the connection between family relationships and the onset of ED (Bulik et al., 2001a).

Across the Lifespan:

The analysis of 32 articles reveals that ED undergo transformations throughout life, with various studies providing valuable insights into this phenomenon. O'Connor et al. focus on puberty, showing a linear increase in eating disorder symptoms during pubertal development, highlighting an increase in genetic effects and non-shared environmental influences over this period (O'Connor et al., 2020). Arribas et al. explore heritability in relation to menarche, finding a greater genetic influence among premenarchal subjects compared to postmenarchal ones, with moderate heritability in Eating Disorder Inventory (EDI) subscales in the postmenarchal group (Arribas et al., 2018b). Klump, Kelly L; Burt, S Alexandra et al. report a shift in the relative importance of genetic and environmental factors in the development of ED throughout adolescence, observing a significant increase in genetic contribution with age, while shared environmental influences decrease (Klump et al., 2007). Mikhail et al, note that girls in advanced pubertal stages exhibit higher symptoms of disordered eating (Mikhail et al., 2021b). Magel et al. found that discrepancies between the actual and ideal body size increased from age 10 until approximately age 30, because actual body size ratings increased while ideal body size perceptions remained relatively stable. These changes in body perception predicted disordered eating behaviors and attitudes; thinner ideal body size being the strongest predictor (Magel et al., 2024). These findings emphasize the need to understand the temporal dynamics of ED for more effective and personalized intervention.

Other Psychiatric Pathologies:

The examination of studies addressing the relationship between ED and other psychiatric pathologies sheds light on the complexities of these connections. Kendler KS et al. identify a positive association between childhood sexual abuse, especially with sexual relations, and various ED and substance dependence. The higher concordance in twins exposed to sexual abuse highlights the relevance of traumatic factors in the etiology of ED (Kendler et al., 2000). Capusan AJ et al. point out that symptoms of ADHD significantly increase the risk of binge eating behavior and BN, documenting a significant shared genetic contribution between ADHD and binge behaviors (Capusan et al., 2017). Harrell ZA et al. find moderate correlations between eating disorder and depression symptoms, while the significant interaction between family history of alcoholism and eating disorder underscores the relevance of considering family contexts in the assessment of ED (Harrell et al., 2009). Bulik CM et al. reveal a higher risk of generalized anxiety disorder in twins affected by ED, along with differences in family perceptions and personal characteristics between affected and unaffected twins (Bulik et al., 2001b). Klump et al. with McGue et al. reinforce phenotypic associations between ED and negative and positive affectivity, suggesting a substantial contribution of shared genetic factors in these connections (Klump, McGue, et al., 2002).

Contrary Findings:

The critical examination of studies addressing findings against proposed associations provides valuable perspectives. Sipilä et al. find no evidence of a significant association between personal or parental religiosity and AN (Sipilä et al., 2017). This finding suggests that religiosity may not be significantly correlated with symptoms of ED, highlighting the complexity of contributing factors to these disorders and the need to consider various dimensions in their understanding. On the other hand, Spanos et al. propose that parent-child conflict may be influenced by, rather than influencing, attitudes and disordered eating behaviors in twins (Spanos et al., 2010). This suggestion underscores the need for additional research to better discern and understand the underlying mechanisms in the relationship between family conflict and ED. These results emphasize the importance of addressing not only proposed associations but also limitations and contradictions in the literature, contributing to a more comprehensive and nuanced understanding of ED.

Discussion

ED represents a multifaceted challenge in psychiatric practice, characterized by complex interactions between genetic predispositions and environmental influences, among other factors.

Considering all the studies included in this review, evidence seems to indicate there are several nonshared environmental factors that can influence the development of ED. The variance over time in continuous measures of eating pathologies (AN, BN, and ED Not Otherwise Specified) can also be accounted for by nonshared environmental factors. Some of the nonshared environmental factors that were found to influence the occurrence and the course of ED include child sexual abuse, perceived warmth and care from both parents, differential treatment among siblings, different peer groups, and peer pressure. There are many more environmental factors that can influence the onset and trajectory of ED not accounted for in previous studies, and more research is needed to identify these influences. Lesser discussed but still significant environmental factors influence ED, such as familial and neighborhood disadvantage and socio-cultural influences.

Traditionally it has been suggested that the covariance between anxiety disorders and ED is mainly due to genetic factors, but in our review, we found that both genetic and environmental factors are important contributors. Additionally, puberty is a critical developmental period for etiologic shifts in risk for the weight/shape concerns that are central to ED, where genetic effects on body dissatisfaction and weight/shape concerns increase. Therefore, it can be concluded that puberty likely accounts for the age-related effects found in many prior studies. Concordant with previous literature, there was an important change in the influence of genetic and environmental factors depending on age: on early to mid-adolescence, genetic factors seem to contribute around 50% towards the development of ED, however, form mid to late adolescence, uniquely environmental factors seem to influence the occurrence of these pathologies. Comparing females and males, genetic factors showed a stronger contribution in males, whereas shared environment contributed more in females.

Our findings emphasize the influence of socio-cultural factors on the occurrence and course of ED. The interplay between cultural ideals of beauty, body image expectations, and societal norms contributes to the divergence in individual experiences. Nonshared environmental factors within the socio-cultural domain emerge as potent determinants, shaping the trajectory of ED. Patients with ED appear to select into weight conscious peer groups instead of the other way around (i.e., people who suffer from AN are more likely to join weight conscious groups, rather than these groups influencing people to develop AN). It has been suggested that religiosity (either the patient or the parents') may be associated with AN, however our research seems to indicate that religiosity is not significantly associated with AN or other ED, however data on this topic is very limited, as there are only a handful of studies that investigate this possible association.

At least one study investigated the association between divorced parents and the development of ED, describing that divorce status did not moderate the heritability of most symptoms of disordered eating except for body dissatisfaction. However, the available data on this particular topic is extremely limited, and further research is needed.

Most of the articles reviewed chose to use twin registries and studies previously developed in this population, so that they performed cross-sectional analysis of the data (Anaya et al., 2022). Whereas in other studies a longitudinal analysis was preferred, with the aim of continuously monitoring the population of interest, so that the differences in genetic and environmental factors at different stages of life were gradually detailed (Klump et al., 2007).

The main strength of this review is that most of the papers found are conducted as primary research, hence the reviews found compiling this topic are scarce. Thus, this review is a novel approach to the topic, since it has not been deeply examined before. Also, integrating into clinical practice the role of environmental influences on the development of ED might allow for a more comprehensive therapeutic approach.

It should be noted that when carrying out studies on twins, a common methodology for this population called the "twin study theory" is usually used, which

supports that hereditary disorders will coincide more in monozygotic twins than in dizygotic twins. Likewise, it will be greater in siblings than in unrelated individuals (Arribas et al., 2018). Other methodologies employed in various studies include performing a statistical analysis by complete model, since it allows the analysis of all the variables or parameters of interest, thus improving the validity of the study, compared to other models (Baker et al., 2009).

Regarding the limitations, the literature regarding ED and its presentation on twins is very limited. There are few articles that explore this association, and they conclude that non-genetic factors tend to have a great influence on the development of ED. Therefore, the variety of information that can be gathered is insufficient. Another limitation to be acknowledged is the small sample size prevalent in most studies, coupled with the absence of a globally representative population. This is attributed to the majority of research being conducted in developed countries, predominantly involving Caucasian ethnic groups.

Several gaps in knowledge were identified through the scoping review. Firstly, the traditional scales used to assess ED, such as the Eating Disorder Inventory (EDI), were primarily developed for female individuals, which can be evidenced in some of the items, especially those that ask about specific body image concerns commonly experienced by women (Smith et al., 2017). This raises concerns about the applicability of the results to male participants in some studies, as it is possible that different domains of eating disorder symptoms are captured in males versus females, raising the need for gender-specific or more gender-neutral assessment tools (Stanford & Lemberg, 2012). In addition, the male population is underrepresented in studies examining non-shared environmental factors, showing the need for further assessment in this population.

Moreover, it is known that screening tools developed for ED have limitations. Some of the studies use parent-reported measures of disordered eating, like the Michigan Twins Project Eating Disorder Survey (MTP-ED), which can alter the results because EDs are often accompanied by a shame and secrecy component, and parents might not be fully aware of the symptoms experienced by their children. However, self-report questionnaires can sometimes result in an overreporting of binge-eating behavior in nonclinical samples (Berg et al., 2011), which should be taken into consideration in future studies.

The findings underscore the necessity for larger and more diverse samples in twin research studies, particularly because current samples may lack the robustness to draw conclusive results when evaluating various age groups or pubertal states, owing to limited statistical power. This need extends to the inclusion of more representative populations, encompassing different ethnic and cultural backgrounds, to enhance the generalizability of the research. Additionally, the scarcity of studies conducted in developing countries, which are representative of distinct socioeconomic backgrounds, is a notable limitation. A significant gap in the literature is the predominant focus on dimensions and symptoms of eating disorders across these studies, rather than on comparisons among clinically diagnosed individuals. This oversight hampers the development of tailored interventions for those with clinically diagnosed ED, a critical area that warrants exploration in future research.

Conclusions:

The data presented above point towards the involvement of nonshared environmental experiences in shaping the development of anorexia nervosa, bulimia nervosa and other ED Not Otherwise Specified (EDNOS). These unique experiences are poised to be a blend of influences stemming from both familial and nonfamilial sources.

This scoping review investigated the existing literature regarding the genetic and environmental factors that influence the diagnosis and maintenance of ED in twin populations, but as mentioned before, this novel approach to the issue has an important limitation in that the data available is somewhat scarce, and future research is needed.

Appendices

Appendix 1: search conducted in the PubMed database

Database	Search equation	Restrictions	Results
PubMed	("ED"[MeSH Terms] OR "eating pathology" OR "pathologic eating behavior" OR "BN"[MeSH Terms] OR "anorexia"[MeSH Terms] OR "bulimia" OR "binge eating" OR purging OR vomiting OR "body dissatisfaction" OR "food neophobia") AND (twin*[MeSH Terms] OR "monozygotic twins"[MeSH Terms] OR "diseases in twins"[MeSH Terms] OR "twin" OR "twin relation" OR "twins") AND ("social determinants"[MeSH Terms] OR "social determining factor" OR "social factors determining health" OR "social health determinant" OR "social determinants of health"[MeSH Terms] OR breeding OR nurture OR "child parent relationship"[MeSH Terms] OR "child parent spatial pattern" OR "correlation, parent child" OR "parent child correlation" OR "parent child relation" OR "parent child relationship"[MeSH Terms] OR "parent infant bonding"[MeSH Terms] OR "parent infant relation" OR "parent to child relation" OR "parent to child relationship" OR "parent-child relations" OR "parental role"[MeSH Terms] OR "parenting"[MeSH Terms] OR "child parent relation" OR "child negligence" OR "childhood neglect" OR "childhood negligence" OR "neglected child" OR "pediatric neglect"[MeSH Terms] OR "child neglect" OR "parent child feeding relation" OR "problem, social" OR "social pressure" OR "social problems" OR "social problem")	None	45

Appendix 2: search conducted in the Embase database

Database	Search equation	Restrictions	Results
Embase	('eating disorder'/exp OR 'eating pathology' OR 'pathologic eating behavior' OR 'BN' OR 'anorexia' OR 'bulimia' OR 'binge eating' OR purging OR vomiting OR 'body dissatisfaction' OR 'food neophobia') AND (twin* OR 'monozygotic twins' OR 'diseases in twins' OR 'twin' OR 'twin relation' OR 'twins') AND ('social determinant' OR 'social determinants' OR 'social determining factor' OR 'social factors determining health' OR 'social health determinant' OR 'social determinants of health' OR breeding OR nurture OR 'child parent relationship' OR 'child parent spatial pattern' OR 'correlation, parent child' OR 'parent child correlation' OR 'parent child relation' OR 'parent child relationship' OR 'parent infant bonding' OR 'parent infant relation' OR 'parent to child relation' OR 'parent to child relationship' OR 'parent-child relations' OR 'parental role' OR 'parenting' OR 'child parent relation' OR 'child negligence' OR 'childhood neglect' OR 'childhood negligence' OR 'neglected child' OR 'pediatric neglect' OR 'child neglect' OR 'parent child feeding relation' OR 'problem, social' OR 'social pressure' OR 'social problems' OR 'social problem')	None	29

Appendix 3: search conducted in the BVS database

Database	Search equation	Restrictions	Results
BVS	"eating disorder" OR "eating pathology" OR "pathologic eating behavior" OR "BN" OR "anorexia" OR "bulimia" OR "binge eating" OR purging OR vomiting OR "body dissatisfaction" AND "twins" OR "monozygotic twins" OR "diseases in twins" OR "twin" OR "twin relation" OR "twins" AND "social determinant" OR "social determinants" OR "social determining factor" OR "social factors determining health" OR "social health determinant" OR "social determinants of health" OR breeding OR nurture OR "child parent relationship" OR "child parent spatial pattern" OR "correlation, parent child" OR "parent child correlation" OR "parent child relation" OR "parent child relationship" OR "parent infant bonding" OR "parent infant relation" OR "parent to child relation" OR "parent to child relationship" OR "parent-child relations" OR "parental role" OR "parenting" OR "child parent relation" OR "child negligence" OR "childhood neglect" OR "childhood negligence" OR "neglected child" OR "pediatric neglect" OR "child neglect" OR "parent child feeding relation" OR "social problem" OR "social pressure" OR "social problems" OR "social problem"	None	43

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