Difficulties with emotion regulation and weight/shape concerns as predictors of eating disorder behaviors among adolescents

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38 **Data availability Statement:**

39 Deidentified data are available upon request from the senior author (D.M.), pertaining to

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42 **Authors' contributions:**

43 **Nora Trompeter:** Conceptualization, Formal analysis, Investigation, Writing - Original

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51   Supervision, Project administration, Funding acquisition.

Abstract

Background: Difficulties with emotion regulation are a proposed key transdiagnostic factor of mental health difficulties, including eating disorders. However, it remains unclear whether difficulties with emotion regulation prospectively predict engagement in eating disorder behaviors. The current study examined whether difficulties with emotion regulation were associated with eating disorder behaviors after one year, in addition to weight and shape concerns. **Methods:** A community sample of high school students ($n = 3074$; 53.2% girls) completed self-report measures of eating behaviors, weight/shape concerns, and difficulties with emotion regulation at two timepoints, one year apart. **Results:** Findings indicated that greater difficulties with emotion regulation were uniquely associated with engaging in binge eating, fasting, and purging after one year. However, only greater weight and shape concerns, not difficulties with emotion regulation, were uniquely associated with engaging in driven exercise. Limited associations were detected for frequency of eating disorder behaviors. Additionally, exploratory analyses were conducted to examine potential onset and persistence of eating disorder behaviors. Few gender differences were observed across analyses, with the exception of driven exercise, which was linked to difficulties with emotion regulation only among adolescent boys, but not girls. **Conclusions:** Findings suggest that difficulties with emotion regulation are a distinct factor in the occurrence of some eating disorder behaviors among adolescents. Exploratory findings further suggest that difficulties with emotion regulation appear to be particularly involved in the persistence of these behaviors in adolescents.

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General Scientific Summary:

Difficulties with emotion regulation are a key correlate for eating disorders. The current study

supports emerging literature positioning difficulties with emotion regulation as a risk and

maintenance factor for some eating disorder behaviors among adolescents.

84

85 **Difficulties with emotion regulation and weight/shape concerns as predictors of**

86 **eating disorder behaviors among adolescents**

87   Eating disorders are characterized by disturbances in body image perception and

88 eating behaviors (American Psychiatric Association, 2013), and are associated with

89 heightened mortality, psychiatric and physical comorbidity, and quality of life impairment

90 (Ágh et al., 2016; Arcelus et al., 2011; Rojo-Moreno et al., 2015). Eating disorders typically

91 develop during adolescence, making this period critical for early intervention efforts (Hudson

92 et al., 2007; Nagl et al., 2016). Effective early intervention is predicated on robust knowledge

93 of risk factors and their prospective relationship with eating disorder symptoms. One risk

94 factor proposed in the onset of eating disorders is difficulties with emotion regulation (Aldao

95 et al., 2010; Haynos & Fruzzetti, 2011; Leehr et al., 2015; Trompeter et al., 2021).

96 Difficulties with emotion regulation refer to difficulties with emotional experiences, resulting

97 in emotional responses that are poorly regulated. For example, this includes difficulties with

98 identifying emotions and selecting appropriate regulatory strategies (Gratz & Roemer, 2008;

99 Keenan, 2000). The current study examines the unique prospective relationship between

100 difficulties with emotion regulation, in addition to weight/shape concerns, with eating

101 disorder behaviors in adolescents.

102   Theoretical models of eating pathology posit that both difficulties with emotion

103 regulation and weight/shape concerns are associated with eating disorder behaviors (Fairburn

104 et al., 2003). Specifically, the cognitive behavioral therapy transdiagnostic model of eating

105 disorders ("CBT-E model") – arguably the most widely used and supported theoretical model

106 of eating disorders (Dakanalis et al., 2014; Hay et al., 2014; Linardon et al., 2017) – proposes

107 that weight/shape concerns are at the core of eating disorder pathology. Additionally, the

108 model proposes that difficulties with emotion regulation are an additional maintenance factor

109 that is specifically linked to binge eating and purging (but not dietary restraint or driven

110　exercise). However, cross-sectional research examining this model suggests that difficulties

111　with emotion regulation are associated with all facets of eating disorder behaviors outlined in

112　the theory, including dietary restraint and driven exercise (Dakanalis et al., 2014; Jones et al.,

113　2020). While the CBT-E model is a maintenance model focused on persistence of eating

114　disorder symptoms, it also recognizes that other factors may be involved in symptom

115　development. Indeed, weight/shape concerns are one of the most established risk factors for

116　eating pathology across different theoretical models (Pennesi & Wade, 2016). Therefore, the

117　transdiagnostic model may require consideration of the role of difficulties with emotion

118　regulation in both the development and maintenance of eating disorder symptoms.

119　　　Our previous research showed that both difficulties with emotion regulation and

120　weight/shape concerns were uniquely related with eating disorder behaviors among

121　adolescents (Trompeter et al., 2022). That study, as well as the current study, distinguished

122　between the frequency of an eating disorder behavior (i.e., how often a person engaged in the

123　behavior) and the likelihood of an eating disorder behavior (i.e., the likelihood of someone

124　engaging in the behavior at any frequency vs not engaging in the behavior at all). Findings

125　showed that difficulties with emotion regulation were associated with higher

126　frequency/likelihood binge eating and purging, as proposed in the CBT-E model. However,

127　regarding fasting, it was the frequency of this behavior rather than its probability that was

128　positively related to severity of difficulties with emotion regulation. Thus, there may be a

129　difference between the role of difficulties with emotion regulation in the likelihood of eating

130　disorder behaviors vs their frequency – and this may map onto development vs maintenance.

131　However, this research was limited to cross-sectional data and longitudinal data are required

132　to determine the time-ordering of effects.

133　　　Few studies have examined the longitudinal relationship between difficulties with

134　emotion regulation and eating pathology (McClure et al., 2022; McLaughlin et al., 2011).

135   One of these studies found that among adolescents, difficulties with emotion regulation

136   predicted subsequent increases in eating disorder pathology after 7 months (McLaughlin et

137   al., 2009). Interestingly, the study showed that eating disorder pathology did not predict

138   subsequent difficulties with emotion regulation. While these findings suggested that

139   difficulties with emotion regulation preceded eating disorder symptoms, the study was

140   limited due to the use of a global eating pathology measure. As such, the authors were unable

141   to draw conclusions about the unique relationships with the array of specific and differing

142   eating disorder behaviors and weight/shape concerns. This distinction is important when

143   considering the development of eating disorders, as weight/shape concerns typically emerge

144   prior to eating disorder behaviors (Rodgers et al., 2014) and are a key risk factor for the

145   development of eating disorder behaviors (Stice et al., 2021). Other longitudinal research

146   examining specific eating disorder behaviors found that high levels of emotion regulation at

147   age 15 predicted lower dietary restraint at age 16 (Shriver et al., 2019), and that maladaptive

148   emotion regulation predicted increases in bulimic symptoms over four years among

149   adolescents (Nolen-Hoeksema et al., 2007). Additionally, among young adult women,

150   McClure et al (2022) found that difficulties with emotion regulation predicted both the onset

151   and persistence of binge eating and compensatory behaviors (purging and driven exercise)

152   after 8 months. However, none of these studies adjusted for weight/shape concerns to

153   examine whether difficulties with emotion regulation were a unique predictor of eating

154   disorder behaviors. Given the central role of weight/shape concerns in predicting eating

155   disorder behaviors, it is unclear from this research whether difficulties with emotion

156   regulation are merely co-occurring alongside weight/shape concerns or add additional risk to

157   the development or maintenance of eating disorder behaviors. Whilst the CBT-E model

158   includes both weight/shape concerns and difficulties with emotion regulation as key factors

159   that contribute to eating disorder behaviors, the model does not describe the relationship

160   between these constructs or theorize their relative importance in the occurrence of eating

161   disorder behaviors.

162   Further, to facilitate effective early intervention for eating disorder symptoms, it is

163   important to examine potential gender differences in these associations. While girls tend to

164   report higher levels of eating disorder behaviors compared to boys, evidence suggests that the

165   impact of these behaviors does not differ across genders (Bentley et al., 2015). Similarly,

166   studies have consistently reported greater difficulties with emotion regulation among

167   adolescent girls compared to boys (Neumann et al., 2010). Further, lower emotion-focused

168   coping has been linked to higher emotional distress in adolescent girls, but not boys (Hampel

169   & Petermann, 2006). Some developmental theories suggest that this gender difference could

170   be accounted for by differential reactions to interpersonal stress (Rudolph, 2002).

171   Accordingly, as girls experience higher levels of interpersonal stress compared to boys, this

172   may lead to higher overall levels of distress and associated difficulties for girls compared to

173   boys. Additionally, some aspects of difficulties with emotion regulation have notable gender

174   differences in socialization (Garside & Klimes-Dougan, 2002; Nolen-Hoeksema, 2012). For

175   example, women are generally more emotionally expressive than men (Fischer & LaFrance,

176   2014), and men have more difficulty identifying emotions compared to women (Levant et al.,

177   2009). Thus far there has been little research examining potential gender differences in the

178   relationship between difficulties with emotion regulation and eating disorder behaviors,

179   especially among adolescents. Research among adults found no evidence that the relationship

180   between difficulties with emotion regulation and disordered eating differs by gender (Horvath

181   et al., 2020). However, existing prevention programs tend to be more effective in reducing

182   eating disorder symptoms among adolescent girls, compared to boys (Chua et al., 2020; Zuair

183   & Sopory, 2022). Thus, research examining potential targets for early intervention, such as

184   difficulties with emotion regulation, should consider gender differences to help resolve these

185   conflicting findings.

186   To address these gaps, the current study examined whether difficulties with emotion

187   regulation predict the occurrence and frequency of disordered eating behaviors (i.e., fasting,

188   binge eating, purging, and driven exercise, each assessed separately). Specifically, we

189   hypothesized that difficulties with emotion regulation would predict the occurrence and

190   frequency of all eating disorder behaviors. Lastly, we wanted to examine whether these

191   associations differed between male and female adolescents. No *a-priori* hypotheses were

192   made regarding potential gender differences, as no study to date has investigated potential

193   gendered effects in these relationships.

194   **Methods**

195   **Participants and procedure**

196   This study used longitudinal data from the second (T1) and third waves (T2) of the

197   EveryBODY study, a large longitudinal project investigating body image and eating disorders

198   among Australian adolescents. These waves were selected because no data on difficulties

199   with emotion regulation were available at wave one of the project. The project is a school-

200   based survey among high school students, whereby all students in years 7-12 (ages 11-19)

201   were invited to participate in the yearly survey (see Trompeter et al., 2018 for full study

202   methodology). At the baseline survey, around 70% of enrolled students completed the study.

203   Additionally, students who participated previously and had left school, were invited to

204   participate in the online survey again. Participants who had left school were offered an

205   incentive of a $10 gift card ($20 at wave three) or the chance to go into a gift card draw (1 of

206    $100 gift cards). Participants at school were offered the chance to go into the draw for the gift

207   card as well. While all schools were retained from wave two to three, drop-out was expected

208   with students changing schools, leaving school and absenteeism on the day of the survey. In

209   total, 3198 students participated at T1, of which 1926 students participated again (60%

210   retention rate).

211   Participants came from four independent schools and four government schools. These

212   varied in terms of socio-economic status (SES) to provide a representative sample of the

213   Australian adolescent population. The Index of Community Socio-Educational Advantage

214   (ICSEA) is a standardized ($M = 1000$, $SD = 100$) measure of educational advantage provided

215   to each school and based on parental occupation and education, geographic location and

216   proportion of Indigenous enrolments. ICSEA scores of schools in the overall sample of the

217   second wave of the EveryBODY study ranged from 915 to 1134 ($M = 1057.38$, $SD = 62.24$),

218   indicating that schools were within the average range of SES. Participants who participated at

219   T1 were included in analyses, regardless of whether they participated again at T2.

220   Additionally, 101 participants were excluded due to non-serious responses at T1—as

221   indicated by bogus or inappropriate responses to open-ended question (e.g., entering "the

222   moon" as their country of birth; $n = 68$), non-serious responses at T2 ($n = 21$), and high

223   amounts of missing data (less than 10% complete) at T2 ($n = 12$). Due to the focus on male

224   and female adolescents in the current study, 15 non-binary participants and 8 participants

225   with missing data on their gender at T1 were excluded. The final sample ($n = 3074$) included

226   1440 boys (46.8%) and 1635 girls (53.2%) with a mean age of 14 years and 5 months ($SD = 1$

227   year and 3 months) at T1. Most participants were born in Australia (82.9%), followed by Asia

228   (11.9%). 5.7% of participants identified as Aboriginal and/or Torres Strait Islander. This is in

229   line with the national average of young people in Australia (Australian Institute of Health and

230   Welfare, 2021).

231   **Measures**

232   **Difficulties with emotion regulation.** To assess participant's difficulties with

233 emotion regulation the Difficulties in Emotion Regulation Scale – Short Form (DERS-SF)

234 was used (Kaufman et al., 2016). This measure is a short form of the original Difficulties in

235 Emotion Regulation Scale (Gratz & Roemer, 2008), a widely used measure of difficulties

236 with emotion regulation. In line with the original scale, the measure examines six factors:

237 non-acceptance of emotional responses, difficulties engaging in goal-directed responses,

238 impulse control difficulties, lack of emotional awareness, lack of emotion regulation

239 strategies and lack of emotional clarity. A total score measuring participant's difficulties with

240 emotion regulation was obtained by a mean score of all items, whereby higher scores indicate

241 greater difficulties in emotion regulation. Previous research has shown the DERS-SF to be

242 both valid and reliable among adolescents (Kaufman et al., 2016). The scale showed good

243 internal consistency in the current study for boys (Cronbach's α = .88; McDonald's ω = .90),

244 and girls (Cronbach's α = .92; McDonald's ω = .93).

245   **Weight/Shape Concerns.** Participants' weight/shape concerns were assessed using

246 the combined weight and shape concerns subscale of the eating disorder examination

247 questionnaire (EDE-Q; (Fairburn et al., 2008). The measure comprises 12 items assessing

248 eating disorder related body image concerns over the previous 28 days and asks participants

249 to rate the frequency/severity of their weight and shape concerns (e.g., *How dissatisfied have*

250 *you been with your shape?*) on a 7-point Likert scale (0 = *No days/Not at all* to 6 =

251 *Everyday/Markedly*). Items on the combined subscales are averaged to provide a mean score,

252 whereby higher scores indicate higher severity. The subscale has shown good reliability

253 among Australian adolescent boys and girls (Bentley et al., 2015; Gall et al., 2016). The scale

254 showed excellent internal consistency in the current study for boys (Cronbach's α = .94;

255 McDonald's ω = .93), and girls (Cronbach's α = .96; McDonald's ω = .96).

256   **Disordered eating.** To examine participants' disordered eating, the behavioral

257   frequency items from the eating disorder examination questionnaire (EDE-Q; Fairburn et al.,

258   2008) were used to obtain a frequency score for fasting, binge eating, purging (vomiting and

259   laxative use), and driven exercise. Participants were asked the number of times they had

260   engaged in binge eating, purging (self-induced vomiting and laxative use), and driven

261   exercise episodes over the past 28 day using an open response frequency format. For fasting,

262   participants were asked to provide the number of days over the past 28 days in which they

263   had gone for 8 or more hours without food in order to influence their weight or shape.

264   **Body mass index (BMI).** All participants provided their self-reported height and

265   weight measurements, which were used to determine BMI (weight (kg)/ height (m)^2). BMI

266   percentiles were calculated in line with the CDC guidelines to account for both age and

267   gender (Centers for Disease Control and Prevention, 2017). Previous research has found that

268   self-reported height and weight measurements are strongly correlated with anthropometric

269   measurements in adolescents (Goodman et al., 2000).

270   **Transparency and openness**

271   All analysis code and the pre-registered analysis plan are available at

272   https://osf.io/79ezw/?view_only=17812d27313345a8b3a7ac6fef644fc7. Data were analyzed

273   using Mplus version 8 (Muthén & Muthén, 2018). The analysis plan was preregistered on the

274   Open Science Framework. All deviations from the a priori analytic plan are explicitly

275   described and explained below.

276   **Data analytic plan**

277   Due to drop-out between waves (60% retention rate), there were high levels of

278   missing data. Little's MCAR test indicated that the data were not missing at random: $X^2(214)$

279   = 1364.62, p = <.001). Further analysis of missing data patterns showed that the most

280   common patterns were data missing on all T2 variables, as would be expected with a 60%

281   retention rate. Patterns were comparable between boys and girls. Analyses were conducted in

282   a zero-inflated Poisson regression framework using full information maximum likelihood

283   estimation through a Monte Carlo integration, which uses all available data to estimate model

284   parameters.

285   The zero-inflated Poisson regression uses a mixture of a Poisson distribution of count

286   data with an excess of zero counts. Using this regression, the occurrence of the behavior

287   (zero-inflated part) and the frequency of the behavior accounting for excess zeros (Poisson

288   part) are examined separately in the same model. Using zero-inflated models is recommended

289   for use with highly skewed clinical data, such as eating disorder behavior (Schaumberg et al.,

290   2018). As occasional episodes of eating disorder behaviors were reasonably expected in the

291   community sample, a zero-inflated Poisson regression was deemed more appropriate than a

292   hurdle approach, which assumes a truly dichotomous process (i.e., abstinence of the behavior

293   reflects true non-occurrence).

294   In line with our pre-registration, we adjusted for frequency of behaviors at baseline.

295   However, this approach does not distinguish adolescents who engaged in eating disorders at

296   baseline from those who did not, (i.e., the distinction observed in the outcome variable in a

297   zero-inflated Poisson regression). To examine whether both difficulties with emotion

298   regulation and weight/shape concerns were involved in the onset and/or maintenance of

299   eating disorder behaviors we added additional analyses to examine this. Specifically, we

300   analyzed two separate groups for each behavior: a potential onset group (no instances of the

301   behavior reported at T1) and a persistence group (at least one instance of the behavior

302   reported at T1). In the persistence group we also adjusted for frequency of behaviors at T1 in

303   the Poisson part of the analyses. For all models, multi-group analyses were conducted to test

304   for potential gender differences in each of the regression coefficients to examine whether

305   gender invariance held.

306   While our pre-registered analyses included an interaction between difficulties with

307   emotion regulation and weight/shape concerns, we have since found little evidence for such

308   an interaction in our cross-sectional analyses (Trompeter et al., 2022). Given this and the very

309   large sample required to detect small interaction effects (Blake & Gangestad, 2020), we

310   decided not to pursue such an analysis. For completeness based on our preregistered analytic

311   plan, we report findings from the interaction analyses in Supplementary 1. No interaction

312   terms were significant.

313   Due to the large range of values on the eating disorder behaviors variables, values

314   were winsorized to three standard deviations. To control for multiple comparisons, the

315   Benjamini–Hochberg procedure was used with a paper-wide false discovery rate of .05,

316   resulting in a critical alpha of .033. All analyses adjusted for age and BMI percentile. The

317   potential clustering effect of schools was assessed using mixed model analysis with school as

318   a random factor. The random factor was not significant, thus school was not adjusted for in

319   any analyses.

320   **Results**

321   **Sample characteristics**

322   As can be seen in Table 1, all variables of interest showed relative between-person

323   stability over the two timepoints. About one third of participants reported engaging in binge

324   eating, fasting, and driven exercise respectively, while less than 10% reported purging. For

325   those reporting eating disorder behaviors at T2, around half had also reported the same

326   behavior at T1 (persistence group). One notable exception was purging, were most

327   participants who reported engaging in purging at T2 did not report purging at T1 (onset

328   group).

329

330   Table 1. *Descriptive statistics at both timepoints. Means and standard deviations or*

331   *percentages are presented as appropriate.*

Variables	T1	T2
	M (SD)	
Weight/shape concerns	1.13 (1.46)	1.16 (1.44)
Difficulties with emotion regulation	2.23 (0.75)	2.30 (0.76)
Binge Eating Frequency (past 28 days)	2.62 (5.96)	2.50 (5.90)
Fasting Frequency (past 28 days)	1.51 (4.40)	1.82 (5.82)
Purging Frequency (past 28 days)	0.77 (4.55)	1.05 (7.20)
Driven Exercise Frequency (past 28 days)	2.88 (6.68)	2.61 (6.32)
	N (%)	
Binge Eating Presence (% yes)	1119 (37.3)	659 (36.0)
Onset	-	265 (20.2)
Persistence	-	394 (59.8)
Fasting Presence (% yes)	679 (22.7)	415 (22.7)
Onset	-	211 (50.8)
Persistence	-	204 (49.2)

Purging Presence (% yes)	274 (9.1)	162 (8.9)
Onset	-	104 (64.2)
Persistence	-	58 (35.8)
Driven Exercise Presence (% yes)	937 (31.3)	533 (29.1)
Onset	-	232 (43.5)
Persistence	-	301 (56.5)

Note. Un-winsorized results are reported.

Correlations

Table 2 shows correlations between the study variables to assess within-person stability. All eating disorder behaviors showed small to moderate associations with difficulties with emotion regulation and weight/shape concerns. Additionally, there were moderate correlations within eating disorder behaviors from T1 to T2, indicating moderate within-person stability.

Table 2: Spearman's correlations of study variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. Weight/shape concerns T1	-											
2. Weight/shape concerns T2	.69*	-										
3. Difficulties with emotion regulation T1	.49*	.41*	-									
4. Difficulties with emotion regulation T2	.41*	.49*	.59*	-								
5. Binge eating T1	.29*	.21*	.27*	.18*	-							

	1	2	3	4	5	6	7	8	9	10	11	12
6. Binge eating T2	.23*	.28*	.23*	.22*	.39*	-						
7. Fasting T1	.42*	.32*	.32*	.24*	.30*	.18*	-					
8. Fasting T2	.34*	.42*	.28*	.33*	.15*	.29*	.36*	-				
9. Purging T1	.25*	.16*	.21*	.13*	.27*	.14*	.44*	.18*	-			
10. Purging T2	.23*	.25*	.19*	.23*	.09*	.27*	.24*	.42*	.32*	-		
11. Driven exercise T1	.41*	.31*	.21*	.18*	.24*	.15*	.39*	.25*	.33*	.17*	-	
12. Driven exercise T2	.27*	.38*	.16*	.19*	.12*	.24*	.20*	.36*	.14*	.36*	.36*	-

Note. Benjamini-Hochberg corrected critical value = 0.033. Significant associations are indicated (*). Un-winsorized results are reported.

Planned analysis

For the planned analyses we ran four separate zero-inflated Poisson regression models for each outcome (binge eating, fasting, purging, and driven exercise at T2). Each model included weight/shape concerns, difficulties with emotion regulation, age and BMI percentile at T1 as predictors. Additionally, models adjusted for frequency of the relevant eating disorder behavior at T1. For each model we tested the invariance of the regression models between boys and girls. As relevant, findings are either presented separately for boys and girls or for the whole sample.

Gender differences

No gender differences were observed for the models predicting binge eating ($\chi^2(10) = 10.76$, $p = .376$), fasting ($\chi^2(10) = 15.18$, $p = .126$) or purging ($\chi^2(10) = 7.75$, $p = .654$) at T2. However, differences were observed in the examined associations for driven exercise ($\chi^2(10) = 24.64$, $p = .006$). Results were therefore interpreted for the whole sample for binge eating,

355   fasting, and purging, whereas for driven exercise the results for boys and girls were examined

356   separately. Full results from the regression analyses are shown in Table 3.

357   Table 3. Regression analysis examining probability and frequency of eating disorder
358   behaviors at T2 as predicted by weight/shape concerns and difficulties with emotion
359   regulation at T1 in the total sample.

		Probability of behavior			Frequency of behavior		
		AOR	p-value	95% CI	B	p-value	95% CI
Binge eating	Weight/shape concerns	1.19*	<.001	[1.09, 1.29]	-.01	.874	[-.07, .06]
(N = 3065)	Difficulties with emotion regulation	1.32*	.001	[1.12, 1.56]	.01	.919	[-.16, .17]
Fasting (N = 3065)	Weight/shape concerns	1.30*	<.001	[1.18, 1.43]	.08	.052	[-.01, .16]
	Difficulties with emotion regulation	1.73*	<.001	[1.44, 2.08]	-.02	.851	[-.19, .16]
Purging (N = 3065)	Weight/shape concerns	1.41*	<.001	[1.24, 1.60]	.12	.188	[-.06, .31]
	Difficulties with emotion regulation	1.44*	.004	[1.12, 1.84]	.09	.758	[-.48, -67]
Driven exercise – Boys (N = 1437)	Weight/shape concerns	1.31*	.002	[1.10, 1.55]	-.07	.371	[-.21, .08]
	Difficulties with emotion regulation	1.19	.239	[0.89, 1.57]	.27*	.024	[.04, .49]
Driven exercise – Girls (N = 1628)	Weight/shape concerns	1.31*	<.001	[1.17, 1.48]	.09	.159	[-.03, .20]
	Difficulties with emotion regulation	1.08	.516	[0.86, 1.34]	-.08	.623	[-.39, .23]

360   *Note.* Benjamini-Hochberg corrected critical value = .033. Significant associations are
361   indicated (*). Analysis adjusted for age, BMI percentile, and T1 frequency of eating disorder
362   behaviors. AOR = Adjusted odds ratio

363

364   **Probability of eating disorder behaviors**

365   Findings from the binomial regression showed that both greater weight/shape

366 concerns and greater difficulties with emotion regulation were uniquely associated with an

367 increased likelihood of engaging in binge eating, fasting, and purging at T2 (see Table 3).

368 Only weight/shape concerns, not difficulties with emotion regulation, were associated with an

369 increased likelihood of driven exercise in both boys and girls.

370   **Frequency of eating disorder behaviors**

371   Findings from the Poisson regression showed only one significant association

372 between weight/shape concerns and difficulties with emotion regulation and increased

373 frequency of eating disorder behaviors at T2. That is, greater difficulties with emotion

374 regulation predicted more frequent driven exercise among boys.

375 **Exploratory analysis: Onset group**

376   For the exploratory analyses we wanted to examine whether difficulties with emotion

377 regulation and weight/shape concerns would further predict the onset of eating disorder

378 behaviors. As such we ran four separate zero-inflated Poisson regression models for each

379 outcome (binge eating, fasting, purging, and driven exercise at T2) among the sub-sample

380 that did not endorse any occurrence of the examined behavior at T1. Each model included

381 weight/shape concerns, difficulties with emotion regulation, age and BMI percentile at T1 as

382 predictors. As above, we tested the invariance of the regression models between boys and

383 girls for each model and present findings as relevant.

384   **Gender differences**

385   No gender differences were observed in the regression models predicting binge eating

386 ($\chi^2(8) = 3.77$, $p = .877$), fasting ($\chi^2(8) = 7.23$, $p = .512$), and purging ($\chi^2(8) = 6.69$, $p = .571$)

387 at T2. However, differences were observed for driven exercise ($\chi^2(8) = 20.06$, $p = .010$).

388 Results were therefore interpreted for the whole sample for binge eating fasting and purging,

389   and for boys and girls separately for driven exercise. Full results from the regression models

390   are shown in Table 4.

391   Table 4. Regression analysis examining probability and frequency of eating disorder behavior
392   onset at T2 as predicted by weight/shape concerns and difficulties with emotion regulation at
393   T1, with the subsample of adolescents not reporting eating disorder behaviors at T1.

		Probability of onset			Frequency of behavior		
		AOR	p-value	95% CI	B	p-value	95% CI
Binge eating	Weight/shape concerns	1.25*	<.001	[1.11, 1.41]	.00	.994	[-.12, .12]
(N = 1877)	Difficulties with emotion regulation	1.21	.099	[0.97, 1.51]	.11	.402	[-.15, .37]
Fasting	Weight/shape concerns	1.37*	<.001	[1.21, 1.55]	.08	.136	[-.02, .17]
(N = 2317)	Difficulties with emotion regulation	1.79*	<.001	[1.28, 2.26]	-.01	.911	[-.22, .19]
Purging	Weight/shape concerns	1.33*	<.001	[1.15, 1.53]	.10	.305	[-.09, .29]
(N = 2722)	Difficulties with emotion regulation	1.40*	.015	[1.07, 1.83]	.11	.591	[-.29, .51]
Driven exercise – Boys	Weight/shape concerns	1.31*	.030	[1.03, 1.67]	-.20*	.013	[-.35, -.04]
(N = 1024)	Difficulties with emotion regulation	1.16	.417	[0.81, 1.66]	.45*	<.001	[.24, .66]
Driven exercise – Girls	Weight/shape concerns	1.36*	<.001	[1.15, 1.61]	.09	.280	[-.07, .26]
(N = 1035)	Difficulties with emotion regulation	1.15	.355	[0.86, 1.53]	-.01	.957	[-.42, .40]

394   *Note.* Benjamini-Hochberg corrected critical value = .03. Significant associations are
395   indicated (*). Analysis adjusted for age and BMI percentile. AOR = Adjusted odds ratio

396

397   **Probability of eating disorder behavior onset**

398   Findings from the binomial regression showed that both weight/shape concerns and

399   difficulties with emotion regulation were uniquely associated with an increased likelihood of

400   fasting onset and purging onset by T2. Only weight/shape concerns, not difficulties with

401   emotion regulation, were associated with an increased likelihood of binge eating, and driven

402   exercise onset by T2, in both boys and girls.

403   **Frequency of eating disorder behaviors**

404   Findings from the Poisson regression showed only two significant associations

405   between weight/shape concerns and difficulties with emotion regulation and the frequency of

406   eating disorder behaviors at T2 among adolescents who did not report these eating disorder

407   behaviors at T1. Specifically, greater difficulties with emotion regulation predicted higher

408   frequency of driven exercise among boys following onset of driven exercise at T2.

409   Additionally, lower weight/shape concerns at T1 predicted higher frequency of driven

410   exercise among boys following onset of driven exercise at T2.

411   **Exploratory analysis: Persistence**

412   For the second set of exploratory analyses, we examined whether difficulties with

413   emotion regulation and weight/shape concerns also predicted the persistence of eating

414   disorder behaviors. As such we ran four separate zero-inflated Poisson regression models for

415   each outcome (binge eating, fasting, purging, and driven exercise at T2) among the sub-

416   sample that *did* endorse at least one occurrence of the examined behavior at T1. Each model

417   included weight/shape concerns, difficulties with emotion regulation, age and BMI percentile

418   at T1 as predictors. Additionally, in the Poisson part of the regression model, T1 frequency of

419   the eating disorder behaviors was also included. As above, we tested the invariance of the

420   regression models between boys and girls for each model and present findings as relevant.

421   **Gender differences**

No gender differences were observed for the regression models predicting binge

eating ($\chi^2(9) = 5.39$, $p = .799$), fasting ($\chi^2(9) = 11.24$, $p = .260$), or driven exercise ($\chi^2(9) =$

12.08, $p = .209$) at T2. However, differences were observed for purging ($\chi^2(9) = 33.09$, $p <$

.001). Results were therefore interpreted for the whole sample for binge eating, fasting, and

driven exercise, and for boys and girls separately for purging. Full results from the regression

models are shown in Table 5.

Table 5. Regression analysis examining probability and frequency of eating disorder behavior
persistence at T2, as predicted by weight/shape concerns and difficulties with emotion
regulation at T1, with the subsample of adolescents reporting the eating disorder behavior at
T1.

		Probability of persistence			Frequency of behavior		
		AOR	*p*-value	95% CI	B	*p*-value	95% CI
Binge eating	Weight/shape concerns	1.09	.784	[1.04, 1.28]	-.02	.653	[-.08, .05]
(*N* = 1118)	Difficulties with emotion regulation	1.32*	.032	[1.22, 2.05]	-.03	.784	[-.20, .15]
Fasting	Weight/shape concerns	1.11	.166	[0.96, 1.30]	.07	.203	[-.04, .18]
(*N* = 678)	Difficulties with emotion regulation	1.50*	.008	[1.11, 2.04]	-.02	.882	[-.26, .22]
Purging – Boys	Weight/shape concerns	0.98	.969	[0.41, 2.48]	.95*	.001	[.39, 1.51]
(*N* = 116)	Difficulties with emotion regulation	1.57	.505	[0.42, 5.88]	1.55	.182	[-.73, 3.82]
Purging – Girls	Weight/shape concerns	1.49	.047	[1.01, 2.11]	-.08	.477	[-.30, .14]
(*N* = 157)	Difficulties with emotion regulation	0.96	.901	[0.47, 1.94]	.23	.349	[-.25, .71]
Driven exercise	Weight/shape concerns	1.19*	.008	[1.05, 1.36]	.07	.262	[-.05, .19]

(N = 936)	Difficulties with emotion regulation	1.04	.738	[0.79, 1.36]	-.06	.719	[-.41, .28]

Note. Benjamini-Hochberg corrected critical value = .03. Significant associations are indicated (*). Analysis adjusted for age and BMI percentile. Poisson regression also adjusted for T1 eating disorder behaviors. AOR = Adjusted odds ratio

Probability of eating disorder behavior persistence

Findings from the binomial regression showed that greater difficulties with emotion regulation, but not weight/shape concerns, was uniquely associated with an increased likelihood of binge eating persistence and fasting persistence from T1 to T2 (see Table 5). Only weight/shape concerns, not difficulties with emotion regulation, were associated with greater likelihood of driven exercise persistence. No significant relationships emerged for purging for boys or girls.

Exacerbation of eating disorder behaviors

Findings from the Poisson regression showed only one significant association between weight/shape concerns and difficulties with emotion regulation with increased frequency of eating disorder behaviors. Among boys who persistently engaged in purging, greater weight/shape concerns predicted an exacerbation of their purging from T1 to T2.

Discussion

The current study examined whether both difficulties with emotion regulation and weight/shape concerns were uniquely associated with eating disorder behaviors after one year among adolescents. Findings suggested that both increased difficulties with emotion regulation and weight/shape concerns uniquely predicted the probability of binge eating, fasting, and purging after one year, but only increased weight/shape concerns predicted higher probability of engaging in driven exercise. Similar patterns emerged when examining

455   onset of eating disorder behaviors, whereby fasting and purging onset were both predicted by

456   higher weight/shape concerns and higher difficulties with emotion regulation. However,

457   binge eating onset after one year was associated only with higher pre-morbid weight/shape

458   concerns, but not difficulties with emotion regulation. In contrast, probability of persistence

459   of binge eating and fasting were uniquely predicted by difficulties with emotion regulation,

460   but not weight/shape concerns. These findings suggest that difficulties with emotion

461   regulation may be particularly important in explaining the maintenance of both binge eating

462   and fasting, and additionally the onset of fasting. Interestingly, this pattern was not observed

463   for purging, although, this may in part be due to the low percentage of adolescents who

464   endorsed this behavior, which resulted in small groups of adolescents represented in the

465   onset/persistence groups.

466   Few studies to date have distinguished between the probability of engaging in eating

467   disorder behaviors after a specified time versus the frequency of those eating disorder

468   behaviors over the same time period, with most previous studies examining eating disorder

469   behaviors on a continuum. However, findings from the current study suggest that there are

470   considerable differences in predicting the probability of *any* level of frequency of eating

471   disorder behaviors versus the frequency with which they occur, with findings suggesting that

472   both difficulties with emotion regulation and weight/shape concerns uniquely predict

473   increased probability of any eating disorder behavior, but not their frequency. This may be

474   due to the relatively high stability of eating behaviors over the course of one year observed

475   both in the current study, as well as previous research (Hautala et al., 2008), which makes it

476   difficult to detect factors accounting for behavioral frequency beyond baseline frequency

477   levels.

478   Interestingly, the current study found few unique associations between emotion

479   dysregulation and driven exercise, when accounting for weight/shape concerns. Within the

480   exercise literature, exercise is well-established as a mood regulation tool (see for review

481   Meyer et al., 2011). However, the role of driven exercise in eating pathology is more

482   complicated. Findings from the current study suggest that weight/shape concerns are more

483   likely to determine the propensity of individuals to engage in driven exercise, than difficulties

484   with emotion regulation. This is consistent with the idea that driven exercise, unlike more

485   "healthy" forms of exercise, is inherently linked to eating pathology (Mond et al., 2004,

486   2006).

487   Regarding gender, the current study found that the associations between difficulties

488   with emotion regulation, weight/shape concerns and eating disorder behaviors were mostly

489   similar for boys and girls. However, some differences were evident for purging and driven

490   exercise. Notably, greater difficulties with emotion regulation were linked with increased

491   frequency of driven exercise among boys, but not girls. This may in part be due to differences

492   in gendered appearance ideals. Compared to girls, boys place greater emphasis on being

493   muscular, with many boys striving to obtain a bigger body (Cohane & Pope Jr., 2001), which

494   is primarily achieved through driven body-building exercise. Research among individuals

495   with anorexia nervosa has further found that driven exercise was more prominent in men

496   compared to women, and that men in particular may use exercise to regulate negative

497   emotions (Murray et al., 2014). Further, boys may have been socialized to express their

498   emotions through physical exercise more than girls (Garside & Klimes-Dougan, 2002).

499   However, findings from the current study contrast with findings from Goodwin et al. (2014),

500   who found difficulties with emotion regulation to significantly predict driven exercise in both

501   boys and girls after one year. However, that study did not consider weight/shape concerns,

502   which may have impacted the relationship. Indeed, findings from the current study are in line

503   with our cross-sectional findings whereby greater difficulties with emotion regulation was

504   associated with a higher probability of engaging in driven exercise among boys, but not girls

505   (Trompeter et al., 2022). Thus, difficulties with emotion regulation could be a relevant factor

506   in explaining driven exercise among boys, but not girls. Further research should explore this

507   relationship to determine how difficulties with emotion regulation and driven exercise relate

508   to one another in the context of the CBT-E model.

509   While the current study had numerous strengths, including the longitudinal design,

510   several limitations should also be considered. Firstly, eating disorder behaviors were

511   measured using a single-item frequency measure that only examines behaviors over the

512   previous month. While the EDE-Q is considered a valid and reliable measure among

513   adolescents (Mond et al., 2014), previous studies have shown that adolescents reported fewer

514   incidents of both binge eating and purging in the EDE-Q compared to clinical interviews

515   (Binford et al., 2005; Pretorius et al., 2009). Secondly, while the exploratory analyses in the

516   current study examined eating disorder onset and persistence, these analyses only included

517   two distinct timepoints and did not consider any prior history or fluctuation of eating disorder

518   behaviors. Additionally, to align our findings with the zero-inflated Poisson approach, we

519   used a lenient cut-off of any occurrence of eating disorder behaviors to classify participants

520   into the onset and persistence groups. Future research should consider whether these findings

521   extend to clinically-relevant thresholds of frequency (e.g., at least once per week; American

522   Psychiatric Association, 2013). This may be particularly relevant for driven exercise, which

523   can may be difficult to distinguish from regular non-pathological types of exercise (Mond et

524   al., 2006). Further, the use of a zero-inflated Poisson regression over a hurdle model may

525   have been more appropriate for more common behaviors, like binge eating, but less

526   appropriate for less common behaviors, like purging (Schaumberg et al., 2018). As such,

527   future research should consider additional statistical approaches to further our understanding

528   of these processes. Lastly, the type of statistical analyses used in the current study do not

529   formally disaggregate between- and within-person variance. As such, it is unclear whether

530 changes in both difficulties with emotion regulation and weight/shape concern at the within-

531 person level (i.e., experiencing greater than usual difficulties with emotion regulation and

532 weight/shape concern for oneself) or at the between-person level (i.e., experiencing greater

533 than average difficulties with emotion regulation and weight/shape concerns compared to

534 peers), or whether both are linked to prospective eating disorder behaviors.

535 Despite these limitations, the current study has important clinical implications. In

536 particular, findings provide additional evidence regarding the prospective relationship

537 between difficulties with emotion regulation and eating disorder behaviors. Results suggest

538 that difficulties with emotion regulation do not merely co-occur with weight/shape concerns,

539 but place adolescents at additional increased risk for engaging in future eating disorder

540 behaviors. Interestingly, difficulties with emotion regulation appeared to be particularly

541 relevant for the persistence of binge eating and fasting. These findings provide further

542 evidence for the potential use of emotion regulation treatments (e.g., dialectical behavioral

543 therapy), which are effective among adults with eating disorders (Sloan et al., 2017).

544 Additionally, the findings may have theoretical implications for the CBT-E model

545 (Fairburn et al., 2003). Currently the CBT-E model links difficulties with emotion regulation

546 to both binge eating and purging, in addition to weight/shape concerns. Findings from the

547 current study provide some support for these associations. Difficulties with emotion

548 regulation were significantly associated with binge eating and particularly involved in the

549 persistence of binge eating. Further, greater difficulties with emotion regulation were

550 associated with a higher likelihood of purging as well as onset of purging after one year. This

551 is in line with our cross-sectional findings (Trompeter et al., 2022), as well as previous

552 research among adults (Pisetsky et al., 2017). However, no significant findings emerged

553 regarding persistence, potentially due to the small subsample size. While the current CBT-E

554 model does not include paths from difficulties with emotion regulation to fasting and driven

555   exercise, we have previously argued that these should be included (Trompeter et al., 2021).

556   Findings from the current study together with our previous work add to the evidence to

557   suggest that difficulties with emotion regulation may give rise to fasting behaviors among

558   adolescents and could be a valuable addition to the CBT-E model. However, the evidence

559   regarding driven exercise is mixed. Lastly, the current study provides important insights into

560   the prospective associations outlined in the CBT-E model regarding the unique additional risk

561   posed by difficulties with emotion regulation, in addition to the core risk factor of

562   weight/shape concerns.

563   In conclusion, the current study supports the notion that weight/shape concerns are a

564   key risk factor for adolescents engaging in eating disorder behaviors. Further, findings add to

565   a growing body of literature positioning difficulties with emotion regulation as an additional

566   eating disorder risk factor among adolescents. In particular, difficulties with emotion

567   regulation were able to account for persistence of binge eating and fasting, which were not

568   accounted for by weight/shape concerns.

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