Reducing Eating Disorder Symptoms and Risk Factors Using the Internet: A Meta-Analytic Review

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ABSTRACT

Objective: The purpose of this meta-analytic review was, first, to evaluate the efficacy of Internet-based programs in decreasing eating disorder (ED) symptoms, and, second, to identify moderator variables these effects.

Method: Twenty studies were identified and between-group effect sizes were calculated for ED symptoms and risk factors.

Results: Compared with control conditions, Internet-based programs successfully decreased body dissatisfaction ($d = 0.28$, 95% CI [0.15–0.41], $p < .001$), internalization of the thin ideal ($d = 0.36$, 95% CI [0.07–0.65], $p < .05$), shape and weight concern ($d = 0.42$, 95% CI [0.13–0.71], $p < .05$), dietary restriction ($d = 0.36$, 95% CI [0.23–0.49], $p < .001$), drive for thinness ($d = 0.47$, 95% CI [0.33–0.60], $p < .001$), bulimic symptoms ($d = 0.31$, 95% CI [0.20–0.41], $p < .001$), purging frequency ($d = 0.30$, 95% CI [0.02–0.57], $p < .05$), and negative affect ($d = 0.32$, 95% CI [0.12–0.52], $p < .001$). Moderator analyses revealed no impact of data analytic strategy on intervention effects. Similarly, participant risk status was not a moderator for most outcomes.

Discussion: Internet-based programs are successful in decreasing ED symptoms and risk factors with small to moderate between-group effect sizes.

Keywords: eating disorders; intervention; prevention; internet; risk factors; moderator

Resumen

Objetivo: El propósito de esta revisión meta-analítica fue, primeramente, evaluar la eficacia de los programas basados en internet para disminuir los síntomas de trastorno de la conducta alimentaria (TCA), y segundo, identificar variables moderadoras de estos efectos.

Método: Se identificaron veinte estudios y se calculó el tamaño del efecto entre grupos para los síntomas de TCA y los factores de riesgo.

Resultados: En comparación con las condiciones de control, los programas basados en Internet redujeron con éxito la insatisfacción corporal (d = 0,28; IC del 95% [0,15-0,41], p <0,001), interiorización del ideal de delgadez (d = 0.36, 95% CI [0,07 hasta 0,65], p <0,05), la preocupación por el peso y la figura (d = 0,42; IC del 95% [0,13 a 0,71], p <0,05), la restricción dietética (d = 0,36; IC del 95% [0,23 a 0,49], p <0,001), la búsqueda de la delgadez (d = 0,47; IC del 95% [0,33 a 0,60], p <0,001), los síntomas bulímicos (d =. 31; IC del 95% [0,20-0,41], p <0,001), la frecuencia de purgación (d = 0,30 IC del 95% [,02-,57], p <0,05) y el afecto negativo (d =. 32; IC del 95% [0,12 hasta 0,52], p <0,001). Los análisis moderador no revelaron ningún impacto de la estrategia analítica de datos sobre los efectos de intervención. Del mismo modo, el estado de riesgo de los participantes no fue un moderador para la mayoría de los resultados.

Discusión: Los programas basados en Internet tienen éxito en la reducción de los síntomas de TCA y los factores de riesgo con un tamaño de efecto pequeño a moderado entre grupos.

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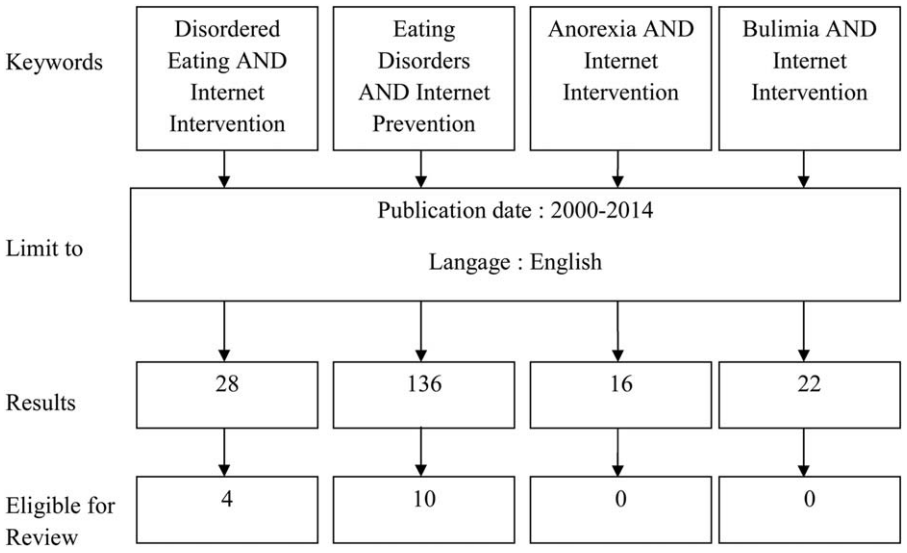
FIGURE 1. Sample search strategy for PsycInfo.



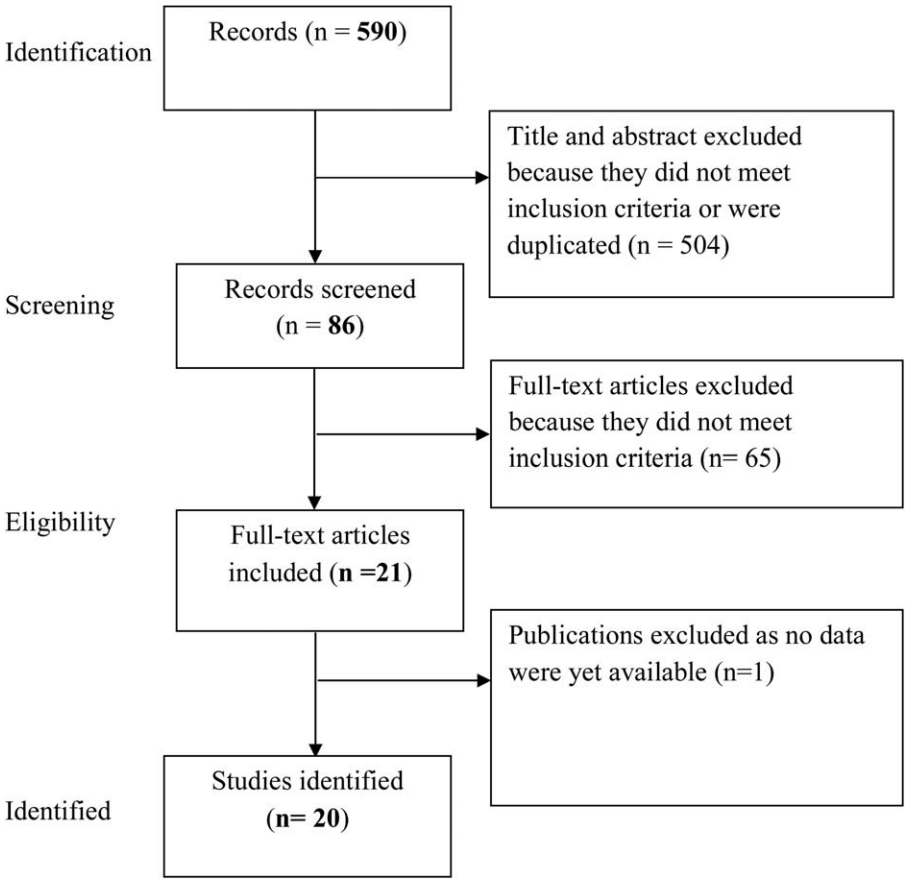
Introduction

Eating disorders (EDs), including subthreshold forms, are increasingly common, and among the most severe of mental disorders.[1–3] Successful prevention and treatment programs for young women have been developed[4–8]; however, these face-to-face interventions present a number of limitations, and are costly and difficult to disseminate, leading to calls capitalize on the possibilities offered by the Internet.[6,9] The Internet may have great potential for enhancing the treatment and prevention of EDs due to advantages in accessibility, cost, and ease of dissemination.[6,10] Internet-based psychotherapeutic intervention programs have been suggested to offer specific advantages for EDs.[11–13] Although the number of Internet-based programs has multiplied, their success in decreasing ED symptoms is still unclear. Because of the potential advantages of Internet-delivered programs, establishing their efficacy is an important step toward greater dissemination.[12,14,15]

Existing Internet-based ED *intervention* programs have been identified in two systematic reviews,[11,16] which have reported encouraging findings, concluding that Internet-based programs are emerging as a successful approach for the treatment of ED symptomatology. The efficacy of ED *prevention* programs delivered exclusively through the Internet (as opposed *to other forms of technology*) has been explored through two meta-analyses.[17,18] The first found little evidence for their efficacy,[18] whereas the second documented moderate improvements in ED symptoms.[17] As both of these reviews focused on the same prevention program (*Student Bodies*), the difference might stem from the fact that the second was far more inclusive and might have greater statistical power[17] than the first one.[18] A third meta-analysis has explored the efficacy of technology-based intervention and both selective and universal prevention programs and provided an overview of e-therapy delivered through computers, CD-Rom, the Internet, or mobile-device applications.[19] The authors concluded that the efficacy of such programs should be considered with caution and that further research was needed.

Although these three meta-analyses have explored the efficacy of ED Internet-based programs,[17–19] their findings are limited by the lack of focus on variables that might account for the efficacy of Internet-based programs. To our knowledge, only one meta-analysis has reported exploratory moderator analyses.[17] Moderator analyses were performed on weight concern outcomes to evaluate the efficacy of the Student Bodies program between U.S. versus German samples and universal versus selective prevention samples. The authors reported heterogeneity on the Weight and Shape Concern Scale (WCS) and suggested differences on weight concern outcomes depending on country and risk status. Regarding individual studies, moderators of intervention effects have been identified in two studies,[20,21] with the greatest effects found among participants with high BMI and compensatory behaviors at baseline[20] and the lowest effects found among participants with

FIGURE 2. Study selection process.



high purge behaviors and restrictive eating at baseline.[21] Exploring the impact of risk status on effects across a larger number of interventions would increase our understanding of the impact of initial symptomatology on intervention effects.

While face-to-face selected prevention programs have been found to result in greater decreases in ED symptoms compared with universal prevention, little is known regarding the potential moderators of their effects. Given the lack of consensus between previous meta-analyses regarding the efficacy of ED Internet-based programs, conducting a meta-analysis incorporating all studies published to date in symptomatic individuals (selective prevention) and those meeting diagnostic criteria (intervention) might help clarify previous results.[17–19] Moreover, it will be useful to clinicians to provide a clearer picture of the efficacy of Internet-based programs in reducing ED symptoms along a continuum of severity. Furthermore, to our knowledge, to date, little is known regarding the influence of potential moderator variables on the efficacy of Internet-based programs. Thus, the aim of this meta-analytic review was twofold: first, to evaluate the efficacy of Internet-based programs in decreasing ED-related risk symptoms among symptomatic individuals as well those with diagnosed ED; second, to identify moderator variables of these effects.

Method

The literature review was conducted according to the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines.[22]

Eligibility Criteria

We included studies that (1) were published in English between January 2000 and January 2015; (2) used experimental or quasi-experimental study designs with a wait-list condition or another type of control group with a minimal intervention such as a brochure (studies with an active control group such as bibliotherapy or comparing face-to-face and Internet-based programs were excluded); (3) included symptomatic participants or

participants with full EDs; (4) provided measures of ED-related symptoms; and (5) provided sufficient data to compute between-group effect sizes. Programs that screened for or used advertisements designed to select symptomatic individuals were considered to be selective prevention programs.[7] Studies that included individuals with an ED diagnosis based on *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (*DSM-IV*) criteria were identified as intervention programs.

Information Sources and Search Strategy

A literature search (Fig. 1) was conducted via PubMed, PsychINFO, Science Direct, and Google Scholar, using the criteria: Language (English), date (2000–2015), and published studies. An ancestry approach was used to complete computer searches.[23] Keywords were "Disordered Eating" and "Internet Intervention"; "EDs" and "Internet Prevention"; "Anorexia" and "Internet Intervention"; "Bulimia" and "Internet Intervention."

TABLE 1. PICOS (participants, intervention, comparison, outcome, study design) characteristics in identified studies

Study	Participants, M_{age} (SD)	Intervention	Comparisons	Outcomes	Design	Type of Control Group
Winzelberg et al.[29a–c]	Women students with desire to improve body image satisfaction 20.0 (2.8)	IBPP: SB	Web-based group ($n = 31$); control ($n = 29$)	BSQ, EDI-DT, EDI-BN, EDE-Q	NR	WLC
Celio et al.[30a–c]	Women with high BD 19.6 (2.2)	IBPP: SB	Web-based group ($n = 27$); control ($n = 24$)	EDE-Q, BSQ, EDI-DT, EDI-BN	R	WLC
Zabinski et al.[31a–c]	Women students with body shape concern 19.3 (1.4)	IBPP: SB	Web-based group ($n = 31$); control ($n = 31$)	BSQ, EDI-DT, EDI-BN, EDE-Q	R	WLC
Zabinski et al.[32]	Women students at risk for developing an ED 18.9 (2.4)	IBPP	Web-based group ($n = 28$); control ($n = 30$)	EDE-Q	R	WLC
Taylor et al.[20b,c]	Women with high weight and shape concern 20.8 (2.6)	IBPP: SB	Web-based group ($n = 192$); control ($n = 199$)	WCS, EDI-DT, EDI-BN, EDE-Q, CES-D	R	WLC
Low et al.[33b,c]	Women students with desire to improve body image	IBBP:SB	Web-based group ($n = 14$); control ($n = 14$)	EDI-DT, EDI-BN, EDI-BD, WSC; SATAQ	R	WLC
Heinicke et al.[34]	Adolescent girls self-identifying as having body image or eating problems 14.4 (1.5)	IBPP: My body, my life	Web-based group ($n = 40$); control ($n = 43$)	BSQ, BCS, DEBQ-R, EWLB, EDI-BN, SATAQ-3, BDISF	R	WLC
Paxton et al.[35]	Women with high BD 25.6 (5.8)	IBPP	Web-based group ($n = 37$); control ($n = 37$)	BSQ, PACS, BULIT-R, DEBQ-R, BDI-II	R	WLC
Jacobi et al.[36b,c]	Women students who wanted to improve their body image 22.5 (2.7)	IBPP: SB	Web-based group ($n = 47$); control ($n = 50$)	EDI-DT, EDI-BN WCS, EDE-Q	R	WLC
Doyle et al.[37c]	Overweight or at risk for overweight adolescents 14.5 (1.7)	IBPP: SB2	Web-based group ($n = 40$); control ($n = 40$)	EDE-Q	R	TAU
Jones et al.[38c,d]	Adolescent at risk for overweight 15.1 (1.0)	IBPP: SB 2	Web-based group ($n = 52$); control ($n = 53$)	EBI, CES-D	R	WLC
Fernández-Aranda et al.[39d,e]	Women with BN 23.7 (3.6)	IBIP	Web-based group ($n = 31$); control ($n = 31$)	EDI, EAT-40, BITE	NR	WLC
Sánchez-Ortiz et al.[40c–e]	Women students with BN or EDNOS 23.9 (5.9)	IBIP	Web-based group ($n = 38$); control ($n = 38$)	EDE-Q	R	WLC
Carrard et al.[41c–e]	Women with full or subthreshold BED 36 (11.4)	IBIP	Web-based group ($n = 37$); control ($n = 37$)	EDE-Q, EDI-DT, EDI-BN, EDI-BD, T-FEQ	R	WLC
Carrard et al.[42d,e]	Obese women and men with BED 42.8 (9.8)	IBIP	Web-based group ($n = 22$); control ($n = 20$)	EDO, EDE-Q, TFEQ	NR	WLC
Fichter et al.[43c]	Women with full or subthreshold *AN* 24.1 (5.6)	IBPP	Web-based group ($n = 106$); control ($n = 113$)	EDI	R	TAU
Jacobi et al.[44c,d]	Women with subthreshold ED 22.3 (2.9)	IBPP: SB+	Web-based group ($n = 51$); control ($n = 52$)	EDE-Q, WCS, EDI-DT, EDI-BN, EDI-BD, BDI	R	WLC

TABLE 1. *Continued*

Study	Participants, M_{age} (SD)	Intervention	Comparisons	Outcomes	Design	Type of Control Group
Stice et al.[45c]	Women students with BD 21.6 (6.6)	IBPP	Web-based group ($n = 19$); control ($n = 39$)	DRES, SDBPS, IBSR, BDI	R	BC
Hötzel et al.[46c]	Women with AN or BN symptoms 27.1 (7.8)	IBPP	Web-based group ($n = 49$); control ($n = 76$)	EDE-Q, SEED	R	WLC
Ruwaard et al.[47c–e]	Women with BN symptoms 31 (10)	IBPP	Web-based group ($n = 35$); control ($n = 35$)	EDE-Q, BAT	R	WLC

Notes: ED, Eating Disorders; BED, Binge Eating Disorder; BN, Bulimia; BD, Body Dissatisfaction; EDNOS, Eating Disorder Not Otherwise Specified; IBPP, Internet-Based Prevention Program; IBIP, Internet-Based Intervention Program; SB, Student Bodies; R, Randomized; NR, No Randomized; WLC, Waiting-List Condition; TAU, Treatment As Usual; BC, Brochure Condition; BSQ, Body Shape Questionnaire[48]; EDI, Eating Disorders Inventory (DT, Drive for Thinness; BN, Bulimia; BD, Body Dissatisfaction)[49]; EDE-Q, Eating Disorder Examination-Questionnaire[50]; WCS, Weight and Shape Concern Scale[51]; SATAQ, Sociocultural Attitudes Toward Appearance Questionnaire[52]; PACS, Physical Appearance Comparison Scale[53]; BULIT-R, Bulimia Test-Revised[54]; DRES Dutch Restrained Eating Scale, DEBQ-R, Dutch Eating Behavior Questionnaire-Restraint Subscale[55]; BCS, Body Comparison Scale[56]; EWLB, Extreme Weight Loss Behaviors Scale[57]; EDDS, Eating Disorder Diagnostic Scale[58]; IBSS-R, The Ideal-Body Stereotype Scale-Revised[59]; MBSRQ, Multidimensional Body Self-Relations Questionnaire[60]; BES, Body Esteem Scale[61]; T-FEQ, Three-Factor Eating Questionnaire Symptom Checklist-90-Revised[62]; EDO, Eating Disorders in Obesity[63]; BAT, Body Attitude Test[64]; EAT-40, Eating Attitudes Test[65]; BITE, Bulimic Investigatory Test Edinburgh[66]; SEED, Short Evaluation of Eating Disorders[67]; SDBPS, Satisfaction and Dissatisfaction with Body Parts Scale[68]; EBI, Eating Behaviors Inventory[69]; BDISF, Beck Depression Inventory short form[70]; BDI, Beck Depression Inventory[71]; CES-D, Center for Epidemiologic Studies Depression Scale[72]; BDI-II, Beck Depression Inventory-Second Edition[73]; PANAS-X, Positive Affect and Negative Affect Scale-Revised Form.[74]

[a]Studies identified by Newton and Ciliska.[18]
[b]Studies identified by Beintner et al.[17]
[c]Studies identified by Loucas et al.[19]
[d]Studies identified by Aardoom et al.[11]
[e]Studies identified by Dölemeyer et al.[16]

TABLE 2. Methodological quality in identified studies

Study	Randomization	ITT Analysis	Dropout < 15%	Score
Winzelberg et al.[29]	No	No	Yes (13%)	1
Celio et al.[30]	Yes	No	No (23%)	1
Zabinski et al.[31]	Yes	No	Yes (2%)	2
Zabinski et al.[32]	Yes	Yes	Yes (2%)	3
Taylor et al.[20]	Yes	No	No (16%)	1
Low et al.[33]	Yes	Yes	Yes (6%)	3
Paxton et al.[35]	Yes	Yes	No (26%)	2
Heinicke et al.[34]	Yes	Yes	No (22%)	2
Jacobi et al.[36]	Yes	No	Yes (3%)	2
Doyle et al.[37]	Yes	Yes	No (20%)	2
Jones et al.[38]	Yes	Yes	No (17%)	2
Fernández-Aranda et al.[39]	No	No	No (35%)	0
Sánchez-Ortiz et al.[40]	Yes	Yes	No (21%)	**2**
Carrard et al.[41]	Yes	Yes	No (17%)	2
Carrard et al.[42]	No	No	Yes (9%)	1
Fichter et al.[43]	Yes	Yes	Yes (6%)	3
Jacobi et al.[44]	Yes	Yes	No (18%)	**2**
Stice et al.[45]	Yes	No	Yes (2%)	2
Hötzel et al.[46]	Yes	Yes	No (41%)	2
Ruwaard et al.[47]	Yes	Yes	No (26%)	2

Notes: Quality scores range from 0 = high risk of bias to 3 = low risk of bias. ITT = intention to treat.

Study Selection and Data Collection Process

Data were collected by the first author (Fig. 2). The data collection form contained the following items: literature (authors, date, title), program (intervention vs. prevention), participants (N, M_{age}, standard deviation [SD], gender), outcomes, and study design (randomized or non-randomized).

Risk of Bias in Individual Studies

Quality assessment and data extraction were conducted by the first author. All studies screened were published in English.

Data Analysis

Statistical heterogeneity across studies was determined using the Q-test for heterogeneity (substantial heterogeneity when $p < .10$[24]) and the I^2 statistic (unimportant to moderate heterogeneity when $I^2 < 50\%$, and substantial when $I^2 > 50\%$[25]). We calculated summary between-group effect sizes for studies testing the effects of Internet programs against a control group. Potential outliers for each outcome were identified using standardized residuals with 1.96 as a cut-off.[26] Between-group effect sizes were interpreted using Cohen's guidelines[27] with 0.20 representing a small effect size, 0.50 a medium effect size, and 0.80 a large effect size. Given the small sample size in some studies, Hedges' g was also calculated for all outcomes as this coefficient provides a better estimation in such cases.[28] Analyses of moderation were conducted to explore the effect of ED symptom severity at baseline (nonclinical/mixed vs. high-risk samples) and data analysis method (intent-to-treat [ITT] vs. completers]. Studies that

TABLE 3. Methodological criterion of intention-to-treat analysis and dropout rates by condition

Study (Reference)	ITT Method	Dropout Internet-Based Program (*n*)	Dropout Control Condition (*n*)
Winzelberg et al.[29]	NA	4	4
Celio et al.[30]	NA	1	3
Zabinski et al.[31]	NA	0	1
Zabinski et al.[32]	BOCF	2	0
Taylor et al.[20]	NA	38	21
Low et al.[33]	BOCF	NA	NA
Paxton et al.[35]	BOCF	13	7
Heinicke et al.[34]	BOCF	28	34
Jacobi et al.[36]	NA	NA	NA
Doyle et al.[37]	BOCF	7	7
Jones et al.[38]	BOCF	8	8
Fernández-Aranda et al.[39]	NA	NA	NA
Sánchez-Ortiz et al.[40]	MEM	8	13
Carrard et al.[41]	MLE	13	4
Carrard et al.[42]	NA	2	2
Fichter et al.[43]	OACD	7	8
Jacobi et al.[44]	MEM	8	3
Stice et al.[45]	NA	2	0
Hötzel et al.[46]	BOCF	54	33
Ruwaard et al.[47]	LOCF	13	4

Notes: ITT = intention to treat; NA: not applicable or not found; MEM: mixed-effects models; BOCF: baseline-observation-carried-forward method; LOCF: last-observation-carried-forward method; MLE: maximum likelihood estimation algorithm; OACD: on available complete data.

included symptomatic individuals were categorized as nonclinical/mixed and studies that included participants with ED diagnoses were classed as high risk. Nonclinical/mixed- and high-risk samples are presented in Table 1 as IBPP (Internet-Based Prevention Program) and IBIP (Internet-Based Intervention Program), respectively.

The analyses were conducted using Comprehensive Meta-Analysis.[26] Effect sizes were calculated with pre- and post-mean and SD information; follow-up data were not used. We calculated overall between-group effect sizes for outcomes assessing symptoms or risk factors of EDs: body dissatisfaction,[48,49,68] thin-ideal internalization,[52,59] shape and weight concern,[50,51,61,69] dietary restriction,[50,55] drive for thinness,[49] bulimic symptoms and purging frequency,[49,50,54,75] and negative affect.[70–74] A random effects model was used to calculate between-group effect size. Moderator analyses were conducted by calculating effect sizes within each group (without pooling within-group estimates of heterogeneity) and effect sizes were then compared.

Results

Study Selection and Study Characteristics

The search strategy led to an initial pool of 590 articles of which 20 were eligible and included (**Table 1**). Study sample sizes ranged from 28 to 391 and mean age was 23.33 years (SD = 7.13). Among the 20 identified studies, 4 were categorized as IBIP and 16 as IBPP. Seventeen of the 20 studies were randomized controlled studies. Among the 20 studies identified, 19 were based on cognitive-behavioral therapy principles (e.g., associations between thoughts, feelings, and behaviors) and 1 study[46] was based on motivational interviewing (i.e., motivational enhancement therapy). A flow diagram with reasons for exclusions is displayed in **Figure 2**.

Study Quality and Risk of Bias

The Cochrane collaboration's risk of bias tool was adapted to identify risk of bias.[25] Thus, three criteria were used to assess study quality and risk of bias: (1) "sequence generation" through randomization; (2) "incomplete outcome data" through ITT analysis; and (3) "other bias" through dropout rates. Among the 20 identified studies, 17 included randomization, 12 were based on ITT, and 8 had a dropout rate below 15% (dropout rates varied between 2% and 41%). The methodological quality of included studies is summarized in **Table 2**. Studies were assessed according to each of the three criteria, and a score of 1 was attributed when the study presented methodological strengths (randomization, ITT, or dropout rate-$< 15\%$). Thus, total study quality scores ranged from 0 (presence of the three sources of bias) to 3 (high quality, absence of bias). The methodological criteria of ITT and dropout rates by condition are displayed in **Table 3**. Among the 20 controlled studies identified, 12 conducted ITT analyses. Five methods of ITT analyses were identified: "baseline-observation-carried-forward method" (BOCF; $n = 7$), "last-observation-carried-forward method" (LOCF; $n = 1$), "maximum likelihood estimation algorithm method" (MLE; $n = 1$), "on available complete data method" (OACD; $n = 1$), and "mixed-effects models" (MEM; $n = 2$).

Results of Individual Studies and Synthesis of Results

Body Dissatisfaction. Among the 20 controlled studies, 12 studies included a measure of body dissatisfaction (**Fig. 3**). None of the 12 studies emerged as outliers, and heterogeneity was unimportant ($Q = 7.71$, $p = .74$, $I^2 = 0\%$). The summary effect size was $d = 0.28$, 95% CI [0.15–0.41], $p < .001$, revealing a small but significant overall effect ($g = .28$, 95% CI [0.15–0.41], $p < .001$). When comparing ITT ($n = 6$) versus completers ($n = 6$), the moderation analysis revealed no significant

FIGURE 3. Body dissatisfaction, drive for thinness, and internalization of the thin ideal.

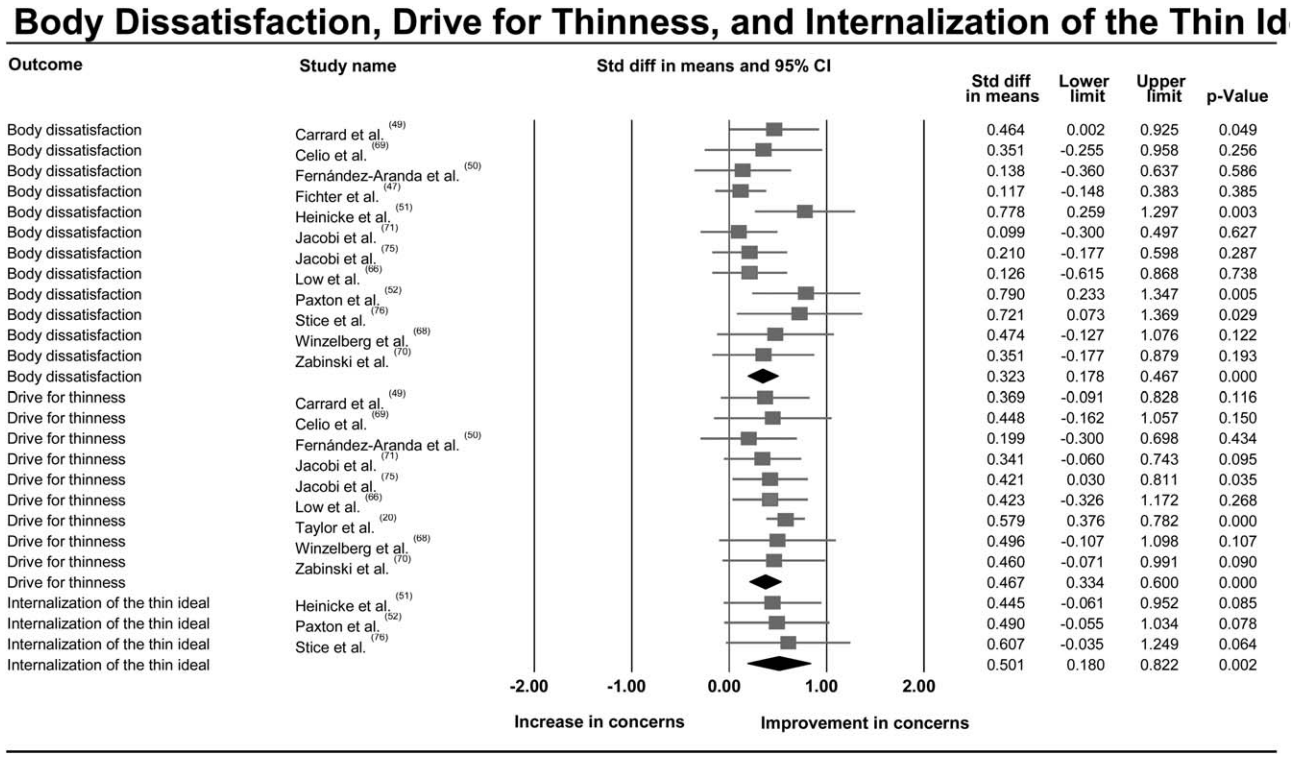


FIGURE 4. Shape and weight concerns.

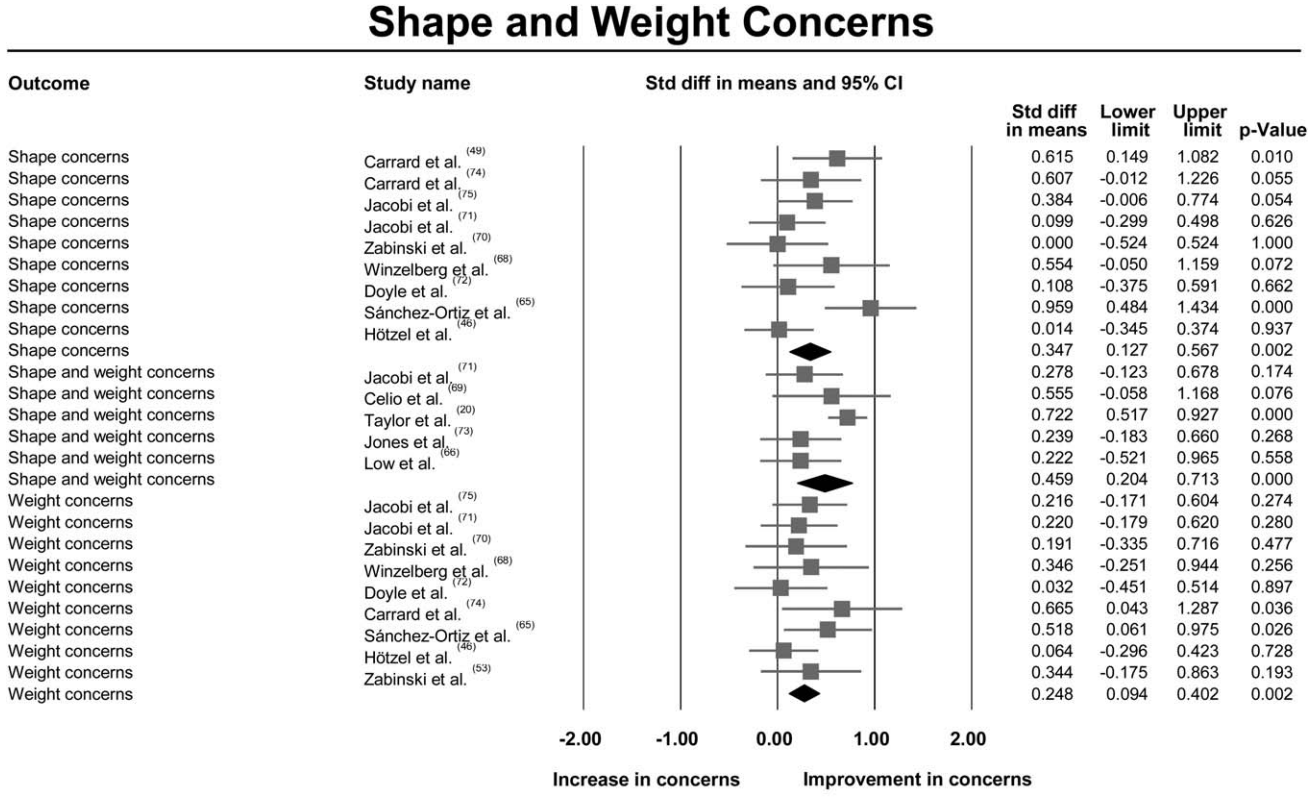
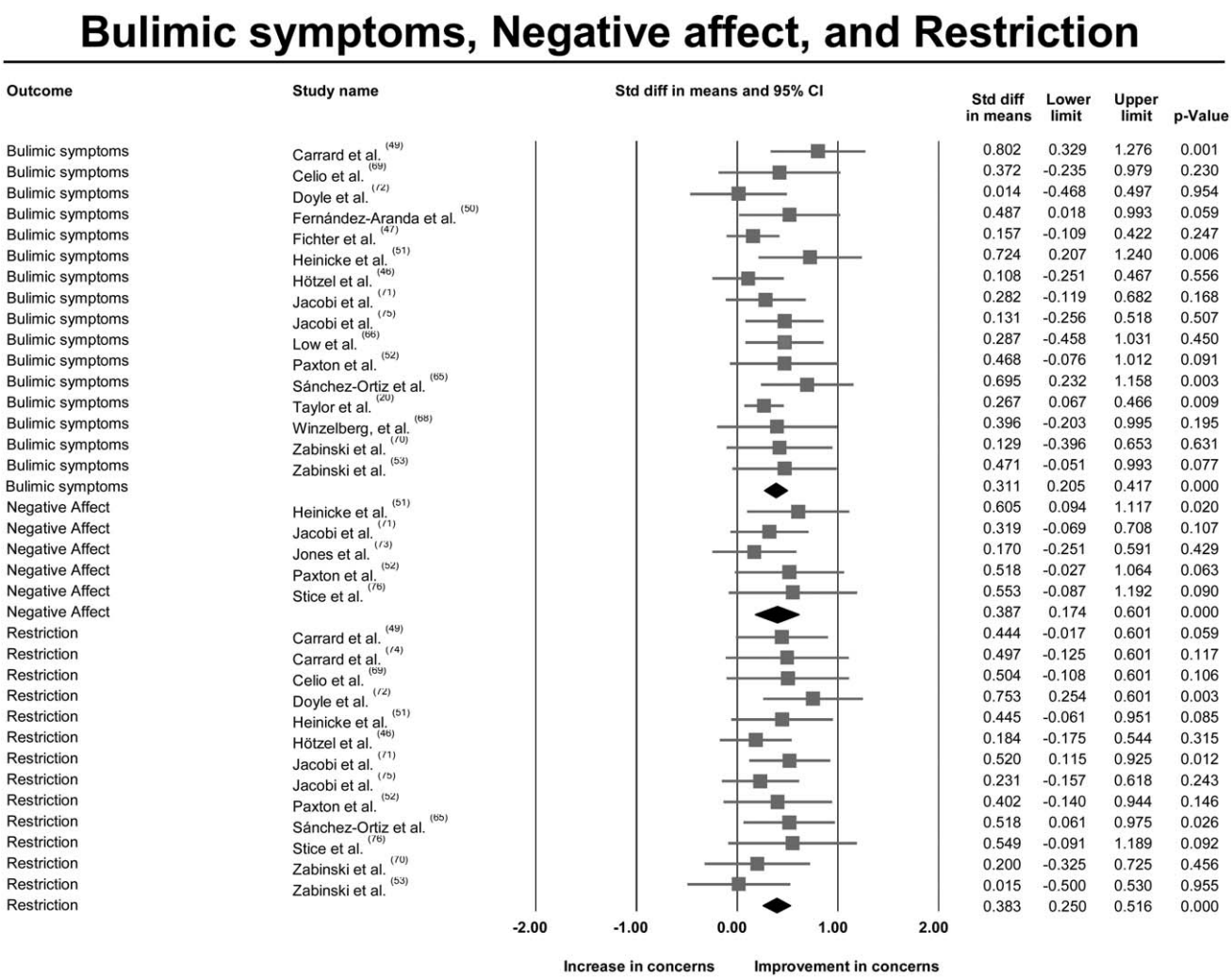


FIGURE 5. Bulimic symptoms, negative affect, and restriction.

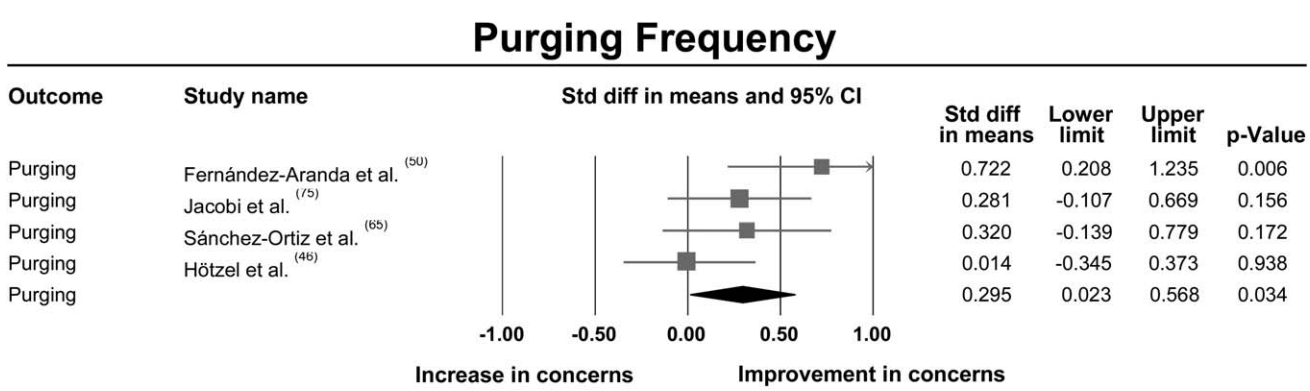


differences in the summary effect, $p = .89$. Similarly, when comparing high-risk ($n = 2$) versus nonclinical/mixed ($n = 10$) participants, the moderation analysis revealed no significant differences in the summary effect size, $p = .85$.

Drive for Thinness. Ten studies included a measure of drive for thinness (**Fig. 3**). One study[43] emerged as an outlier with a standardized residuals value of -2.19 (>1.96) and was removed from this analysis. Tests of homogeneity showed an unimportant heterogeneity across the nine remaining studies ($Q = 2.91$, $p = .94$, $I^2 = 0\%$). The summary effect size was $d = 0.47$, 95% CI [0.33–0.60], $p < .001$, indicating a significant small effect on drive for thinness ($g = .46$, 95% CI [0.33–0.60], $p < .001$). When comparing ITT ($n = 3$) versus completers ($n = 6$), a moderation analysis revealed no significant differences in the summary effect size, $p = .60$. Similarly, when comparing high-risk ($n = 2$) versus nonclinical/mixed ($n = 7$) participants, the moderation analysis revealed no significant differences in the summary effect size, $p = .27$.

Internalization of the Thin Ideal. Three studies provided effect sizes for internalization of the thin ideal, and none emerged as outliers (**Fig. 3**). Tests of homogeneity showed an unimportant heterogeneity ($Q = .73$, $p = .70$, $I^2 = 0\%$). The summary effect size was $d = 0.36$, 95% CI [0.07–0.65], $p < .05$, revealing a moderate positive effect on internalization of the thin ideal ($g = .36$, 95% CI [0.07–0.64], $p < .05$). As the three studies aimed to prevent ED using data from completers, no moderation analyses were conducted.

FIGURE 6. Purging frequency.



Shape and Weight Concern. Nine studies provided effect sizes for shape concern, and none were outliers (**Fig. 4**). Substantial heterogeneity emerged for the shape concern outcome ($Q = 15.93$, $p < .05$, $I^2 = 50\%$). The summary effect was $d = 0.35$, 95% CI [0.13–0.57], $p < .05$, revealing a significant effect on shape concern ($g = .34$, 95% CI [0.13–0.56], $p < .05$). When comparing ITT ($n = 5$) versus completers ($n = 4$), a moderation analysis revealed no significant differences in the summary effect size, $p = .52$. When comparing high ($n = 3$) versus nonclinical/mixed ($n = 6$) participants, the moderation analysis revealed that the summary effect size for high-risk participants ($d = 0.74$, 95% CI [0.45–1.04], $p < .001$; $g = .73$, 95% CI [0.44–1.02], $p < .001$) was significantly larger than for nonclinical/mixed participants ($d = 0.17$, 95% CI [−0.01 to 0.35], $p = .066$; $g = .17$, 95% CI [−0.01 to .34], $p = .066$), $Q = 10.68$, $p < .05$.

Nine of the studies provided effect sizes for weight concern, with no outliers. Tests of homogeneity revealed unimportant heterogeneity ($Q = 5.13$, $p = .74$, $I^2 = 0\%$) with a summary effect size of $d = 0.25$, 95% CI [0.09–0.40], $p < .05$, revealing a small significant effect on weight concern ($g = .25$, 95% CI [0.09–0.40], $p < .05$). When comparing ITT ($n = 5$) versus completers ($n = 4$), the moderation analysis revealed no significant differences in the summary effect size, $p = .54$. When comparing high ($n = 2$) versus nonclinical/mixed ($n = 7$) participants, the moderation analysis revealed no significant differences in the summary effect size, $p = .06$.

Five studies included combined measures of shape and weight concern, with no outliers. Moderate heterogeneity was found ($Q = 9.19$, $p = .056$, $I^2 = 47\%$). The summary effect size was $d = 0.42$, 95% CI [0.13–0.71], $p < .05$, indicating a moderate significant effect on shape and weight concern ($g = .42$, 95% CI [0.13–0.70], $p < .05$). When comparing ITT ($n = 2$) versus completers ($n = 3$), a moderation analysis revealed no significant differences in the summary effect size, $p = .09$. As the five studies aimed to prevent ED, no comparison was made with high-risk participants.

Dietary Restriction. Thirteen studies included a measure of dietary restriction, with no outliers (**Fig. 5**). Tests of homogeneity revealed an unimportant heterogeneity ($Q = 7.96$, $p = .79$, $I^2 = 0\%$). The summary effect size for dietary restriction was $d = 0.36$, 95% CI [0.23–0.49], $p < .001$, revealing a small overall effect ($g = .36$, 95% CI [0.23–0.49], $p < .001$). When comparing ITT ($n = 8$) versus completers ($n = 5$), a moderation analysis revealed no significant differences in the summary effect size, $p = .38$. Similarly, when comparing high-risk ($n = 3$) versus nonclinical/mixed ($n = 10$) participants, a moderation analysis revealed no significant differences in the summary effect size, $p = .34$.

Bulimic Symptoms and Purging Frequency. Eighteen studies provided a measure for bulimic symptoms (**Figs. 5** and **6**). Two studies[42,47] emerged as outliers and were removed from this analysis (standardized residuals value of 3.95 and 2.02, respectively). Tests of homogeneity revealed an unimportant heterogeneity ($Q = 9.24$, $p = .87$, $I^2 = 0\%$). The overall effect size was $d = 0.27$, 95% CI [0.17–0.37], $p < .001$, revealing a small but significant effect on bulimic symptoms ($g = .26$, 95% CI [0.16–0.36], $p < .001$). When comparing ITT ($n = 9$) versus completers ($n = 7$), a moderation analysis revealed no significant differences in the summary effect size, $p = .72$. Similarly, when comparing high-risk ($n = 3$) versus nonclinical/mixed ($n = 13$) participants, the moderation analysis revealed no significant differences in the summary effect size, $p = .11$. Five studies provided a measure for purging frequency. One study[47] emerged as an outlier and was removed

(standardized residuals value of 3.79). Tests of homogeneity revealed a moderate heterogeneity ($Q = 4.97$, $p = .17$, $I^2 = 40\%$). The summary effect size for the remaining four studies was $d = 0.30$, 95% CI [0.02–0.57], $p < .05$, indicating an overall significant small effect on purging frequency ($g = .29$, 95% CI [0.02–0.56], $p < .05$). When comparing ITT ($n = 3$) versus completers ($n = 1$), a moderation analysis revealed no significant differences in the summary effect size, $p = .06$. When comparing high-risk ($n = 2$) versus nonclinical/mixed ($n = 2$) participants, the moderation analysis revealed no significant difference in the summary effect sizes, $p = .13$.

Negative Affect. Five studies provided a measure for negative affect with no outliers (**Fig. 5**). Tests of homogeneity revealed an unimportant heterogeneity ($Q = .916$, $p = .92$, $I^2 = 0\%$). The summary effect size for the remaining five studies was $d = 0.32$, 95% CI [0.12–0.52], $p < .05$, indicating an overall significant small effect on negative affect ($g = .32$, 95% CI [0.12–0.52], $p < .05$). As the five studies aimed to prevent ED using data from completers, no moderation analyses were conducted.

Between-group effect sizes were also calculated for all outcomes by excluding studies in which a wait list condition (WLC) control group was not reported (control group with minimal intervention such as a brochure were removed from this analysis). The summary effect sizes of studies exclusively including a WLC group were not significantly different from the effect sizes calculated for studies including a WLC or another type of control group (i.e., minimal intervention).

Discussion

The primary aim of this meta-analysis was to evaluate the efficacy of Internet-based selective prevention and intervention programs for EDs, so as to bridge the gap in meta-analytic reviews of the success of Internet-based programs targeting ED symptoms along a continuum of severity. Findings indicated that Internet-based programs were successful in decreasing ED symptomatology, suggesting that efforts to move the field toward implementing effectiveness trials are warranted. The secondary aim was to identify variables that moderated the efficacy of ED Internet-based programs. Overall, no differences in effects were found between interventions conducted in populations that included individuals with clinical diagnoses compared to those with "symptoms" only (except for shape concern) or between ITT or completers analyses, suggesting that these variables might not account for the efficacy of ED Internet-based programs.

Compared with previous meta-analyses, the current study provides an up-to-date more inclusive review, including five studies[32,34,35,39,42] that were not present in the previous 2014 meta-analysis,[19] and by excluding programs delivered by CD-Rom. Furthermore, by excluding universal prevention studies and controlled studies between two active conditions, in contrast to the latest meta-analysis,[19] our study provides summary effects of the reduction in existing ED symptoms through Internet-based programs. Finally, our study makes an important original contribution by including moderation analyses, and thus bridging a gap in the literature.

Regarding the efficacy of ED Internet-based programs, consistent with previous research,[17] small to moderate effect sizes were found for decreases in internalization of the thin ideal, shape and weight concern, body dissatisfaction, bulimic symptoms and purging behaviors, dietary restriction, negative affect, and drive for thinness. In addition, it is important to note that there was no evidence of negative effects. Although previous meta-analyses have reported contradictory findings regarding the efficacy of IBPPs,[17–19] our results are consistent in supporting their efficacy.

To date, little is known regarding moderator variables of the efficacy of Internet-based programs. Our moderator analyses revealed no significant differences between nonclinical/mixed and high-risk participants on all outcomes excepted for shape concern; a larger decrease was found among the high-risk sample. The extant literature indicated that face-to-face selected prevention produced larger decrease than universal programs for most of the outcomes, and that level of eating pathology may influence engagement and intervention effects.[7] The current study suggests that Internet-based programs might be equally effective for most outcomes among nonclinical/mixed and high-risk participants. Therefore, intervention effects might depend on other variables. Regarding data analysis methodology, no difference was found in program efficacy between ITT and completer analyses. It has been argued that ITT analyses might decrease the attrition biases associated with dropout in randomized trials, and, therefore, limit bias in estimates of intervention effects.[76] Internet programs have high dropout rates[16] suggesting that intervention effects might differ depending on data analytic strategy (i.e., ITT and completer analyses). Nevertheless, the current meta-analysis suggests that completer analyses produce similar intervention effects as compared with ITT analyses.

Given the advantages of Internet-based programs, evaluating their efficacy compared with face-to-face ED programs is of particular interest. Although this was not tested in the present study, a recent meta-analysis comparing the efficacy of face-to-face and Internet CBT on psychiatric and somatic diseases concluded that both formats might be similarly efficacious.[77] Clearly, more research in this area, including non-inferiority or equivalence studies, is warranted. Our results showed a wide range of dropout rates. As study design, implementation, guidance (e.g., self-help guided by a therapist), and intervention duration might explain dropout rates,[78] further exploration of these variables as potential moderators of programs engagement is an important area for future research.[17,79]

Internet-based programs present numerous advantages over face-to-face ones, thus our encouraging findings highlight the importance of further implementing and disseminating these programs and extending their applications within treatment and prevention settings. For example, the Internet could offer many opportunities for aftercare interventions,[80] symptom-monitoring via cell phones,[81] or family-based programs.[82] The Internet might also provide training opportunities for carers of individuals suffering from EDs.[83–85] Moreover, as most studies have focused on interventions for bulimia or binge ED, studies evaluating Internet-based interventions for anorexia nervosa are needed.[39,40,86]

Our study presents a number of limitations. First, it does not provide evidence for the long-term efficacy of Internet-based programs. In addition, the lack of consensus across the literature regarding the definition of selective prevention might have led to studies being classified as one category in the present study, but another in a different meta-analysis, depending on the definition used. Furthermore, regarding methodological quality, studies reporting a low dropout rate were considered to present a low risk of bias, which could be considered as biased against studies with high ecological validity (e.g., when assessment and intervention occur entirely on-line). Nevertheless, Internet-based programs have been found to successfully decrease ED-related symptoms and risk factors. These findings highlight the importance of moving toward large-scale effectiveness trials as there is little data in this area.[29,33,87] In the current study, risk status (high and low) and data analytic strategy (ITT or completer) were no moderator variables of intervention effects. Future research should thus address other moderator variables such as program interactivity, guidance frequency, and participant age.

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