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Development and Validation of the Child Three Factor Eating Questionnaire (CTFEQr17)

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30 INTRODUCTION

31 The prevalence of obesity in children and adolescents has reached epidemic proportions
32 worldwide and is associated with many comorbidities ⁽¹⁻³⁾. Pediatric obesity is closely linked
33 to the so-called “obesogenic” environment where a myriad of factors are conducive to eating
34 too much and not moving enough, thereby promoting weight gain and ultimately overweight
35 and obesity ^(4, 5). Among the many factors that explain the susceptibility to gain weight, a
36 better understanding of the link between eating behaviours and weight gain is of crucial
37 importance to overcome the rising rates of obesity.

38

39 Obesity interventions have to consider individuals’ eating behaviours, especially those that
40 have been associated with obesity and weight gain ^(6, 7). For example, dietary restriction can
41 promote overeating in dietary restrained adolescents having disinhibited eating behaviour ⁽⁸⁾.
42 Additionally, adolescents with high restrained eating behaviour scores are more likely to gain
43 weight over time ⁽⁹⁾. Properly assessing eating behaviours of children and adolescents
44 remains, however, challenging.

45

46 In 1985, Stunkard & Messick developed the Three-Factor Eating Questionnaire (TFEQ) as a
47 self-reported scale based on the Restraint ⁽¹⁰⁾ and the Latent Obesity ⁽¹¹⁾ theories, in order to
48 assess Dietary Restraint (restriction of food intake to control weight), Disinhibition (tendency
49 to overeat opportunistically), and Hunger (responsiveness to internal hunger sensations).
50 While this initial version of the TFEQ developed in adults has been shown to clearly link
51 eating behaviours with weight gain and weight loss success ⁽¹²⁻¹⁵⁾, it has been recently revised
52 into a shorter 21-item version (TFEQr21) focusing on Restraint, Uncontrolled Eating, and
53 Emotional Eating ⁽¹³⁾. In this last version, although the restraint dimension remains
54 unchanged, uncontrolled eating refers to eating in response to food palatability and the
55 likelihood to over-consume, and emotional eating represents the process to eat in response to
56 negative moods ⁽¹³⁾.

57

58 Despite a significant body of literature regarding the utility of the TFEQ in adults ⁽¹³⁻¹⁸⁾, the
59 validity of this TFEQr21 remains to be tested among children and adolescents. Although,
60 Martin-Garcia et al. ⁽¹⁹⁾ recently reported a strong association between body composition and
61 Cognitive Restraint in 7-17-year-old Spanish youth using a modified version of the Spanish
62 adult TFEQ. These results highlight the usefulness of the TFEQr21 in children, but only in a

63 limited population. It thus remains important to develop and validate a specific version of the
64 English TFEQr21 for children and adolescents in order to better characterize their eating
65 behaviour traits and evaluate the impact of obesity interventions in this population.

66

67 The objective of this study was to develop an adapted-version of the adult TFEQr21 to be
68 used among children and adolescents (CTFEQr17), and to assess its psychometric properties
69 and factor structure. We also examined the associations between the CTFEQr17 and body
70 mass index (BMI) and food preferences as a secondary objective.

71

72

73 **METHODS**

74 The process of developing and validating the CTFEQr17 was a two-phase process: the
75 CTFEQr17 was developed in phase 1 and validated in phase 2. Each phase and subsequent
76 results are detailed below.

77

78 **Phase 1: Development of the CTFEQr17**

79 *Participants*

80 A sample of 76 children (39 boys and 37 girls) recruited between 2013 – 2014, from primary
81 and secondary schools in North and West Yorkshire, UK were interviewed to determine their
82 understanding of the original TFEQr21 ⁽¹³⁾ items and to develop the wording of the
83 CTFEQr17 (mean age: 12.3±1.4 years; mean BMI: 19.1±2.5 kg/m²; mean BMI percentile:
84 59.4±25.8). All children, their guardians and the school gave informed consent for
85 participation. Children who had any known eating disorders or eating issues, or who had
86 difficulties with reading were excluded from participation (n=5 excluded). These children
87 were identified by parents and/or teachers. The project gained full ethical approval from the
88 University of Bradford Ethics Committee.

89

90 *Qualitative Design*

91 The children took part in one-to-one structured interviews with the researchers. The child was
92 presented with the adult version of the TFEQr21 ⁽¹³⁾ and was asked whether they understood
93 each item, if they understood how to respond to each question, and asked to put each item

94 into their own words. The interviews allowed the researchers to determine the children's
95 understanding of each item. Sample percentages were calculated for correct understanding of
96 each item. In addition, the wording the children used to describe each item was then used to
97 develop the CTFEQr17. This was achieved by recording the most frequently used words and
98 phrases for each item and adopting these words, and phrases, in the new items. The
99 interviews were tape-recorded and transcribed for analysis. Two researchers independently
100 analysed the children's responses to try to reach a subjective consensus on the child's
101 responses.

102

103 *Anthropometric Measurements*

104 Body weight was assessed using a Seca 877 weighing scale and was measured to the nearest
105 0.1 kg. Children wore loose and lightweight shorts and a T-shirt to be weighed. Height was
106 measured while the child was barefoot, using a Leicester stadiometer and was measured to
107 the nearest 0.1 cm. BMI was calculated as weight (kg) / height (m)². BMI percentiles were
108 calculated using the WHO ⁽²⁰⁾ criteria based on age and sex.

109

110 **Phase 2: Validation of the CTFEQr17**

111 A sample of 433 children (230 boys; mean age: 12.0±1.7 years; mean BMI: 19.7±4.5 kg/m²;
112 mean BMI percentile: 57.6±30.9) from primary and secondary schools in West Yorkshire and
113 Lancashire, UK were recruited between 2016-2017. A subsample of 45 children (23 boys and
114 22 girls) took part in interviews to confirm their understanding of the CTFEQr17. All
115 children, their guardians and the school gave informed consent for participation. Children
116 who had any known eating disorders or eating issues, or who had difficulties with reading
117 were excluded from participation (n = 23). The project gained full ethical approval from the
118 University of Bradford Ethics Committee.

119

120 *Validation Design*

121 Children were asked to self-complete the CTFEQr17 and an adapted paper-based Leeds Food
122 Preference Questionnaire (LFPQ), suitable for use with children ⁽²¹⁾. The LFPQ consists of a
123 list of common UK foods (e.g., crisps, strawberries, yoghurt, biscuits) and the child was
124 asked to indicate if they would like to consume these foods. Responses were then coded and
125 summed into preference for high protein (8 items), high fat (8 items), high carbohydrate (8
126 items), and low energy foods (8 items). Mean taste preference scores were also calculated for

127 low fat savoury foods (LFSA: 12 items), low fat sweet foods (LFSW: 5 items), high fat
128 savoury foods (HFSA: 8 items), and high fat sweet foods (HFSW: 7 items).

129

130 *Anthropometric Measurements*

131 A subsample of children had their height and weight measured (131 boys and 122 girls).
132 Anthropometric measures were taken using the same procedure used in phase 1.

133

134 *Qualitative Design*

135 The children took part in structured one-to-one interviews with a researcher. They were
136 presented with the CTFEQr17 and asked if they understood each item, understood how to
137 respond to each question and asked to elaborate on what they thought each item meant, to
138 confirm their understanding. Each interview lasted approximately 20 minutes. Interviews
139 were recorded and transcribed for analysis.

140

141

142

143 *Statistical Analysis*

144 We calculated that a total sample of 338 would be sufficient ($1-\hat{\alpha} = \sim 0.90$, effect size = 0.25, α
145 = 0.05) to run the planned analysis. An exploratory, varimax rotation, principal components
146 factor analysis (PCA) was carried out to determine the factor structure of the CTFEQr17. An
147 item analysis was also conducted to confirm the internal consistency, item-convergent and
148 item-divergent validity of the CTFEQr17 items. Bivariate correlations explored relationships
149 between age and CTFEQr17 factors by sex, and an ANOVA was used to determine
150 differences between sex and age groups (7-10 years and 11-15 years) on each CTFEQr17
151 factor. Partial correlations, controlling for age, were used to examine relationships between
152 CTFEQr17 factors and anthropometric measurements. Partial correlations, controlling for age
153 and BMI, were also used to explore relationships between CTFEQr17 factors and food and
154 taste preference. Only correlations above 0.20 are reported. Groups were formed using a
155 median split on cognitive restraint (CR), uncontrolled eating (UE) and emotional eating (EE)
156 scale scores to create a low and high CR groups (LCR & HCR), low and high UE groups
157 (LUE & HUE) and low and high EE groups (LEE & HEE). ANCOVAs were used to analyse
158 differences in anthropometric measures (controlling for age) and in food and taste preference
159 (controlling for age and BMI) by sex and eating behaviour groupings. Effect size was
160 measured through Eta^2 (η^2). For the qualitative data, the children's comments were used to

161 determine their level of understanding of each item of the CTFEQr17, and percentages of the
162 correctly understood items were calculated. Understanding of items between phase 1 and 2
163 was examined using t-tests. SPSS version 22 was used to conduct the analysis, and the level
164 of statistical significance was set at $p < 0.05$ for all analyses.

165

166 **RESULTS**

167 **Phase 1: Development of the CTFEQr17**

168 The qualitative data from the interviews with children revealed that there were a number of
169 items in the TFEQr21⁽¹³⁾ that the children had difficulty in understanding, particularly items
170 9, 17 and 21. To develop a more understandable questionnaire, these items were reworded,
171 using the children's own language, and ascertained from the interviews (see Appendix for the
172 CTFEQr17). In addition, the children also deemed the response format of the TFEQr21
173 unclear and too complex; thus, the response format of the CTFEQr17 was altered to read
174 'totally true', 'mostly true' 'mostly false', and 'totally false', again utilising the phraseology
175 of the children from the interviews.

176

177 **Phase 2: Validation of the CTFEQr17**

178 *Structure and Internal Consistency of the CTFEQr17*

179 The data met the assumptions for factor analysis with the Kaiser-Meyer-Olkin measure of
180 sampling adequacy index $KMO = 0.87$, and Bartlett's test of sphericity ($\chi^2 = 2706.45$,
181 $p < 0.001$), indicating that the correlations between items were sufficiently large for a PCA. A
182 varimax rotation PCA initially revealed four factors with Eigenvalues > 1 , which in
183 combination explained 51.6% of the variance. The factors of UE (items 3, 6, 8, 9, 12, 13, 15,
184 19 and 20) and EE (items 2, 4, 7, 10, 14 and 16) were retained as in the original TFEQr21.
185 However, CR loaded into two factors: CR1 items 1, 5 and 11 and CR2 items 17, 18 and 21.
186 The items in CR1 are related to current food restriction behaviour, whereas CR2 is related to
187 more prospective food restriction behaviours. However, following the removal of weak items
188 due to low inter-item and item-total correlations and Cronbach's α increasing after item
189 removal (17, 18, 19 & 21), a three factor structure was revealed, which explained 53.5%
190 variance. The factors of UE (items 3, 6, 8, 9, 12, 13, 15 and 20), EE (items 2, 4, 7, 10, 14 and
191 16) and CR (items 1, 5 and 11) were retained to create a CTFEQr17.

192

193 Following an analysis of internal consistency, the CTFEQr17 had a Cronbach's α of 0.85,
194 with the factors of UE ($\alpha = 0.85$) and EE ($\alpha = 0.83$) showing similarly high scores. The factor

195 of CR was ($\alpha = 0.67$) which although lower than UE and EE, was deemed adequate. The item
196 analysis also revealed that the factors had adequate to good inter-item correlations for CR ($r =$
197 $0.38 - 0.47$), UE ($r = 0.32 - 0.58$) and EE ($r = 0.36 - 0.59$), showing that the items within
198 each scale correlated with one another. The corrected item-total correlations were good; CR
199 ($r = 0.46 - 0.52$), UE ($0.53 - 0.63$) and EE ($r = 0.55 - 0.70$), with the items correlating most
200 strongly with their respective factors, supporting item-discriminant and convergent validity.
201 The factor of UE correlated significantly with EE ($r = 0.47, p < 0.001$) only.

202

203 Insert Table 1 here

204

205 *Children's Understanding of the Items*

206 The qualitative aspect of the analysis, concerning the children's understanding of the
207 questionnaire items, revealed a very good level of understanding of the CTFEQr17. More
208 specifically, in comparison to the original TFEQr21, all items of the CTFEQr17 were more
209 understandable (mean understanding of 95% compared with 81% for the original TFEQr21;
210 see Figure 1), where items 2, 9, 10, 11 and 12 were significantly more understood ($p < 0.05$)
211 compared to the original TFEQr21.

212

213 Insert Figure 1 here

214 Insert Table 2 here

215

216 *Participant Characteristics and CTFEQr17*

217 For both boys and girls, UE correlated negatively with age ($r = -0.32, p < 0.001$ and $r = -0.25,$
218 $p = 0.001$, respectively). CR correlated negatively with age for girls only ($r = -0.21, p < 0.01$).
219 No significant correlations for EE were found. Younger children scored higher on CR and
220 UE respectively ($F(1, 439) = 4.56, p < 0.05, \eta^2 = 0.01$; $F(1, 437) = 34.61, p < 0.001, \eta^2 = 0.07$).
221 While boys reported higher UE scores ($F(1, 437) = 7.07, p < 0.01, \eta^2 = 0.02$). No differences
222 for age and sex were found for EE (see Table 2).

223

224 Insert Table 3 here

225

226 *CTFEQr17, Body Weight, and BMI*

227 After controlling for age, CR was found to correlate positively with weight ($r = 0.21$,
228 $p < 0.05$), BMI ($r = 0.25$, $p < 0.01$) and BMI percentile ($r = 0.21$, $p < 0.05$) for girls only. No
229 other associations were found.

230

231 Table 3 presents the participant characteristics by CTFEQr17 group. The ANCOVA revealed
232 that those who have a HCR had a significantly higher weight ($F(1, 247) = 8.29$, $p < 0.01$, $\eta^2 =$
233 0.04), higher BMI ($F(1, 247) = 12.35$, $p = 0.001$, $\eta^2 = 0.05$), and higher BMI percentile ($F(1,$
234 $246) = 8.41$, $p < 0.01$, $\eta^2 = 0.04$), regardless of sex. No significant differences between UE and
235 EE groups and anthropometric measures were evident. Age was a significant covariate
236 throughout these analyses ($p < 0.01$).

237

238 Insert Table 4 here

239

240 *CTFEQr17, Food and Taste Preference*

241 Younger children were found to have a higher food preference for all categories; high
242 carbohydrate ($r = -0.33$, $p < 0.001$), high fat ($r = -0.24$, $p < 0.001$), and low energy ($r = -0.23$,
243 $p < 0.001$). This was particularly so for younger girls compared to boys. BMI correlated
244 negatively with high carbohydrate ($r = -0.24$, $p < 0.001$). This association was found to be
245 stronger in boys. No association between BMI percentile and food preference was found.

246

247 Partial correlations showed that UE was positively related to preferences for high fat foods (r
248 $= 0.26$, $p < 0.001$), high protein foods ($r = 0.27$, $p < 0.001$) and high carbohydrate foods ($r =$
249 0.23 , $p < 0.001$). The relationships between UE and food preferences were found to be
250 stronger in girls. Also, for EE significant relationships existed only for girls, for high
251 carbohydrate foods ($r = 0.25$, $p < 0.01$), high protein foods ($r = 0.22$, $p < 0.05$) and high fat
252 foods ($r = 0.21$, $p < 0.05$). No significant correlations between CR and food preference were
253 found.

254

255 Food preferences were found to differ significantly between the CTFEQr17 groups (see Table
256 4). ANCOVA revealed that for high protein preference, the HUE group had a higher
257 preference compared to the LUE ($F(1, 241) = 17.74, p < 0.001, \eta^2 = 0.07$). Boys consistently
258 showed a higher protein preference, regardless of CR, UE and EE groups ($F(1, 242) = 20.09,$
259 $p < 0.001, \eta^2 = 0.08$; $F(1, 241) = 14.98, p < 0.001, \eta^2 = 0.06$; $F(1, 242) = 18.28, p < 0.001, \eta^2 =$
260 0.07 , respectively). Both the HUE and HEE groups reported a greater preference for high fat
261 ($F(1, 241) = 16.79, p < 0.001, \eta^2 = 0.07$ and $F(1, 242) = 5.45, p < 0.05, \eta^2 = 0.02$ respectively)
262 and high carbohydrate foods ($F(1, 241) = 16.85, p < 0.001, \eta^2 = 0.07$ and $F(1, 242) = 4.63,$
263 $p < 0.05, \eta^2 = 0.02$, respectively). No differences were found for preference for low energy
264 foods. Age was a significant covariate throughout the analyses ($p < 0.001$).

265

266 In terms of taste preference, younger children had a higher preference across most categories;
267 LFSA ($r = -0.25, p < 0.001$), LFSW ($r = -0.23, p < 0.001$) and HFSW ($r = -0.26, p < 0.001$).
268 Taste preference was found to correlate more strongly for girls compared to boys for age.
269 However, BMI was only found to correlate with taste preference in boys for HFSW foods (r
270 $= -0.24, p < 0.01$).

271

272 Partial correlations revealed that UE was positively correlated with preference for HFSA ($r =$
273 $0.31, p < 0.001$) and HFSW foods ($r = 0.27, p < 0.001$). When examined by sex, taste
274 preference associations were stronger in girls: UE and EE with HFSW ($r = 0.38, p < 0.001$; $r =$
275 $0.25, p < 0.01$, respectively), and HFSA foods ($r = 0.34, p < 0.001$; $r = 0.20, p < 0.05,$
276 respectively) and UE with LFSA foods ($r = 0.25, p < 0.01$). No taste preference associations
277 were found with CR.

278

279 The CTFEQr17 groups also discriminated between taste preferences (see Table 4). The
280 ANCOVA revealed that irrespective of CR, UE or EE group, boys consistently had higher
281 preferences for LFSA foods ($F(1, 241) = 6.50, p < 0.05, \eta^2 = 0.03$; $F(1, 240) = 4.23, p < 0.05, \eta^2 =$
282 0.02 ; $F(1, 241) = 6.02, p < 0.05, \eta^2 = 0.02$) and HFSA foods ($F(1, 242) = 9.44, p < 0.01, \eta^2 =$
283 0.04 ; $F(1, 241) = 6.70, p = 0.01, \eta^2 = 0.02$; $F(1, 242) = 8.71, p < 0.01, \eta^2 = 0.04$, respectively).
284 The HUE group had a higher preference for LFSA foods ($F(1, 240) = 9.24, p < 0.01, \eta^2 =$
285 0.04). In addition, those with a HUE and HEE had a higher preference for HFSA foods ($F(1,$

286 240) = 18.66, $p < 0.001$, $\eta^2 = 0.09$; $F(1, 242) = 3.62$, $p = 0.058$, $\eta^2 = 0.02$) and HFSW foods
287 ($F(1, 241) = 18.60$, $p < 0.001$, $\eta^2 = 0.07$; $F(1, 242) = 8.45$, $p < 0.01$, $\eta^2 = 0.03$). Age was a
288 significant covariate throughout the analyses ($p < 0.001$).

289

290

291 **DISCUSSION**

292 The main aim of the present work was to propose a validated adaptation of the TFEQr21
293 among children and adolescents. According to our results, the proposed CTFEQr17
294 successfully assesses psychological eating behaviour traits in children and adolescents, and
295 also shows associations with body weight, BMI and food preference. These findings are
296 supported by qualitative data showing that the children had a good understanding of the
297 CTFEQr17 items, confirming the strength and usefulness of this tool.

298

299 **CTFEQr17 and Anthropometric Measures**

300 A high CR score was shown to be associated with a higher body weight, BMI and BMI
301 percentile, in girls. This finding supports previous work with adolescents by van Strein et al
302 ⁽⁸⁾, Snoek et al ⁽⁹⁾ and Martin-Garcia et al ⁽¹⁹⁾. Evidence also supports a stronger association
303 between adverse weight regulation and dietary restraint in girls compared to boys ⁽²²⁾. These
304 seemingly counterintuitive findings are explained well with the goal conflict theory ⁽²³⁾. This
305 theory posits that weight regulation issues are a result of the conflict between the goal of
306 weight control and the goal of eating enjoyment; the hedonic expectation of food often
307 undermines the goal of weight control ⁽²⁴⁾. In the current obesogenic environment, replete
308 with palatable foods, the goal of eating enjoyment is more often primed, requiring a higher
309 cognitive effort to maintain the goal of weight control ⁽²³⁾. Such cognitive effort can easily
310 become more difficult to maintain when other issues (e.g. emotions, work) reduce cognitive
311 capacity available, resulting in the goal of eating enjoyment becoming much easier to access
312 ⁽²³⁾. As a consequence, a less healthy eating pattern can occur, leading to a susceptibility to
313 weight gain ⁽²⁵⁾.

314

315 Although the goal conflict theory supports our results, conflicting evidence exists, as
316 restrained eating has also been associated with lower food intake and better weight regulation
317 (e.g. 26-28). This suggests that some individuals are better able to maintain their weight control
318 goal in comparison to their eating enjoyment goal. Thus, the relationship between CR and
319 weight is complex, and CR likely interacts with other eating behaviour traits (e.g.
320 Disinhibition) to produce differing influences upon body weight (6;29). That CR was
321 associated with a higher weight and BMI in this child and adolescent sample supports a large
322 body of adolescent and adult data, suggesting the CTFEQr17 has successfully measured this
323 psychological construct.

324

325 Both UE and EE were found not to be related to anthropometric measures. This lack of
326 association has also been found in adults (13). However, there is evidence that suggests EE (30),
327 UE (19;31) or both UE and EE (32;33) are associated with higher weight and BMI in adolescents
328 and adults. Where relationships have been found in adolescents (19), the study sample
329 consisted of overweight/obese and lean groups of children/adolescents. In the current study,
330 children and adolescents were sampled from schools and not selected based on their weight
331 status, thus having a lower proportion of overweight and obese participants. This could
332 explain why associations with UE and EE were not found. In addition, where relationships
333 have been found in adult samples, this has, at least partially, been attributed to food choice,
334 whereby those with a higher UE and EE have a less healthful diet, higher energy intake and
335 higher snack intake (31; 33) and partake in less physical activity (33). This suggests that the food
336 preferences of UE and EE can impact adversely upon weight status.

337

338 **CTFEQr17, Food and Taste Preference**

339 Higher preferences for HFSA, HFSW, high carbohydrate and high fat foods were evident in
340 those children who were characterised with higher UE and EE scores; this relationship was
341 particularly strong in girls. This taste preference pattern reflects evidence from adult
342 populations, which have shown a higher preference for high fat foods in UE and EE adults
343 (34). A preference for HFSW foods in individuals with a high EE has also been found to be
344 particularly strong in women compared to men (34). This indicates that the taste preferences,
345 and associated sex differences, found in adults are also found in children and adolescents,

346 suggesting these preferences begin in childhood and persist into adulthood. Furthermore, UE
347 and EE are characterised by eating in response to the palatability of food, eating
348 opportunistically and eating in response to negative affect. Individuals with a HUE and HEE
349 report a higher preference for high fat (savoury and sweet) and high carbohydrate foods ^(34;35).
350 These foods typically reflect highly palatable, energy dense foods (e.g. crisps, sausage roll,
351 biscuits, cakes). Due to their macronutrient content, these foods have a relatively low
352 satiating ability ⁽³⁶⁾, and eating them can result in passive overconsumption ⁽³⁷⁾, increasing
353 vulnerability to future weight gain ⁽³⁸⁾. Indeed, this is reflected in adult data where UE and EE
354 are related to higher body weight ^(32;33).

355

356 Independently of CTFEQr17 scores, males were found to have a higher preference for high
357 protein food, HFSA and LFSA foods. This pattern has previously been reported in children
358 and adolescents ⁽³⁹⁾, and in adults ⁽⁴⁰⁾. In addition, younger children also reported higher food
359 preferences than older children, regardless of gender; this has also been previously reported
360 ⁽³⁹⁾. Interestingly, food and taste preference were more strongly related to psychological
361 factors of the CTFEQr17 in girls than boys, whereas food preference was more strongly
362 associated with anthropometric measures in boys. This is despite no difference in sex being
363 reported for CR and EE, and boys scoring higher on the UE scale. Existing evidence purports
364 that females tend to score more highly on CR, UE and EE in adolescents ⁽⁴¹⁾, on EE in adults
365 ^(14;42) and CR in adults ^(43;44). Thus, females are reporting a higher influence of psychological
366 eating behaviour traits over their eating behaviour. The reason for this sex difference is
367 unclear and needs to be further elucidated.

368

369 **Strengths and Limitations**

370 A strength of this study is that the CTFEQr17 was both statistically and qualitatively verified
371 as valid. The development of the CTFEQr17 involved creating accessible items by using the
372 children/adolescent's own phraseology ascertained from interviews. This produced a
373 questionnaire that was highly understandable for children and adolescents. However,
374 although associations between the CTFEQr17 and food and taste preference were found,
375 measurement of actual food intake was not carried out. Food preferences and the relationship
376 between 'liking' and 'wanting' of foods have been found to be related to food intake ⁽⁴⁵⁾ and

377 also associated with TFEQ factors in adults (e.g. 46), thus an examination of this relationship in
378 children and adolescents would be beneficial. A further limitation of the study is that body
379 composition was not assessed; with research suggesting measurement of actual body
380 composition is more accurate in determining relevant relationships than BMI (47, 48). Research
381 by Martin-Garcia et al., (19) also found an association between fat mass and CR in children
382 and adolescents, therefore further exploration of this is of interest. Furthermore, although our
383 sample size was adequate for the intended analysis, there were a larger proportion of
384 secondary school children; further consideration of the CTFEQr17 in primary school children
385 would be interesting. However, our sample did reflect that which was used to validate the
386 Spanish TFEQr21C (19).

387

388

389 **CONCLUSION**

390 The CTFEQr17 shows good internal consistency and is suitable for use in children and
391 adolescents. The factor of CR was found to be associated with higher body weight, BMI and
392 BMI percentile, thus those children who were larger showed more restrictive eating
393 behaviours. Both UE and EE were associated with a higher preference for HFSA and HFSW
394 foods, which is consistent with adult data and demonstrates that children with these eating
395 behaviour traits have less healthy food preferences. Furthermore, a sex difference in the
396 relationships between CTFEQr17 factors, anthropometric measurements and food
397 preferences was apparent, whereby a stronger relationship was observed in girls. Collectively,
398 the CTFEQr17 appears to be a valid and suitable tool to measure eating behaviour traits in
399 children and adolescents.

400

401

402 **APPENDIX 1**

403 The items have been coded as in the original TFEQr21 (13).

404 1. I eat small portions of food to help control my weight: Totally true (4); Mostly true
405 (3); Mostly false (2); Totally false (1).

- 406 2. I start to eat when I feel worried: Totally true (4); Mostly true (3); Mostly false (2);
407 Totally false (1).
- 408 3. Sometimes when I start eating, it seems I can't stop: Totally true (4); Mostly true (3);
409 Mostly false (2); Totally false (1).
- 410 4. When I am sad, I usually eat too much: Totally true (4); Mostly true (3); Mostly false
411 (2); Totally false (1).
- 412 5. I don't eat some kinds of food because they can make me fat: Totally true (4); Mostly
413 true (3); Mostly false (2); Totally false (1).
- 414 6. When I am next to someone who is eating, I also feel like eating: Totally true (4);
415 Mostly true (3); Mostly false (2); Totally false (1).
- 416 7. When I feel angry, I need to eat: Totally true (4); Mostly true (3); Mostly false (2);
417 Totally false (1).
- 418 8. I often get so hungry that I feel like I could eat loads of food without getting full:
419 Totally true (4); Mostly true (3); Mostly false (2); Totally false (1).
- 420 9. When I am hungry, I feel like to have to eat all of the food on my plate in one go,
421 without stopping: Totally true (4); Mostly true (3); Mostly false (2); Totally false (1).
- 422 10. When I feel lonely, I make myself feel better by eating: Totally true (4); Mostly true
423 (3); Mostly false (2); Totally false (1).
- 424 11. I eat less than I want at meal times to stop myself putting on weight: Totally true (4);
425 Mostly true (3); Mostly false (2); Totally false (1).
- 426 12. When I smell or see my favourite food, I find it hard to stop myself from eating it,
427 even if I've just finished a meal: Totally true (4); Mostly true (3); Mostly false (2); Totally
428 false (1).
- 429 13. I'm always hungry enough to eat at any time: Totally true (4); Mostly true (3); Mostly
430 false (2); Totally false (1).
- 431 14. If I feel nervous, I try to calm myself down by eating: Totally true (4); Mostly true
432 (3); Mostly false (2); Totally false (1).

- 433 15. When I see something that looks delicious, I get so hungry that I have to eat it right
434 away: Totally true (4); Mostly true (3); Mostly false (2); Totally false (1).
- 435 16. When I feel really upset, I want to eat: Totally true (4); Mostly true (3); Mostly false
436 (2); Totally false (1).
- 437 17. How often do you feel hungry? Only at mealtimes (1); Sometimes between meals (2);
438 Often between meals (3); Almost always (4).

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440 REFERENCES

441

- 442 1. The GBD 2015 Obesity Collaborators (2017) Health Effects of Overweight and
443 Obesity in 195 Countries over 25 Years. *The New Eng. J. Med.* Published online 12th
444 June 2017: DOI: 10.1056/NEJMoa1614362
- 445 2. Ogden CL, Lamb MM, Carroll MD *et al.* (2010) Obesity and socioeconomic status in
446 children and adolescents: United States, 2005-2008. *NCHS Data Brief.* **51**, 1-8.
- 447 3. Cattaneo A, Monasta L, Stamatakis E *et al.* (2010) Overweight and obesity in infants
448 and pre-school children in the European Union: a review of existing data. *Obes Rev.*
449 **11**, 389-98.
- 450 4. Swinburn, B., Egger, G., & Raza, F. (1999) Dissecting obesogenic environments: the
451 development and application of a framework for identifying and prioritizing
452 environmental interventions for obesity. *Prev. Med.* **29**, 563-570.
- 453 5. Swinburn BA, Sacks G, Hall KD *et al.* (2011) The global obesity pandemic: shaped
454 by global drivers and local environments. *Lancet.* **378**, 804-14.
- 455 6. Gallant AR, Tremblay A, Perusse *et al.* (2010) The Three-Factor Eating
456 Questionnaire and BMI in adolescents: results from the Quebec Family Study. *Brit.*
457 *J. Nutr.* **104**, 1074-9.
- 458 7. Chaput JP, Leblanc C, Pérusse L *et al.* (2009) Risk factors for adult overweight and
459 obesity in the Quebec Family Study: have we been barking up the wrong tree?
460 *Obesity.* **17**, 1964-70.
- 461 8. van Strien T, Herman CP, Verheijden MW (2012) Eating style, overeating and weight
462 gain. A prospective 2-year follow-up study in a representative Dutch sample.
463 *Appetite.* **59**, 782-9.

- 464 9. Snoek HM, Engels RC, van Strien T *et al* (2013) Emotional, external and restrained
465 eating behaviour and BMI trajectories in adolescence. *Appetite*. **67**, 81-7.
- 466 10. Polivy J, & Herman, CP (1976) Effects of alcohol on eating behavior: influence of
467 mood and perceived intoxication. *J. Abnorm. Psych.* **85**, 601.
- 468 11. Meyer JE, & Pudel VE (1977). Experimental feeding in man: a behavioral approach
469 to obesity. *Psych. Med.* **39**, 153-157.
- 470 12. Bryant EJ, King NA & Blundell JE (2008) Disinhibition: its effect on appetite and
471 weight regulation. *Ob. Rev.* **9**, 409-419.
- 472 13. Cappelleri JC, Bushmakin AG, Gerber RA *et al.* (2009) Psychometric analysis of the
473 Three-Factor Eating Questionnaire-R21: results from a large diverse sample of obese
474 and non-obese participants. *Int. J. Obes.* **33**, 611–620.
- 475 14. Karlsson J, Persson LO, Sjostrom L *et al.* (2000) Psychometric properties and factor
476 structure of the Three-Factor Eating Questionnaire (TFEQ) in obese men and women.
477 Results from the Swedish Obese Subjects (SOS) study. *Int. J. Obes.* **24**, 1715–1725.
- 478 15. Stunkard AJ, & Messick S (1985). The three-factor eating questionnaire to measure
479 dietary restraint, disinhibition and hunger. *J. Psychosom. Res.* **29**, 71-83.
- 480 16. Karakuş SŞ, Yıldırım, H, & Büyüköztürk Ş (2016) Adaptation of three factor eating
481 questionnaire (TFEQ-R21) into Turkish culture: A validity and reliability study. *TAF*
482 *Prevent. Med. Bull.* **15**, 229-237.
- 483 17. Drapeau V, Depres JP, Bouchard C *et al* (2004) Modifications in food-group
484 consumption are related to long-term body-weight changes. *Am. J. Clin. Nutr.* **80**, 29-
485 37.
- 486 18. de Medeiros ACQ, Yamamoto ME, Pedrosa LFC *et al.* (2016). The Brazilian version
487 of the three-factor eating questionnaire-R21: psychometric evaluation and scoring
488 pattern. *Eat. Weight Dis.* **22**, 169-175.
- 489 19. Martín-García M, Vila-Maldonado S, Rodríguez-Gómez I, *et al.* (2016) The Spanish
490 version of the Three Factor Eating Questionnaire-R21 for children and adolescents
491 (TFEQ-R21C): Psychometric analysis and relationships with body composition and
492 fitness variables. *Physiol Behav.* **165**, 350-7.
- 493 20. de Onis M, Onyango AW, Borghi E *et al.* (2007) Development of a WHO growth
494 reference for school-aged children and adolescents. *Bull. WHO.* **85**, 660-67.
- 495 21. Halford JCG, Boyland E J, Cooper GD *et al.* (2008) Children's food preferences:
496 Effects of weight status, food type, branding and television food advertisements
497 (commercials). *Int. J.Ped. Obes.* **3**, 31-38.

- 498 22. Halberstadt J, van Strien T, de Vet E *et al.* (2016) The association of eating styles
499 with weight change after an intensive combination lifestyle intervention for children
500 and adolescents with severe obesity. *Appetite*. **99**, 82-90.
- 501 23. Stroebe W, van Koningsbruggen GM, Papies EK *et al.* (2013) Why most dieters fail
502 but some succeed: A goal conflict model of eating behavior. *Psych. Rev.* **120**, 110-
503 138.
- 504 24. Veling H, Aarts H, & Papies EK (2011) Using stop signals to inhibit chronic dieters'
505 responses toward palatable foods. *Beh. Res. & Therapy*. **49**, 771-780.
- 506 25. van Strien T, Herman CP, Verheijden MW (2014) Dietary restraint and body mass
507 change. A 3-year follow-up study in a representative Dutch sample. *Appetite*. **76**, 44-
508 49.
- 509 26. Kemps E, Herman CP, Hollitt S *et al.* (2016) The role of expectations in the effect of
510 food exposure on food intake. *Appetite*. **103**, 259-264.
- 511 27. Graham A, Gluck ME, Votruba SB *et al* (2014) Perseveration augments the effect of
512 cognitive restraint on ad libitum food intake in adults seeking weight loss. *Appetite*.
513 **82**, 78-84.
- 514 28. Roberts CJ, Campbell IC & Troop N (2013) Increases in weight during chronic stress
515 are partially associated with a switch in food choice towards increased carbohydrate
516 and saturated fat intake. *Euro. Eating Dis. Rev.* **22**, 77-82.
- 517 29. Bryant EJ, Kiezebrink K, King NA *et al* (2010) Interaction between disinhibition and
518 restraint: implications for body weight and eating disturbance. *Eat. Weight Disord*.
519 **15**, e43 – e51.
- 520 30. Angle S, Engblom J, Eriksson T *et al* (2009) Three Factor Eating Questionnaire R18
521 as a measure of cognitive restraint, uncontrolled eating and emotional eating in a
522 sample of young Finnish females. *Int. J. Beh. Nutr & Phys. Activity*. **6**, 41-48.
- 523 31. de Lauzon B, Roman M, Deschamps V *et al* (2004) The Three Factor Eating
524 Questionnaire R18 is able to distinguish among different eating patterns in the general
525 population. *Am. Soc. Nutr. Sci.* **134**, 2372-2380.
- 526 32. Kontinen H, Haukala A, Sarlio-Lahteenkarva S *et al* (2009) Eating styles, self-
527 control and obesity indicators. The moderating role of obesity status and dieting
528 history on restrained eating. *Appetite*. **53**, 131-134.
- 529 33. Green GW, Schembre SM, White AA *et al.* (2011) Identifying clusters of college
530 students at elevated health risk based on eating and exercise behaviors and
531 psychosocial determinants of body weight. *J. Am. Dietetic Assoc.* **111**, 394-400.

- 532 34. Keski-talo K, Tuorila H, Spector TD *et al* (2008) The Three Factor Eating
533 Questionnaire, body mass index, and responses to sweet and salty fatty foods: a twin
534 study of genetic and environmental associations. *Am. J. Clin. Nutr.* **88**, 263-71.
- 535 35. Camilleri GM, Mejean C, Kesse-Guyot E *et al.* (2014) The associations between
536 emotional eating and consumption of energy-dense snack foods are modified by sex
537 and depressive symptomology. *J. Nutr.* doi: 10.3945/jn.114.193177.
- 538 36. Gerstein DE, Woodward-Lopez G, Evans AE *et al.* (2004) Clarifying concepts about
539 macronutrients' effects on satiation and satiety. *J. Am. Diet. Assoc.* **104**, 1151-1153.
- 540 37. Westerterp KR (2006) Perception, passive overfeeding and energy metabolism. *Phys.*
541 *Behav.* **89**, 62-65.
- 542 38. Blundell JE & MacDiarmid JI (1997) Fat as a risk factor for overconsumption:
543 satiation, satiety and patterns of eating. *J. Am. Diet. Assoc.* **97**, S63-S69.
- 544 39. Caine-Bish NL & Scheule B (2009) Gender differences in food preferences of school-
545 aged children and adolescents. *J. Sch. Health.* **79**, 532-540.
- 546 40. Arganini C, Saba A, Comitato F, Turrini A (2012) Gender differences in food choice
547 and dietary intake in modern western societies. *Public Health – Social and Behavioral*
548 *Health*. Chapter 4. Intech: open science.
- 549 41. Vagstrand K, Linne Y, Karlsson J *et al* (2009) Correlates of soft drink and fruit juice
550 consumption among Swedish adolescents. *Brit. J. Nutr.* **101**, 1541-1548.
- 551 42. Peneau S, Menard E, Mejean C *et al.* (2013) Sex and dieting modify the association
552 between emotional eating and weight status. *Am. Soc. Nutr.* **97**, 1307-1313.
- 553 43. Hainer V, Kanesova M, Bellisle F *et al.* (2006) The Eating Inventory, body adiposity
554 and prevention of diseases in a quota of Czech adults. *Int. J. Obes.* **30**, 830-36.
- 555 44. Provencher V, Drapeau V, Tremblay A *et al* (2003) Eating behaviors and indices of
556 body composition in men and women from the Quebec family study. *Obes. Res.* **11**,
557 783-792.
- 558 45. Finlayson G, Dalton M (2012) Current progress in the assessment of 'liking' vs.
559 'wanting' food in human appetite. Comment on "'You say it's liking, i say it's
560 wanting...". On the difficulty of disentangling food reward in man'. *Appetite.* **58**, 373-
561 378.
- 562 46. Finlayson G, Bordes I, Griffioen-Roose S *et al.* (2012) Susceptibility to Overeating
563 Affects the Impact of Savory or Sweet Drinks on Satiation, Reward, and Food Intake
564 in Nonobese Women. *Am. Soc. Nutr.* **142**, 125-130.

565 47. Prentice AM, and Jebb SA (2001) Beyond body mass index. *Ob. Rev.* **2**, 141-
566 147.
567 48. Wells JCK, Coward WA, Cole TJ *et al.* (2002) The contribution of fat and fat-
568 free tissue to body mass index in contemporary children and the reference
569 child. *Int. J. Obes. Rel. Metab. Dis.* **26**, 1323-1329.

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589 **Table 1.** Rotated factor structure loading of the CTFEQr17.

| | Uncontrolled Eating | Emotional Eating | Cognitive Restraint (1) | Communalities |
|---|---------------------|------------------|-------------------------|---------------|
| 12. When I smell or see my favourite food, I find it hard to stop myself from eating it, even if I've just finished a meal. | 0.73 | | | 0.56 |
| 8. I often get so hungry that I feel like I could eat loads of food without getting full. | 0.72 | | | 0.53 |
| 15. When I see something that looks delicious, I get so hungry that I have to eat it right away. | 0.70 | | | 0.53 |
| 3. Sometimes when I start eating, it seems I can't stop. | 0.69 | | | 0.52 |
| 6. When I am next to someone who is eating, I also feel like eating. | 0.67 | | | 0.51 |
| 13. I'm always hungry enough to eat at any time. | 0.66 | | | 0.49 |
| 20. How often do you feel hungry? | 0.63 | | | 0.47 |
| 9. When I am hungry, I feel like to have to eat all of the food on my plate in one go, without stopping. | 0.61 | | | 0.45 |
| 16. When I feel really upset, I want to eat. | | 0.81 | | 0.67 |
| 14. If I feel nervous, I try to calm myself down by eating. | | 0.73 | | 0.60 |
| 2. I start to eat when I feel worried. | | 0.72 | | 0.55 |
| 7. When I feel angry, I need to eat. | | 0.68 | | 0.49 |

| | | | |
|--|-------|-------|-------|
| 4. When I am sad, I usually eat too much. | 0.66 | | 0.49 |
| 10. When I feel lonely, I make myself feel better by eating. | 0.65 | | 0.51 |
| 1. I eat small portions of food to help control my weight. | | 0.80 | 0.64 |
| 11. I eat less than I want at meal times to stop myself putting on weight. | | 0.78 | 0.61 |
| 5. I don't eat some kinds of food because they can make me fat. | | 0.72 | 0.55 |
| Explained variance | 31.20 | 12.75 | 9.54 |
| Cumulative variance | 31.20 | 43.95 | 53.45 |

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607 **Table 2.** CTFEQr17 factor scores between age groups and sex.

| | Primary School (7-10 years) | | Secondary School (11-15years) | |
|----|-----------------------------|----------------|-------------------------------|-----------------|
| | Boys (n = 46) | Girls (n = 39) | Boys (n = 184) | Girls (n = 174) |
| CR | 2.38 (0.78)# | 2.52 (0.81)# | 2.37 (0.72) | 2.16 (0.66) |
| UE | 2.88 (0.87)*# | 2.50 (0.88)# | 2.25 (0.59)* | 2.11 (0.64) |
| EE | 1.52 (0.61) | 1.65 (0.65) | 1.48 (0.54) | 1.58 (0.63) |

608 Data are presented as mean (SD).

609 CR, cognitive restraint; UE, uncontrolled eating; EE, emotional eating.

610 *Boys have a significantly higher UE score compared to girls (p<0.001).

611 #Younger children have a significantly higher CR and UE compared to older children
 612 (p<0.01).

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614 **Table 3.** Body measurements and food preference by CTFEQr17 groups.

| | Low CR | | High CR | | Low UE | | High UE | | Low EE | | High EE | |
|---|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|
| | Boys (n = 48) | Girls (n = 55) | Boys (n = 82) | Girls (n = 66) | Boys (n = 48) | Girls (n = 55) | Boys (n = 82) | Girls (n = 66) | Boys (n = 48) | Girls (n = 55) | Boys (n = 82) | Girls (n = 66) |
| Weight (kg) | 44.41 (16.71) | 45.60 (12.78) | 48.37¶ (17.91) | 45.77¶ (16.88) | 50.29 (18.54) | 47.85 (14.69) | 44.85 (16.63) | 43.63 (15.51) | 45.92 (17.21) | 48.01 (15.52) | 47.73 (17.84) | 43.52 (14.57) |
| BMI (kg/m²) | 18.60 (3.72) | 19.47 (3.78) | 20.02¶ (4.72) | 20.36¶ (4.94) | 20.35 (5.04) | 20.25 (4.47) | 18.99 (3.93) | 19.69 (4.52) | 19.59 (4.70) | 20.31 (4.43) | 19.49 (4.28) | 19.64 (4.51) |
| BMI percentile | 50.34 (31.90) | 51.24 (31.36) | 60.69¶ (30.27) | 63.32¶ (29.53) | 60.86 (32.79) | 56.69 (31.62) | 54.81 (29.93) | 59.17 (30.46) | 60.69 (30.87) | 58.81 (29.42) | 54.92 (31.23) | 57.19 (32.30) |
| % overweight / obese¹ | 18.2 | 11.1 | 22.4 | 25.0 | 24.2 | 15.9 | 17.9 | 23.1 | 26.0 | 15.3 | 17.7 | 22.2 |

615 Data are shown as mean (SD).

616 CR, cognitive restraint; UE, uncontrolled eating; EE, emotional eating; BMI, body mass index.

617 ¹Based on the World Health Organization criteria.

618 ¶ = high CR, UE or EE group was significantly different to low CR, UE or EE group

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624 Table 4 – Food preference by sex and CTFEQr17 groups

| | | CR | | | UE | | | EE | | |
|-------------------------------------|-----------------------|----------------|----------------|-----------------|----------------|----------------|-----------------|----------------|----------------|-----------------|
| | | Low | High | Mean Sex Score | Low | High | Mean Sex Score | Low | High | Mean Sex Score |
| High Protein Preference | Boys | 2.91 (2.96) | 2.42 (2.25) | 2.59 (2.52) | 1.82 (1.98) | 3.09 (2.71) | 2.59 (2.52) | 2.59 (2.92) | 2.59 (2.23) | 2.59 (2.52) |
| | Girls | 1.19 (1.66) | 1.56 (1.82) | 1.40 (1.76)* | 0.79 (1.03) | 2.03 (2.11) | 1.40 (1.77)* | 0.93 (1.40) | 1.83 (1.95) | 1.40 (1.76)* |
| | Mean | 1.97 | 2.03 | | 1.25 | 2.63 | | 1.71 | 2.24 | |
| | CTFEQr17 Score | (2.48) | (2.11) | | (1.61) | (2.52) ¶ | | (2.38) | (2.13) | |
| High Carbohydrate Preference | Boys | 3.27 (2.23) | 3.24 (2.17) | 3.25 (2.19) | 2.50 (2.09) | 3.74 (2.12) | 3.25 (2.19) | 3.29 (2.19) | 3.22 (2.20) | 3.25 (2.19) |
| | Girls | 2.36 (1.96) | 3.35 (2.02) | 2.92 (2.05) | 2.21 (1.93) | 3.68 (1.92) | 2.93 (2.05) | 2.28 (2.13) | 3.51 (1.80) | 2.92 (2.05) |
| | Mean | 2.77 | 3.29 | | 2.34 | 3.71 | | 2.75 | 3.35 | |
| | CTFEQr17 Score | (2.13) | (2.11) | | (2.00) | (2.02) ¶ | | (2.21) | (2.03) ¶ | |
| High Fat Preference | Boys | 3.45 (2.19) | 3.51 (2.43) | 3.50 (2.34) | 2.86 (2.63) | 3.90 (2.05) | 3.50 (2.34) | 3.29 (2.26) | 3.63 (2.40) | 3.50 (2.34) |
| | Girls | 3.64 (2.47) | 3.51 (1.74) | 3.57 (2.08) | 2.77 (1.38) | 4.42 (2.35) | 3.58 (2.09) | 3.05 (1.61) | 4.05 (2.36) | 3.57 (2.08) |
| | Mean | 3.56 | 3.51 | | 2.81 | 4.13 | | 3.17 | 3.82 | |
| | CTFEQr17 Score | (2.34) | (2.14) | | (2.03) | (2.20) ¶ | | (1.93) | (2.38) ¶ | |
| Low Energy Preference | Boys | 3.25 (2.31) | 3.01 (1.82) | 3.10 (2.15) | 3.28 (2.05) | 2.97 (1.97) | 3.10 (2.00) | 3.45 (2.35) | 2.85 (1.70) | 3.10 (2.00) |
| | Girls | 2.49 (2.15) | 3.59 (2.01) | 3.11 (2.14) | 2.69 (1.92) | 3.56 (2.28) | 3.12 (2.14) | 2.67 (1.88) | 3.51 (2.29) | 3.11 (2.14) |
| | Mean | 2.84 | 3.27 | | 2.96 | 3.23 | | 3.04 | 3.15 | |
| | CTFEQr17 Score | (2.25) | (1.92) | | (1.99) | (2.13) | | (2.13) | (2.01) | |

| | | | | | | | | | | |
|------------------------|-----------------|----------------|----------------|-----------------|----------------|----------------|-----------------|----------------|----------------|-----------------|
| | <i>Score</i> | | | | | | | | | |
| LFSA Preference | Boys | 0.35 (0.30) | 0.32 (0.20) | 0.33 (0.24) | 0.28 (0.22) | 0.36 (0.25) | 0.33 (0.24) | 0.35 (0.27) | 0.32 (0.22) | 0.33 (0.24) |
| | Girls | 0.22 (0.21) | 0.30 (0.20) | 0.26 (0.21)* | 0.19 (0.17) | 0.34 (0.22) | 0.26 (0.21)* | 0.20 (0.18) | 0.32 (0.21) | 0.26 (0.21)* |
| | <i>Mean</i> | 0.28 | 0.31 | | 0.23 | 0.35 | | 0.27 | 0.32 | |
| | <i>CTFEQr17</i> | (0.26) | (0.20) | | (0.20) | (0.24) ¶ | | (0.24) | (0.22) | |
| | <i>Score</i> | | | | | | | | | |
| LFSW Preference | Boys | 0.48 (0.33) | 0.48 (0.30) | 0.48 (0.31) | 0.48 (0.31) | 0.48 (0.32) | 0.48 (0.31) | 0.54 (0.35) | 0.44 (0.28) | 0.48 (0.31) |
| | Girls | 0.41 (0.28) | 0.59 (0.28) | 0.51 (0.29) | 0.48 (0.30) | 0.55 (0.29) | 0.51 (0.29) | 0.47 (0.29) | 0.55 (0.29) | 0.51 (0.29) |
| | <i>Mean</i> | 0.44 | 0.53 | | 0.48 | 0.51 | | 0.50 | 0.49 | |
| | <i>CTFEQr17</i> | (0.31) | (0.30) | | (0.30) | (0.31) | | (0.32) | (0.29) | |
| | <i>Score</i> | | | | | | | | | |
| HFSA Preference | Boys | 0.36 (0.25) | 0.34 (0.27) | 0.35 (0.26) | 0.25 (0.24) | 0.41 (0.26) | 0.35 (0.26) | 0.34 (0.27) | 0.35 (0.26) | 0.35 (0.26) |
| | Girls | 0.21 (0.22) | 0.28 (0.21) | 0.25 (0.22)* | 0.17 (0.16) | 0.34 (0.23) | 0.25 (0.22)* | 0.20 (0.19) | 0.30 (0.23) | 0.25 (0.22)* |
| | <i>Mean</i> | 0.28 | 0.31 | | 0.21 | 0.38 | | 0.26 | 0.33 | |
| | <i>CTFEQr17</i> | (0.24) | (0.25) | | (0.21) | (0.25) ¶ | | (0.24) | (0.25) | |
| | <i>Score</i> | | | | | | | | | |
| HFSW Preference | Boys | 0.49 (0.30) | 0.46 (0.34) | 0.47 (0.33) | 0.38 (0.37) | 0.53 (0.28) | 0.47 (0.33) | 0.44 (0.32) | 0.49 (0.34) | 0.47 (0.33) |
| | Girls | 0.47 (0.39) | 0.47 (0.32) | 0.47 (0.32) | 0.35 (0.21) | 0.60 (0.37) | 0.47 (0.32) | 0.37 (0.25) | 0.56 (0.36) | 0.47 (0.32) |
| | <i>Mean</i> | 0.48 | 0.46 | | 0.36 | 0.56 | | 0.40 | 0.52 | |
| | <i>CTFEQr17</i> | (0.35) | (0.31) | | (0.29) | (0.32) ¶ | | (0.28) | (0.35) ¶ | |
| | <i>Score</i> | | | | | | | | | |

625 Data are shown as mean (SD).

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627 CR, cognitive restraint; UE, uncontrolled eating; EE, emotional eating.

628 LFSA, low fat savoury; HFSA, high fat savoury; LFSW, low fat sweet; HFSW, high fat sweet.

629 * = boys are significantly different to girls.

630 ¶ = high CR, UE or EE group was significantly different to low CR, UE or EE group.

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638 **FIGURE LEGEND**

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640 **Figure 1.** Comparison of percentage correct understanding of items between the original
641 TFEQr21 and the new CTFEQr17.

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643 *Understanding of the CTFEQr17 item is significantly higher than original TFEQr21 ($p < 0.05$).

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