

Weight-related teasing and non-normative eating behaviors as predictors of weight loss maintenance. A longitudinal mediation analysis

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– Original Article –

The final publication is available at <http://dx.doi.org/10.1016/j.appet.2016.02.017>. © 2016.

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Running title: Predictors of weight loss maintenance

1 Abstract

2 Weight loss maintenance is essential for the reduction of obesity-related health
3 impairments. However, only a minority of individuals successfully maintain reduced weight
4 in the long term. Research has provided initial evidence for associations between weight-
5 related teasing (WRT) and greater non-normative eating behaviors. Further, first evidence was
6 found for associations between non-normative eating behaviors and weight loss maintenance.
7 Hence, the present study aimed to examine the predictive value of WRT for weight loss
8 maintenance and the role of non-normative eating behaviors as possible mediators of this
9 relationship. The study was part of the German Weight Control Registry that prospectively
10 followed individuals who had intentionally lost at least 10% of their maximum weight and
11 had maintained this reduced weight for at least one year. In $N = 381$ participants, retrospective
12 WRT during childhood and adolescence, current non-normative eating behaviors (i.e.,
13 restrained, external, emotional eating), and change in body mass index (BMI, kg/m^2) over two
14 years were examined using self-report assessments. Structural equation modeling was used to
15 analyze the assumed mediational relationship. As a result, a greater effect of retrospective
16 WRT during childhood and adolescence predicted less successful adult weight loss
17 maintenance over two years. Current emotional eating fully mediated this relationship while
18 current restrained and external eating yielded no mediational effects. Hence, a greater effect
19 of WRT predicted greater current emotional eating, which in turn predicted a smaller decrease
20 or a greater increase in BMI. Our findings suggest that suffering from WRT during childhood
21 and adolescence might lead to emotional eating which in turn impairs long-term weight loss
22 maintenance. Thus, our results highlight the need for interventions aiming at reducing weight
23 stigmatization and targeting emotional eating for successful long-term weight loss
24 maintenance.

- 25 *Keywords:* weight loss, weight loss maintenance, weight-related teasing, non-normative
26 eating behavior, emotional eating, mediation

27 Introduction

28 Long-term weight loss maintenance is most important for the reduction of obesity-
29 related health impairments achieved by modest weight loss (Dixon, Anderson, Cameron-
30 Smith, & O'Brien, 2004; Wing et al., 2011). However, only a minority of individuals who lose
31 weight maintain the reduced weight successfully in the long term (17-34%; Kraschnewski et
32 al., 2010; Phelan, Wing, Loria, Kim, & Lewis, 2010). Therefore, studies have sought to
33 identify psychosocial predictors of weight loss maintenance in order to establish more
34 efficacious interventions (Elfhag & Rössner, 2005). In this context, the influence of weight
35 stigmatization has been noted (Latner, Wilson, Jackson, & Stunkard, 2009; Rancourt et al.,
36 2014; Wott & Carels, 2010).

37 Individuals with overweight and obesity experience weight stigmatization, which is
38 characterized by negative stereotypes, prejudice, and discrimination (Major & O'Brien, 2005)
39 because of the increased weight. Discrimination may manifest in the form of weight-related
40 teasing (WRT) that often starts in childhood or adolescence (Puhl & Heuer, 2009). Weight
41 stigmatization in general is related to various psychosocial impairments (e.g., depression, non-
42 normative eating behaviors; Durso, Latner, & Hayashi, 2012; Puhl & Heuer, 2009). Hence,
43 experiences of WRT may influence the outcome of later weight loss efforts although the few
44 intervention studies to date have produced mixed results. While lifetime WRT was associated
45 with poorer weight loss in adults (Wott & Carels, 2010), decreases in current WRT did not
46 predict changes in percent overweight in adolescents (Rancourt et al., 2014). Surprisingly, the
47 results of a prospective study suggested that greater lifetime WRT predicts greater weight loss
48 and weight loss maintenance in adults (Latner et al., 2009). However, as this study used
49 strategies which might have promoted a selection bias of participants (e.g., dismissal from
50 treatment in the case of failure to meet prescribed weight loss goals), the findings can hardly
51 be compared to those of other studies.

52 In addition, evidence consistently suggests non-normative eating behaviors to be
53 predictive of weight loss maintenance. A greater increase in cognitive dietary restraint (i.e.,
54 control over food intake in order to influence body weight and shape) following weight loss
55 was found among those maintaining their weight relative to those regaining weight (Vogels &
56 Westerterp-Plantenga, 2007). In a longitudinal study, increases in cognitive dietary restraint
57 during weight loss predicted successful weight loss maintenance after at least two years
58 (Vogels, Diepvens, & Westerterp-Plantenga, 2005). Further studies examined the influence of
59 dietary disinhibition, which is defined by a susceptibility to loss of control over eating (Wing
60 et al., 2008) in response to internal cues (e.g., emotional and cognitive cues; internal
61 disinhibition) and external cues (e.g., social cues; external disinhibition; Niemeier, Phelan,
62 Fava, & Wing, 2007). A longitudinal study found internal but not external disinhibition after
63 weight loss to predict one-year weight loss maintenance (Niemeier et al., 2007). While
64 emotional eating (i.e., overeating in response to negative emotions) and external eating (i.e.,
65 eating in response to food-related stimuli regardless of the internal states of hunger and
66 satiety) are similar to the concepts of internal and external disinhibition, respectively, their
67 frequency prior to weight loss did not predict weight loss maintenance after 12 months in
68 women (Teixeira et al., 2010).

69 Moreover, numerous cross-sectional studies provide evidence for an association
70 between weight stigmatization during childhood and adolescence as well as lifetime weight
71 stigmatization and non-normative eating behaviors including restrained eating (i.e., attempts
72 to refrain from eating), external, and emotional eating (Durso, Latner, & Hayashi, 2012;
73 Farrow & Tarrant, 2009; Goldfield et al., 2010; Olvera, Dempsey, Gonzalez, & Abrahamson,
74 2013; Rojo-Moreno et al., 2013; Wertheim, Koerner, & Paxton, 2001).

75 In this context, the present prospective study was the first to investigate the influence
76 of retrospective WRT during childhood and adolescence on adult weight loss maintenance
77 and of current non-normative eating behaviors (i.e., restrained, external, and emotional eating)

78 as possible mediators of this relationship. Based on studies suggesting negative effects of
79 weight stigmatization on various health-related aspects (Puhl & Heuer, 2009), we
80 hypothesized that greater retrospective WRT during childhood and adolescence would predict
81 less successful weight loss maintenance in adulthood. We further hypothesized that current
82 non-normative eating behaviors, i.e., smaller restrained, greater external and emotional eating,
83 to mediate this relationship.

84 Materials and Methods

85 *Participants*

86 This study was part of the German Weight Control Registry, which aimed to identify
87 psychosocial predictors for successful weight loss maintenance in order to improve current
88 treatment strategies. To this end, a consecutive sample was recruited between 2009 and 2011
89 with the help of a broad publicity campaign and was followed prospectively for two years.
90 Eligible participants were individuals at least 18 years of age whose lifetime maximum weight
91 (excluding pregnancy) was in the range of overweight ($25.0 \leq \text{BMI} < 30.0 \text{ kg/m}^2$) or obesity
92 ($\text{BMI} \geq 30.0 \text{ kg/m}^2$) and who had intentionally lost weight at any time of their lives.
93 According to the definition of weight loss maintenance (Wing & Hill, 2001), this weight loss
94 amounted to at least 10% of participants' maximum weight and was maintained for at least
95 one year. A total of $N = 410$ participants completed paper-and-pencil- or web-based
96 questionnaires at baseline as well as after being contacted again at one- and two-year follow-
97 up. For follow-up assessments, participants were offered a financial compensation. Informed
98 consent was obtained prior to study participation. The study was approved by the ethics
99 committee of the Medical Faculty, University of Erlangen-Nuremberg, and is described in
100 detail elsewhere (Feller et al., 2015; Mayr et al., 2012). In this study, participants who had
101 undergone bariatric surgery were excluded from the analyses as their weight change is
102 different relative to that of individuals who had lost weight due to nonsurgical methods
103 (Sjöström, 2013). Further, participants who were older than 70 years at baseline were not
104 included due to a potential memory bias in the recall of retrospective WRT during childhood
105 and adolescence. Overall, the final sample consisted of $N = 381$ individuals.

106

107 *Measures*

108 *Predictor variable.* The Effect subscale of the German version of the Perception of
109 Teasing Scale (POTS; Thompson, Cattarin, Fowler, & Fisher, 1995; German translation by
110 AH – unpublished manuscript) was administered at baseline to measure the retrospective
111 effect of WRT on the individual during ages 5 to 16 years. This subscale contains 6 items
112 (e.g., “People made fun of you because you were heavy”) rated on a 5-point Likert scale
113 ranging from 1 = *not upset* to 5 = *upset*. A sum score was computed with higher scores
114 indicating greater effect of WRT. In accordance with a previous study reporting appropriate
115 psychometric properties of the German version (Losekam, Kraeling, Goetzky, Rief, &
116 Hilbert, unpublished manuscript), internal consistency in the current sample was $\alpha = 0.90$.

117 *Mediator variable.* The adapted German version of the Dutch Eating Behavior
118 Questionnaire (DEBQ; Grunert, 1989; van Strien, Frijters, Bergers, & Defares, 1986) was
119 used to assess three different forms of current non-normative eating behavior at baseline:
120 restrained eating (e.g., “I eat deliberately less in order not to become heavier”), external eating
121 (e.g., “If food smells or looks good, I eat more of it than normal”), and emotional eating (e.g.,
122 “I have the desire to eat when I’m depressed or discouraged”). Each of these subscales
123 consists of ten items rated on a 5-point Likert scale from 1 = *never* to 5 = *very often*. Mean
124 subscale scores were computed with higher scores indicating more frequent non-normative
125 eating behavior. The well-established DEBQ has shown good validity and adequate reliability
126 (Grunert, 1989). Internal consistencies in this study’s sample were $\alpha = 0.82$ (restrained
127 eating), $\alpha = 0.90$ (external eating), and $\alpha = 0.94$ (emotional eating), respectively.

128 *Outcome variable.* Participants’ body mass index (BMI, kg/m^2) was calculated based
129 on self-reported body weight and height. The change in BMI was computed as the difference
130 between BMI at two-year follow-up and BMI at baseline. Thus, negative values indicate that
131 participants’ BMI decreased, while positive values represent an increase in BMI.

132 *Data Analytic Plan*

133 Missing values of change in BMI at two-year follow-up ($n = 40$; 10.50%) were
134 replaced by the last observed change in BMI after one year.

135 In Model 1, the effect of retrospective WRT during childhood and adolescence
136 predicting change in BMI over two years was tested, while controlling for age and sex. In
137 case of a significant relationship, Model 2 added the non-normative eating behaviors at
138 baseline as postulated mediators of the relationship between the effect of retrospective WRT
139 during childhood and adolescence and change in BMI. Subsequently, non-significant
140 relationships were deleted and only significant relationships remained in the model.

141 The models were tested through structural equation modeling using AMOS™ 20
142 (IBM, Armonk, New York) and were estimated by maximum likelihood method approach.
143 The following indices were considered for evaluation of model fit: the χ^2 test statistic (Bollen-
144 Stine bootstrap corrected in the case of multivariate non-normality; Bollen & Stine, 1992); the
145 minimum discrepancy, divided by its degrees of freedom (CMIN/DF); the goodness-of-fit
146 index (GFI); the comparative fit index (CFI); the Tucker-Lewis Index (TLI); the root mean
147 square error of approximation (RMSEA); and the standardized root mean square residual
148 (SRMR). A non-significant χ^2 value indicates that the model is compatible with the data
149 (Schermelleh-Engel, Moosbrugger & Müller). While the ratio CMIN/DF should be between 0
150 and 2 for a good model fit, GFI, CFI, and TLI should be > 0.95 (Schermelleh-Engel,
151 Moosbrugger & Müller, 2003). Further, RMSEA values < 0.06 and SRMR values < 0.08
152 indicate a good model fit (Hu & Bentler, 1999).

153 Interpretation of standardized regression weights referred to Cohen (small: ≥ 0.10 and
154 < 0.30 ; medium: ≥ 0.30 and < 0.50 ; large: ≥ 0.50 ; Cohen, 1988). A two-tailed α of 0.05 was
155 applied for all statistical tests.

156

Results

157 *Participants*

158 Sample characteristics are summarized in Table 1. A maximum lifetime BMI of $M =$
159 33.02 kg/m^2 ($SD = 6.09$) was reported at a mean age of $M = 40.67$ years ($SD = 12.45$). At the
160 time of maximum weight, overweight ($n = 140$; 36.75%) and class I obesity ($30.0 \leq \text{BMI} <$
161 35.0 kg/m^2 ; $n = 138$; 36.22%) were present in the majority of participants. Intentional weight
162 loss between maximum and baseline weight amounted to $M = -7.38 \text{ kg/m}^2$ ($SD = 3.81$) or $M =$
163 -21.70% ($SD = 7.96$) and was maintained for $M = 5.61$ years ($SD = 5.78$). At baseline, the
164 mean BMI was $M = 25.64 \text{ kg/m}^2$ ($SD = 4.25$) and most participants were classified as normal
165 weight ($18.5 \leq \text{BMI} < 25.0 \text{ kg/m}^2$; $n = 203$; 53.28%) or overweight ($n = 134$; 35.17%). At
166 two-year follow-up, participants reported a mean BMI of $M = 26.60 \text{ kg/m}^2$ ($SD = 4.94$). The
167 change in BMI between baseline and two-year follow-up ranged from -6.73 to $+13.30 \text{ kg/m}^2$
168 with a mean change of $M = +0.96$ ($SD = 1.88$). Based on previous research (Warziski Turk et
169 al., 2012; Weiss, Galuska, Kettel Khan, Gillespie, & Serdula, 2007), a BMI change of more
170 than $\pm 5\%$ from baseline was considered to be of clinical relevance. Hence, a BMI change of
171 less than or equal to $\pm 5\%$ was considered successful weight loss maintenance. Using this
172 threshold, the majority of participants successfully maintained their reduced BMI at two-year
173 follow-up ($n = 228$; 59.84%) or had a further decrease ($n = 23$; 6.04%), while 34.12% of the
174 participants ($n = 130$) experienced an increase in BMI.

175

176 *Structural Equation Modeling*

177 In Model 1 controlling for age and sex, a higher effect of retrospective WRT during
178 childhood and adolescence directly predicted a less favorable change in BMI between
179 baseline and two-year follow-up, i.e., a greater increase or a lower decrease in BMI
180 (standardized value: 0.12, $p < 0.05$; small effect). Further, female sex and lower age were

181 correlated and were both associated with a higher effect of retrospective WRT during
182 childhood and adolescence (standardized value for sex: -0.13, $p < 0.05$; standardized value for
183 age: -0.24, $p < 0.001$; small effects). Based on the Bollen-Stine bootstrap corrected χ^2 test
184 statistic, the model was compatible with the data, $\chi^2(2) = 3.74$, $p = 0.19$. A good model fit was
185 indicated by the following fit indices: CMIN/DF = 1.87; GFI = 1.00; CFI = 0.97; RMSEA =
186 0.05; SRMR = 0.03. TLI indicated an acceptable model fit: TLI = 0.92.

187 Figure 1 presents all significant paths of Model 2 including non-normative eating
188 behaviors at baseline as postulated mediators of the direct relationship tested in Model 1.
189 Controlling for age and sex, a higher effect of retrospective WRT during childhood and
190 adolescence predicted higher levels of restrained, external, and emotional eating (small
191 effects). Greater emotional eating in turn predicted a greater increase or a lower decrease in
192 BMI between baseline and two-year follow-up (small effect). Thus, there was a full mediation
193 effect of emotional eating, i.e., when emotional eating was included, the effect of
194 retrospective WRT during childhood and adolescence did not add to the prediction of change
195 in BMI over two years. However, there was no mediational effect of restrained and external
196 eating. With respect to sociodemographic variables, female sex and lower age were associated
197 with a higher effect of retrospective WRT during childhood and adolescence as shown in
198 Model 1 (small effects). In addition, restrained and emotional eating yielded an effect of sex,
199 with women reporting greater restrained and emotional eating than men (small effects).
200 Further, higher age was associated with more restrained and less external eating (small
201 effects). In accordance with Model 1, age and sex were correlated. Based on the Bollen-Stine
202 bootstrap corrected χ^2 test statistic, the model fit the data: $\chi^2(7) = 6.86$, $p = 0.47$. A good fit of
203 the model was indicated by the following fit indices: CMIN/DF = 0.98; GFI = 1.00; CFI =
204 1.00; TLI = 1.00; RMSEA < 0.001; SRMR = 0.03. Thus, CFI, TLI, RMSEA, and SRMR
205 indicate a better model fit compared to Model 1 without non-normative eating behaviors.

206 Discussion

207 The present prospective study is unique in examining both the influence of WRT on
208 weight loss maintenance and the role of non-normative eating behaviors as possible mediators
209 of this relationship. Confirming our hypotheses, a greater effect of retrospective WRT during
210 childhood and adolescence predicted less successful maintenance of adult weight loss over the
211 course of two years. This relationship was fully mediated by greater emotional eating. In
212 contrast, there was no mediational effect of restrained and external eating, respectively. Thus,
213 our results indicate that suffering from WRT during childhood and adolescence might lead to
214 emotional eating which in turn impairs long-term weight loss maintenance.

215 Given the lack of studies investigating the influence of weight stigmatization on
216 weight loss efforts, our study provides preliminary evidence for the predictive value of
217 retrospective WRT during childhood and adolescence for less successful weight loss
218 maintenance in adulthood. Our results are in line with a previous intervention study in adults
219 focusing on weight loss rather than on its maintenance (Wott & Carels, 2010). However, our
220 findings are in contrast to a previous intervention study suggesting that WRT predicted better
221 weight loss maintenance (Latner et al., 2009). It is noteworthy that the potential self-selection
222 bias of participants in the aforementioned study makes comparisons with our results difficult.
223 In addition, emotional eating was found to fully mediate the relationship between
224 retrospective WRT during childhood and adolescence and adult weight loss maintenance.
225 Thus, we confirmed that emotional eating – a concept similar to internal disinhibition –
226 predicted less successful weight loss maintenance (Niemeier et al., 2007), which extends the
227 evidence of most previous weight loss studies (Blair, Lewis, & Booth, 1990; Canetti, Berry,
228 & Elizur, 2009). However, this result is in contrast to an earlier intervention study that yielded
229 no predictive value of emotional eating (Teixeira et al., 2010). Contrary to our study, the

230 mentioned study focused on weight change in general without prior successful weight loss
231 rather than weight loss maintenance.

232 In accordance with previous studies, external eating did not predict adult weight loss
233 maintenance (Niemeier, Phelan, Fava, & Wing, 2007; Teixeira et al., 2010). Surprisingly, we
234 further did not find a predictive value of restrained eating while previous evidence suggested
235 that cognitive dietary restraint predicted successful weight loss maintenance (Vogels,
236 Diepvens, & Westerberp-Plantenga, 2005; Vogels & Westerberp-Plantenga, 2007). In contrast
237 to restrained eating, cognitive dietary restraint focuses more on the cognitive rather than the
238 behavioral aspects. Overall, the associations between WRT and restrained, external as well as
239 emotional eating in our study support findings of previous work (Durso, Latner, & Hayashi,
240 2012; Farrow & Tarrant, 2009; Goldfield et al., 2010; Olvera, Dempsey, Gonzalez, &
241 Abrahamson, 2013; Rojo-Moreno et al., 2013; Wertheim, Koerner, & Paxton, 2001).

242 In addition, women reported greater WRT than men, which is in line with previous
243 evidence (Neumark-Sztainer et al., 2002). Furthermore, greater retrospective WRT during
244 childhood and adolescence was found in younger individuals. This might be the result of a
245 cohort effect as weight stigmatization has increased over the last decades (Latner & Stunkard,
246 2003) and/or of a memory bias with older individuals recalling retrospective WRT during
247 childhood and adolescence not as distressing as younger ones due to the greater distance of
248 time (Faith, Storch, Roberti, & Ledley, 2008). In accordance with previous studies, women
249 reported more emotional as well as restrained eating than men, and older individuals reported
250 more restrained and less external eating compared to younger ones (van Strien, Herman, &
251 Verheijden, 2009).

252 Altogether, our finding that retrospective WRT during childhood and adolescence
253 predicted greater emotional eating which in turn predicted less successful weight loss
254 maintenance in adulthood provides important information on the negative consequences of
255 weight stigmatization. As experiences of WRT are highly distressing and may induce intense

256 negative emotions, emotional eating is a common coping strategy in individuals with
257 overweight and obesity to alleviate these adverse affects by distracting and providing comfort
258 in the short term (Puhl & Brownell, 2006; Spoor, Bekker, van Strien, & van Heck, 2007).
259 However, our results underline the negative influence of emotional eating on long-term
260 weight loss efforts. This finding is essential as only a small proportion of individuals
261 successfully maintain the reduced weight in the long term (Kraschnewski et al., 2010; Phelan,
262 Wing, Loria, Kim, & Lewis, 2010) although this is of primary importance for the reduction of
263 obesity-related comorbidities (Dixon, Anderson, Cameron-Smith, & O'Brien, 2004; Wing et
264 al., 2011).

265 Our findings need to be interpreted while taking into account the strengths and
266 limitations of this study. Strengths include the longitudinal design following a large sample
267 over the course of two years. In addition, study inclusion took place irrespective of whether
268 participants had sought weight loss treatment or had lost weight on their own. This is of
269 importance as individuals seeking clinical obesity treatment are a specific subsample of the
270 overweight and obese population, e.g., differing in maximum BMI and eating disorder
271 psychopathology (Stubbs et al., 2011). Further, retrospective WRT during childhood and
272 adolescence and non-normative eating behaviors were assessed by internationally accepted
273 and well-established self-report questionnaires.

274 Limitations include the retrospective assessment of WRT during childhood and
275 adolescence. While it can be assumed that WRT as a hurtful childhood experience is
276 memorable (Hardt & Rutter, 2004), findings regarding the accuracy of childhood experiences
277 are heterogeneous (Masia et al., 2003; Offer, Kaiz, Howard, & Bennett, 2000). Hence, the
278 recall of WRT may be susceptible to memory bias. Further biases are also conceivable. For
279 example, experiencing more current weight stigmatization or greater adult psychopathology
280 might result in an overestimation of past WRT (Faith et al., 2008). In addition to current
281 weight stigmatization, the internalization of this weight bias was found to be associated with

282 several health-related problems (Hübner et al., 2015; Latner, Durso, & Mond, 2013). Hence,
283 one area for future research would be to examine the relevance of these two aspects for
284 weight loss maintenance. A further limitation of the present study is that measurement of BMI
285 relied on self-reported body weight and height. Even though self-reported weight and height
286 were found to be highly associated with objectively measured body weight and height, self-
287 reports may result in a slight underestimation of BMI (Connor Gorber, Tremblay, Moher, &
288 Gorber, 2007; Wing & Phelan, 2005). Interpretation of our findings is further limited due to
289 simultaneous assessment of retrospective WRT during childhood and adolescence and non-
290 normative eating behaviors at baseline. Even though WRT was reported for childhood and
291 adolescence precluding associations in the opposite direction, cross-sectional data prevent
292 causal interpretation of an influence of WRT during childhood and adolescence on non-
293 normative eating-behaviors – but not on adult weight loss maintenance – as the same set of
294 cognitive biases might have an impact on the responses as described above. Moreover,
295 clinical interpretation of our results is limited due to small effect sizes. Besides the good fit of
296 the tested model, the observed influence of retrospective WRT during childhood and
297 adolescence and emotional eating on weight loss maintenance in adulthood is small.
298 However, given the limited knowledge about psychosocial predictors of weight loss
299 maintenance, our findings contribute to the current literature.

300 In conclusion, our findings highlight the negative influence of WRT during childhood
301 and adolescence on long-term adult weight loss maintenance through its impact on emotional
302 eating. Thus, with regard to increased weight stigmatization among children and adolescents
303 (Latner & Stunkard, 2003) and numerous negative problems associated with these
304 experiences beyond non-normative eating behaviors (e.g., low self-esteem, depression;
305 Quinlan, Hoy, & Costanzo, 2009), the need for interventions aiming at reducing weight
306 stigmatization is further highlighted. However, evidence on the efficacy of existing anti-
307 weight stigmatization interventions in children is poor, underscoring that further studies are

308 warranted (Anesbury & Tiggemann, 2000; Bell & Morgan, 2000). Moreover, improving
309 coping with weight stigmatization and the resulting negative emotions needs to be targeted in
310 children, adolescents, and adults. As emotional eating might be the result of lacking
311 functional coping approaches in individuals with overweight and obesity (Hörchner,
312 Tuinebreijer, Kelder, & van Urk, 2002), our findings provide practitioners with information
313 on the importance of targeting emotional eating by identifying triggers (e.g., experiences of
314 WRT) and by improving emotion regulation skills. While this approach is already
315 recommended for contemporary weight loss programs (Tsigos et al., 2008), special
316 approaches have been developed, such as an adapted dialectical behavioral therapy whose
317 efficacy regarding both emotional eating and weight loss has been shown in individuals with
318 obesity (Roosen, Safer, Adler, Cebolla, & van Strien, 2012). Overall, the long-term success of
319 weight loss programs might be increased by including complementary treatment modules
320 targeting emotional eating.

Acknowledgements

The authors' responsibilities were as follows – MdZ, RDC, AM, and AH developed the protocol. MdZ, RDC, and AM contributed to data collection, and CH analyzed the data. All authors were involved in writing the manuscript and had approval of the submitted and published versions.

The study was supported by the BMBF (German Federal Ministry of Education and Research) grant 01GI0835 within the German Competence Network of Obesity and by the BMBF grant 01EO1001.

Conflict of interest statement

The authors declare no conflicts of interest.

References

- Anesbury, T., & Tiggemann, M. (2000). An attempt to reduce negative stereotyping of obesity in children by changing controllability beliefs. *Health Education Research, 15*(2), 145–152.
- Bell, S. K., & Morgan, S. B. (2000). Children's attitudes and behavioral intentions toward a peer presented as obese: does a medical explanation for the obesity make a difference? *Journal of Pediatric Psychology, 25*(3), 137–145.
- Blair, A. J., Lewis, V. J., & Booth, D. A. (1990). Does emotional eating interfere with success in attempts at weight control? *Appetite, 15*(2), 151–157.
- Bollen, K. A., & Stine, R. A. (1992). Bootstrapping goodness-of-fit measures in structural equation models. *Sociological Methods & Research, 21*(2), 205–229.
- Canetti, L., Berry, E. M., & Elizur, Y. (2009). Psychosocial predictors of weight loss and psychological adjustment following bariatric surgery and a weight-loss program: the mediating role of emotional eating. *International Journal of Eating Disorders, 42*(2), 109–117.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2. ed). Hillsdale NJ: Erlbaum.
- Connor Gorber, S., Tremblay, M., Moher, D., & Gorber, B. (2007). A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. *Obesity reviews : An Official Journal of the International Association for the Study of Obesity, 8*(4), 307–326.
- Dixon, J. B., Anderson, M., Cameron-Smith, D., & O'Brien, P. E. (2004). Sustained weight loss in obese subjects has benefits that are independent of attained weight. *Obesity Research, 12*(11), 1895–1902.

- Durso, L. E., Latner, J. D., & Hayashi, K. (2012). Perceived discrimination is associated with binge eating in a community sample of non-overweight, overweight, and obese adults. *Obesity Facts*, 5(6), 869–880.
- Elfhag, K., & Rössner, S. (2005). Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obesity reviews : An Official Journal of the International Association for the Study of Obesity*, 6(1), 67–85.
- Faith, M. A., Storch, E. A., Roberti, J. W., & Ledley, D. R. (2008). Recalled childhood teasing among non-clinical, non-college adults. *Journal of Psychopathology and Behavioral Assessment*, 30(3), 171–179.
- Farrow, C. V., & Tarrant, M. (2009). Weight-based discrimination, body dissatisfaction and emotional eating: the role of perceived social consensus. *Psychology & Health*, 24(9), 1021–1034.
- Feller, S., Müller, A., Mayr, A., Engeli, S., Hilbert, A., & Zwaan, M. de. (2015). What distinguishes weight loss maintainers of the German Weight Control Registry from the general population? *Obesity (Silver Spring, Md.)*, 23(5), 1112–1118.
- Goldfield, G., Moore, C., Henderson, K., Buchholz, A., Obeid, N., & Flament, M. (2010). The relation between weight-based teasing and psychological adjustment in adolescents. *Paediatrics & Child Health*, 15(5), 283–288.
- Grunert, S. C. (1989). Ein Inventar zur Erfassung von Selbstaussagen zum Ernährungsverhalten. *Diagnostica*, 35(2), 167–179.
- Hardt, J., & Rutter, M. (2004). Validity of adult retrospective reports of adverse childhood experiences: review of the evidence. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, 45(2), 260–273.

- Hörchner, R., Tuinebreijer, W. E., Kelder, H., & van Urk, E. (2002). Coping behavior and loneliness among obese patients. *Obesity Surgery, 12*(6), 864–868.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1–55.
- Hübner, C., Baldofski, S., Zenger, M., Tigges, W., Herbig, B., Jurowich, C., . . . Hilbert, A. (2015). Influences of general self-efficacy and weight bias internalization on physical activity in bariatric surgery candidates. *Surgery for Obesity and Related Diseases : Official Journal of the American Society for Bariatric Surgery, 11*(6), 1371–1376.
- Kraschnewski, J. L., Boan, J., Esposito, J., Sherwood, N. E., Lehman, E. B., Kephart, D. K., & Sciamanna, C. N. (2010). Long-term weight loss maintenance in the United States. *International Journal of Obesity, 34*(11), 1644–1654.
- Latner, J. D., Durso, L. E., & Mond, J. M. (2013). Health and health-related quality of life among treatment-seeking overweight and obese adults: associations with internalized weight bias. *Journal of Eating Disorders, 1*(3), 1–6.
- Latner, J. D., & Stunkard, A. J. (2003). Getting worse: the stigmatization of obese children. *Obesity Research, 11*(3), 452–456.
- Latner, J. D., Wilson, G. T., Jackson, M. L., & Stunkard, A. J. (2009). Greater history of weight-related stigmatizing experience is associated with greater weight loss in obesity treatment. *Journal of Health Psychology, 14*(2), 190–199.
- Losekam, S., Kraeling, S., Goetzky, B., Rief, W., & Hilbert, A. (in prep). Evaluation of the German version of The Perception of Teasing Scale (POTS).
- Major, B., & O'Brien, L. T. (2005). The social psychology of stigma. *Annual Review of Psychology, 56*, 393–421.

- Masia, C. L., Storch, E. A., Dent, H. C., Adams, P., Verdeli, H., Davies, M., & Weissman, M. M. (2003). Recall of childhood psychopathology more than 10 years later. *Journal of the American Academy of Child and Adolescent Psychiatry*, 42(1), 6–12.
- Mayr, A., Gefeller, O., Prokosch, H.-U., Pirkl, A., Fröhlich, A., & Zwaan, M. de. (2012). Web-based data collection yielded an additional response bias—but had no direct effect on outcome scales. *Journal of Clinical Epidemiology*, 65(9), 970–977.
- Neumark-Sztainer, D., Falkner, N., Story, M., Perry, C., Hannan, P. J., & Mulert, S. (2002). Weight-teasing among adolescents: correlations with weight status and disordered eating behaviors. *International Journal of Obesity and Related Metabolic Disorders : Journal of the International Association for the Study of Obesity*, 26(1), 123–131.
- Niemeier, H. M., Phelan, S., Fava, J. L., & Wing, R. R. (2007). Internal disinhibition predicts weight regain following weight loss and weight loss maintenance. *Obesity (Silver Spring, Md.)*, 15(10), 2485–2494.
- Offer, D., Kaiz, M., Howard, K. I., & Bennett, E. S. (2000). The altering of reported experiences. *Journal of the American Academy of Child and Adolescent Psychiatry*, 39(6), 735–742.
- Olvera, N., Dempsey, A., Gonzalez, E., & Abrahamson, C. (2013). Weight-related teasing, emotional eating, and weight control behaviors in Hispanic and African American girls. *Eating Behaviors*, 14(4), 513–517.
- Phelan, S., Wing, R. R., Loria, C. M., Kim, Y., & Lewis, C. E. (2010). Prevalence and predictors of weight-loss maintenance in a biracial cohort: results from the coronary artery risk development in young adults study. *American Journal of Preventive Medicine*, 39(6), 546–554.

- Puhl, R. M., & Brownell, K. D. (2006). Confronting and coping with weight stigma: an investigation of overweight and obese adults. *Obesity (Silver Spring, Md.)*, *14*(10), 1802–1815.
- Puhl, R. M., & Heuer, C. A. (2009). The stigma of obesity: a review and update. *Obesity (Silver Spring, Md.)*, *17*(5), 941–964.
- Quinlan, N. P., Hoy, M. B., & Costanzo, P. R. (2009). Sticks and stones: the Effects of teasing on psychosocial functioning in an overweight treatment-seeking sample. *Social Development*, *18*(4), 978–1001.
- Rancourt, D., Barker, D. H., Sato, A. F., Lloyd-Richardson, E. E., Hart, C. N., & Jelalian, E. (2014). Longitudinal associations among change in overweight status, fear of negative evaluation, and weight-related teasing among obese adolescents. *Journal of Pediatric Psychology*, *39*(7), 697–707.
- Rojo-Moreno, L., Rubio, T., Plumed, J., Barberá, M., Serrano, M., Gimeno, N., . . . Livianos, L. (2013). Teasing and disordered eating behaviors in Spanish adolescents. *Eating Disorders*, *21*(1), 53–69.
- Roosen, M. A., Safer, D., Adler, S., Cebolla, A., & van Strien, T. (2012). Group dialectical behavior therapy adapted for obese emotional eaters; a pilot study. *Nutrición hospitalaria*, *27*(4), 1141–1147.
- Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: tests of significance and descriptive goodness-of-fit Measures. *Methods of Psychological Research*, *8*(2), 23–74.
- Sjöström, L. (2013). Review of the key results from the Swedish Obese Subjects (SOS) trial - a prospective controlled intervention study of bariatric surgery. *Journal of Internal Medicine*, *273*(3), 219–234.

- Spoor, Sonja T P, Bekker, Marrie H J, van Strien, T., & van Heck, Guus L. (2007). Relations between negative affect, coping, and emotional eating. *Appetite*, 48(3), 368–376.
- Stubbs, J., Whybrow, S., Teixeira, P., Blundell, J., Lawton, C., Westenhoefer, J.,. . . Raats, M. (2011). Problems in identifying predictors and correlates of weight loss and maintenance: implications for weight control therapies based on behaviour change. *Obesity Reviews : An Official Journal of the International Association for the Study of Obesity*, 12(9), 688–708.
- Teixeira, P. J., Silva, M. N., Coutinho, S. R., Palmeira, A. L., Mata, J., Vieira, P. N.,. . . Sardinha, L. B. (2010). Mediators of weight loss and weight loss maintenance in middle-aged women. *Obesity (Silver Spring, Md.)*, 18(4), 725–735.
- Thompson, J. K., Cattarin, J., Fowler, B., & Fisher, E. (1995). The Perception of Teasing Scale (POTS): a revision and extension of the Physical Appearance Related Teasing Scale (PARTS). *Journal of Personality Assessment*, 65(1), 146–157.
- Tsigos, C., Hainer, V., Basdevant, A., Finer, N., Fried, M., Mathus-Vliegen, E.,. . . Zahorska- Markiewicz, B. (2008). Management of obesity in adults: European clinical practice guidelines. *Obesity Facts*, 1(2), 106–116.
- van Strien, T., Frijters, Jan E. R., Bergers, Gerard P. A., & Defares, P. B. (1986). The Dutch Eating Behavior Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. *International Journal of Eating Disorders*, 5(2), 295–315.
- van Strien, T., Herman, C. P., & Verheijden, M. W. (2009). Eating style, overeating, and overweight in a representative Dutch sample. Does external eating play a role? *Appetite*, 52(2), 380–387.
- Vogels, N., Diepvens, K., & Westerterp-Plantenga, M. S. (2005). Predictors of long-term weight maintenance. *Obesity Research*, 13(12), 2162–2168.
- Vogels, N., & Westerterp-Plantenga, M. S. (2007). Successful long-term weight maintenance: a 2-year follow-up. *Obesity (Silver Spring, Md.)*, 15(5), 1258–1266.

- Warziski Turk, M., Sereika, S. M., Yang, K., Ewing, L. J., Hravnak, M., & Burke, L. E. (2012). Psychosocial correlates of weight maintenance among black & white adults. *American Journal of Health Behavior, 36*(3), 395–407.
- Weiss, E. C., Galuska, D. A., Kettel Khan, L., Gillespie, C., & Serdula, M. K. (2007). Weight regain in U.S. adults who experienced substantial weight loss, 1999-2002. *American Journal of Preventive Medicine, 33*(1), 34–40.
- Wertheim, E. H., Koerner, J., & Paxton, S. J. (2001). Longitudinal predictors of restrictive eating and bulimic tendencies in three different age groups of adolescent girls. *Journal of Youth and Adolescence, 30*(1), 69–81.
- Wing, R. R., & Hill, J. O. (2001). Successful weight loss maintenance. *Annual Review of Nutrition, 21*, 323–341.
- Wing, R. R., Lang, W., Wadden, T. A., Safford, M., Knowler, W. C., Bertoni, A. G., . . . Wagenknecht, L. (2011). Benefits of modest weight loss in improving cardiovascular risk factors in overweight and obese individuals with type 2 diabetes. *Diabetes Care, 34*(7), 1481–1486.
- Wing, R. R., Papandonatos, G., Fava, J. L., Gorin, A. A., Phelan, S., McCaffery, J., & Tate, D. F. (2008). Maintaining large weight losses: the role of behavioral and psychological factors. *Journal of Consulting and Clinical Psychology, 76*(6), 1015–1021.
- Wing, R. R., & Phelan, S. (2005). Long-term weight loss maintenance. *The American Journal of Clinical Nutrition, 82*(1 Suppl), 222S-225S.
- Wott, C. B., & Carels, R. A. (2010). Overt weight stigma, psychological distress and weight loss treatment outcomes. *Journal of Health Psychology, 15*(4), 608–614.

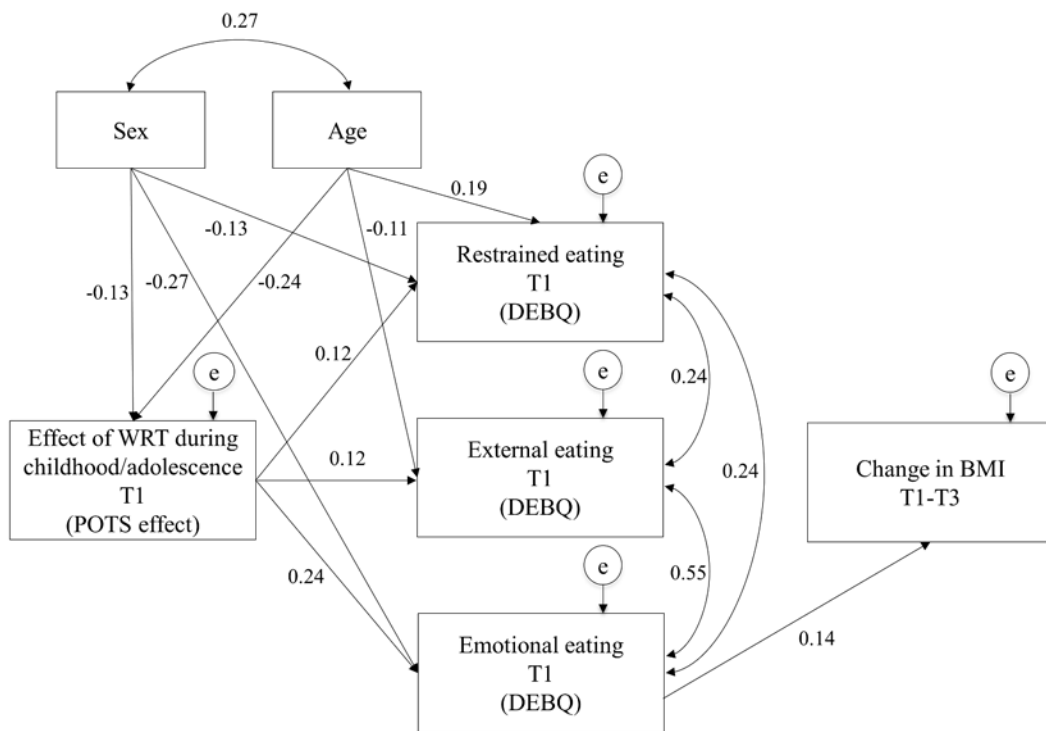


Figure 1. Structural equation model on the mediating role of emotional eating on the relationship between effect of retrospective weight-related teasing during childhood and adolescence and adult weight loss maintenance.

Standardized values are depicted ($p < 0.05$). T1 = baseline; T3 = two-year follow-up; POTS effect = Perception of Teasing Scale – Effect subscale (6-30*, less favorable scores are asterisked); DEBQ = Dutch Eating Behavior Questionnaire (1-5*); Change in BMI = negative values indicate a decrease and positive values an increase in body mass index; e = error term.

Table 1

Sample Characteristics (N = 381)

	<i>M, n</i>	<i>SD, %</i>
Sex, female	242	63.52
Education, academics	178	46.84 ^a
Weight history		
Age at minimum weight, years	32.05	13.19
BMI at minimum weight, kg/m ²	23.33	3.56
Age at maximum weight, years	40.67	12.45
BMI at maximum weight, kg/m ²	33.02	6.09
Age at baseline, years	46.29	11.75
BMI at baseline, kg/m ²	25.64	4.25
Weight status at baseline		
Normal weight (18.5 ≤ BMI < 25.0 kg/m ²)	203	53.28
Overweight (25.0 ≤ BMI < 30.0 kg/m ²)	134	35.28
Class I obesity (30.0 ≤ BMI < 35 kg/m ²)	29	7.61
Class II obesity (35.0 ≤ BMI < 40. kg/m ²)	7	1.84
Class III obesity (BMI ≥ 40.0 kg/m ²)	8	2.10
Retrospective effect of WRT during childhood/adolescence	13.29	7.84
(POTS effect)		
Non-normative eating behaviors at baseline (DEBQ)		
Restrained eating	3.33	0.65
External eating	2.62	0.71
Emotional eating	2.13	0.90
Change in BMI, kg/m ²	+0.96	1.88

Notes. BMI = body mass index; WRT = weight-related teasing; POTS effect = Perception of Teasing Scale – Effect subscale (6*-30, less favorable scores are asterisked); DEBQ = Dutch Eating Behavior Questionnaire (1-5*); Change in BMI = change in BMI between baseline and two-year follow-up (negative values indicate a decrease and positive values an increase in BMI).

^a Calculation of % from valid cases ($n = 380$).