

Article

1 The effectiveness of a social media intervention for reducing portion sizes in young adults
2 and adolescents

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29 **Abstract**

30 **Objective:** Adolescents and young adults select larger portions of energy-dense food than
31 recommended. The majority of young people have a social media profile, and peer influence
32 on social media may moderate the size of portions selected.

33 **Methods:** Two pilot-interventions examined whether exposure to images of peers' portions
34 of high-energy-dense (HED) snacks and sugar-sweetened-beverages (SSBs) on social media
35 (Instagram) would influence reported desired portions selected on a survey. Confederate
36 peers posted 'their' portions of HED snacks and SSBs on Instagram. At baseline and
37 intervention end participants completed surveys that assessed desired portion sizes.

38 **Results:** In intervention 1, Undergraduate students (N=20, Mean age=19.0y, SD=0.65y)
39 participated in a two-week intervention in a within-subjects design. Participants reported
40 smaller desired portions of HED snacks and SSBs following the intervention, and smaller
41 desired portions of HED snacks for their peers. In intervention 2, adolescents (N=44, Mean
42 age=14.4y, SD=1.06y) participated in a four-week intervention (n=23) or control condition
43 (n=21) in a between-subjects design. Intervention 2 did not influence adolescents to reduce
44 their desired reported portion sizes of HED snacks or SSBs relative to control.

45 **Conclusions:** These preliminary studies demonstrated that social media is a feasible way to
46 communicate with young people. However, while the intervention influenced young adults'
47 reported desired portions and social norms regarding their peers' portions, no significant
48 impact on desired reported portion sizes was found for HED snacks and SSBs in adolescents.
49 Desired portion sizes of some foods and beverages may be resistant to change via a social
50 media intervention in this age group.

51 **Keywords**

52 Social norms, peers, eating behaviour, nutrition, nudging

53

54 **Introduction**

55 Food and beverage portion sizes have increased in recent years ^{1,2} and there is robust
56 evidence that adults and children eat more when served a larger portion than when served a
57 smaller portion ³⁻⁷. In particular, high energy-dense foods (HED) such as sweet and savoury
58 snacks, and sugar-sweetened beverages (SSBs) have been shown to be chosen in larger
59 portions than recommended ^{8,9}, with adolescents preferentially selecting these items ⁹.
60 Hollands et al (2015) suggest that reduced exposure to larger than recommended portions
61 across the diet could reduce energy intake by 12-16% in adults and children. Therefore,
62 finding strategies to reduce exposure and to encourage selection of smaller portions of HED
63 snacks and SSBs is an important next step ⁷.

64 Social media is widely used, with 2.89 billion active users as of 2017 ¹⁰, and 74% of
65 adolescents having a social media profile ¹¹. A recent study found that the majority of images
66 (67.7%) posted by adolescents on social media were of HED snack foods ¹². Therefore, social
67 media may be a valuable intervention tool for encouraging the selection of smaller portions of
68 HED snacks and SSBs. There is evidence that incorporating peers in a social media
69 intervention may improve young adults' sexual health knowledge and behaviour ^{13,14},
70 however, less is known about the influence of peers on social media for eating behaviour.

71 According to the normative model of social influence ¹⁵ people are often uncertain about how
72 to act in a situation, and rely on the behaviour of others for guidance when such behaviours
73 are salient. Peers are known to be a key influence on eating behaviour in experimental studies
74 ¹⁶⁻²⁰, and people have been shown to adjust their eating behaviour to that of a present
75 instructed confederate peer ²¹⁻²³, to remote peers who are visible but not present ¹⁸, and to
76 social norms which indicate the behaviour of others ²⁴. For example, a peer on a video
77 influenced adolescents' food intake, with adolescents eating more when the video peer ate a
78 large amount, and less when the video peer ate a small amount ¹⁸. Furthermore, exposing

79 participants to information about how other people in the study have eaten (e.g. an
80 information sheet which states the amount of food eaten by other people) has been shown to
81 influence eating behaviour²⁴. Thus, it is plausible that images of remote-confederate peers'
82 snacks and drinks on social media may set a social norm and influence other people's portion
83 sizes. However, to our knowledge this has not been examined and warrants investigation.

84 Here, two pilot interventions examined the feasibility of a social media intervention which
85 involved exposure to images of peers' portions of HED snacks and SSBs (which depicted the
86 recommended portion size), as a way of reducing participants' own self-reported desired
87 portion sizes of HED snacks and SSBs. The influence of the intervention on participants'
88 perceptions of their peers' portions (social norms) was also examined. Pilot intervention 1
89 assessed the feasibility of this intervention in young adults and pilot intervention 2 in
90 adolescents. Based on the normative model of social influence¹⁵, and previous social norm
91 studies^{17,18,25,26}, it was hypothesised that viewing images of peers' portions of HED snacks
92 and SSBs (which depicted the recommended portion) via social media would reduce self-
93 reported desired portion sizes of HED snacks and SSBs.

94

95 **Methods**

96 *Pilot intervention 1*

97 *Participants*

98 Undergraduate Psychology students (N = 21) were recruited from the University of Leeds
99 Psychology research participation system and received study credit for taking part. The study

100 was advertised on the research participation system for one week in March 2017¹ until a
101 sufficient number of participants were recruited. A power calculation was not conducted in
102 either intervention since these were pilot interventions were designed to test feasibility. In
103 intervention 1 we aimed to recruit a minimum of 20 participants. One participant was
104 excluded due to not completing the second survey. The final sample consisted of 20 young
105 adults (19 females, 1 male) aged 18-20 years old (M=19.00, SD=.65). One participant did not
106 enter their height and weight and so their BMI could not be calculated. Of the 19 participants
107 whose BMI was calculated, the majority were classed as having a BMI within the healthy
108 range (70 % healthy-weight, M=22.17, SD=2.54). Studies 1 and 2 received ethical approval
109 from the School of Psychology University of Leeds Research Ethics committee, Faculty of
110 Medicine and Health (ref: 17-0094 and 17-0001).

111

112 *Pilot intervention 2*

113 *Participants*

114 The intervention was advertised to 16-year-olds and parents of 13-16-year-old adolescents on
115 social media (Facebook)² over a three-week period in April 2017 until a sufficient number of
116 participants had been recruited. Those interested in the research were asked to contact the
117 researcher via email or on Facebook. Parents were provided with an information sheet which
118 fully informed them of the study aims and procedures. Parents assented to their adolescent
119 child participating through providing their adolescent child with the details of the research if

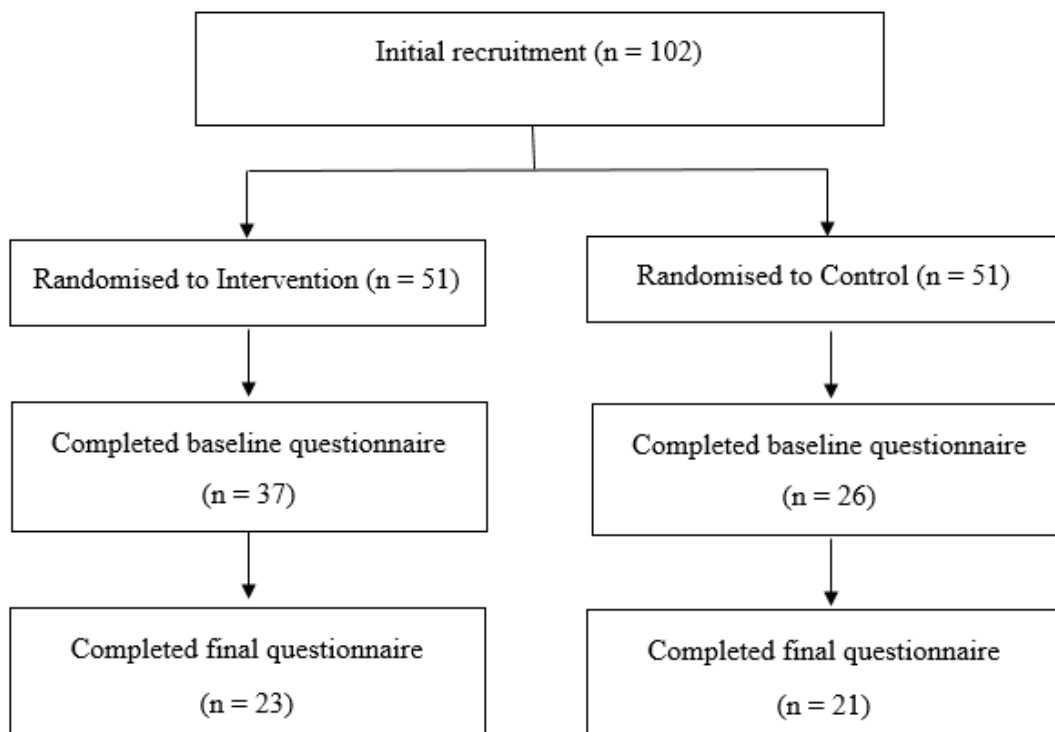
¹ The advert stated that participants were required for a two-week snacking intervention and must be aged 18 or over.

² The lead author joined multiple Facebook groups targeted at parents and advertised the study to parents of 13-16 year old children and 16 year olds within these groups and on the lead author's personal Facebook profile. The adverts were not targeted at a specific geographic region or gender. The advert provided details about the intervention (i.e. A 4 week snacking study) and that we were looking for 13-16 year olds to participate and that they would receive a voucher for participating.

120 they were happy for them to take part. All adolescents who were interested in the research
121 emailed the researcher and were provided with a link to the baseline survey where they were
122 required to read an information sheet and provide their consent. Due to potential dropout we
123 aimed to recruit a minimum of 100 adolescents (50 per condition). 102 adolescents were
124 recruited from Facebook and the final sample consisted of 44 adolescents (23 intervention, 21
125 control, 31 females, 13 males), aged 13-16 years old ($M = 14.36$, $SD = 1.06$) (see Figure 1 for
126 the participant recruitment and retention flowchart). Ten adolescents did not self-report their
127 height and weight. Of the 34 who did, the majority were classed as having a BMI within the
128 healthy range (85.3% healthy-weight, Mean BMI = 20.63, $SD = 3.85$). Adolescents received
129 a £10 voucher for participating in the intervention.

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131 **Figure 1.** Intervention 2 participant recruitment and retention flowchart.



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134 *Interventions 1 and 2*

135 *Design*

136 Intervention 1 lasted for two-weeks and used a 2 x 2 within-subjects repeated-measures
137 design, with factors food type (HED snacks and SSBs) and time (baseline and intervention
138 end). Intervention 2 lasted for four weeks and employed a 2 x 2 x 2 mixed design, with a
139 between-subjects factor of condition (intervention vs. control) and within-subjects factors of
140 food type (HED snacks and SSBs) and time (baseline and intervention end). In intervention 2
141 adolescents were randomly allocated to a condition (the lead author randomised participant
142 numbers to a condition (using randomizer.org) and adolescents were allocated to a condition
143 based on the order in which they contacted the lead author). In both interventions all
144 participants were informed that the intervention was examining snacking behaviour but were
145 not informed that the research was investigating portion sizes. Surveys were completed at
146 baseline and at the end of the intervention to examine whether the intervention reduced
147 desired portion size. The survey also examined whether the intervention influenced
148 participants' perceptions of their peers' 'desired' portion sizes, as well as participants'
149 frequency of consumption, liking, and intentions regarding their portions of HED snacks and
150 SSBs.

151 In the intervention conditions (all participants in study 1, and intervention condition
152 participants only in intervention 2) one confederate peer (who was a member of the research
153 team) posted daily on the behalf of all four confederate peers in a joint Instagram account
154 called Smart Snacking. The images of the same four confederate peers (two females and two
155 males) were used in both interventions. The images showed the peers when they were 18-20
156 years old in intervention 1 and 16-18 years old in intervention 2. We opted to show the peers
157 within these age ranges as research has shown that people model on peers of a similar age or

158 older than themselves ²⁷. (This was achieved by the confederate peers providing images of
159 themselves between the age of 16-18 years and 18-20 years)³. Participants were not aware
160 that the peers were confederates. Each week the confederate peer posted images of the four
161 peers' portions of HED snacks or SSBs (which constituted the recommended portion)⁴. The
162 confederate peer also posted images of content related to snacking and portion size such as
163 snack information images (including calorie information, sugar content and portion size
164 information of popular snacks) and quizzes (see Figure 2 for the intervention posting
165 timeline). The snack information images and the quizzes were only included to corroborate
166 the cover story that the intervention was looking at snacking behaviour. All peer portion
167 images were created by the experimenter and were not the peers' actual snack or SSB images.
168 The peer portion images contained the snack/SSB for all four peers and were presented with
169 the pronoun 'our' and were not linked to a particular peer (see Figure 3)⁵. Week 1 of both
170 interventions focussed on cookies/ biscuits, week 2 on SSBs, week 3 and 4 of intervention 2
171 only, focussed on savoury snacks and confectionary respectively. Participants in the control
172 condition only completed the baseline surveys and were emailed the quizzes.

173

174 *Procedure*

175 Interested participants were emailed a link to access the survey hosted on Bristol Online
176 Surveys (<https://www.onlinesurveys.ac.uk>). Participants were given information and invited

³ The confederate peers were friends of the lead author who consented to their photographs being used for the purpose of the project.

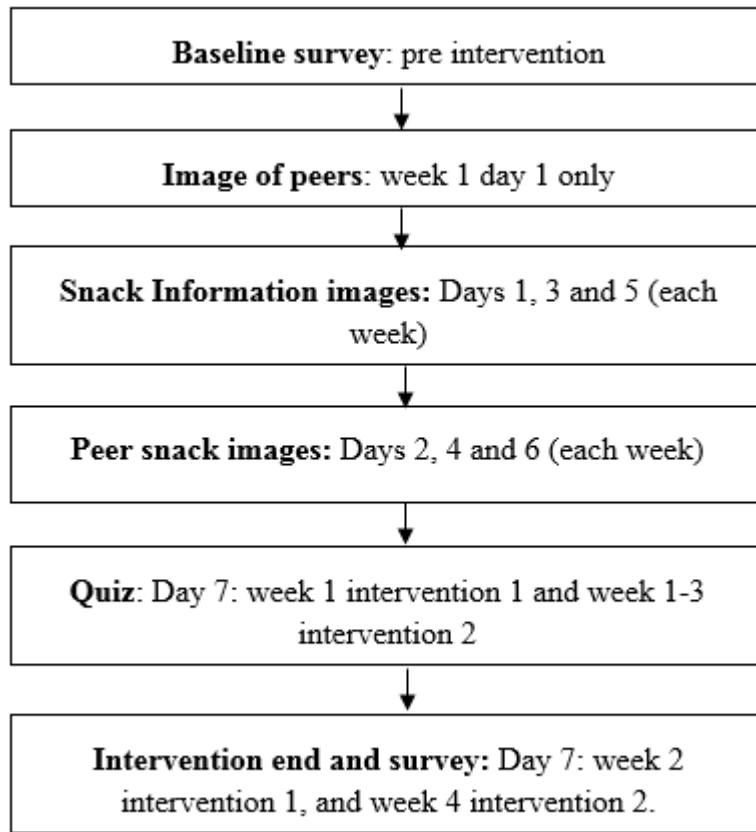
⁴ The HED snack images were always presented on a plate or napkin, while the SSBs were always presented as a can or bottle. The peers explicitly stated the portion size of the SSBs (250ml) to avoid any ambiguity about the portion size of the can/ bottle. However, the peers did not state the portion size of the HED snacks as these were not deemed to be ambiguous

⁵ The peers were always shown to be eating the same type of snack (e.g. all the peers had a biscuit as their snack in week 1) because research has shown that ambiguous norms do not influence eating behaviour ⁴⁰, therefore, we wanted the norm to be as clear as possible, and displaying a different type of snack for each peer may produce an ambiguous norm.

177 to consent to participation. Participants in the intervention conditions were asked to enter
178 their Instagram username at the end of the baseline survey. Once the required number of
179 participants were recruited, participants in the intervention conditions were added to the
180 Instagram account and the intervention began. Participants in the intervention conditions
181 were required to log on daily and to like every post, and all participants (intervention and
182 control) were required to complete the weekly quizzes. A link was provided to the quizzes in
183 the Instagram group for the intervention participants and was emailed to the control condition
184 participants. At the end of the intervention participants completed the end of intervention
185 survey. Upon completion of the study a de-brief statement and study credit (intervention 1)/
186 payment (intervention 2) were sent to participants.

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188 **Figure 2.** Intervention content posting timeline for intervention 1 and 2.



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191 **Figure 3.** Peer HED snack and SSB images for intervention 1 and 2.

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198 *Survey*

199 *Participants' desired portion sizes and perceptions of their peers' desired portion sizes*

200 To set the scene for the survey, participants were told to 'Imagine it is 3pm in the afternoon.
201 You had a sandwich for your lunch at 12 noon, and you still have a few hours before the
202 evening meal and you are about to have a snack'. For SSBs, participants were presented with
203 the statement 'Imagine that it is 5pm in the afternoon and you decide to have a drink'. For
204 each image, judgements were made on whether the portion was 'too little', 'slightly less than
205 I would eat', 'just right', 'slightly more than I would eat', or 'too much'. See supplementary
206 material for information about the snacks and SSBs and how desired portion sizes were
207 calculated and see Table 1 for energy and macronutrient content of the HED snacks and
208 SSBs.

209 **Table 1.** Energy content and macronutrient content of HED snacks and SSBs used in the intervention pictures.

	Food item	Recommended portion*	Energy/ macronutrient content per portion and per 100g											
			Energy Kcal (kJ)		Fat** (saturated fat)		Carbohydrate** (of which sugars)		Fibre**		Protein**		Salt**	
			Per portion	Per 100g	Per portion	Per 100g	Per portion	Per 100g	Per portion	Per 100g	Per portion	Per 100g	Per portion	Per 100g
HED snacks	Chocolate buttons	25g	134 (558.5)	535.0 (2234.0)	7.5 (4.5)	30.0 (18)	14.25 (14)	57.0 (56.0)	0.5	2.1	1.8	7.3	0.05	0.2
	Chocolate digestive	16.7g	83 (346)	495.0 (2071.0)	3.9 (2.1)	23.6 (12.4)	10.4 (4.9)	62.2 (29.5)	0.5	3.0	1.1	6.7	0.2	1.0
	Jelly sweets	29g	97 (414)	334.0 (1420.0)	Trace	0.1 (0.1)	22.6 (15.5)	77.4 (53.1)	0.3	1.1	1.6	5.4	0.01	0.03
	Chocolate chip cookies	21g	104 (438)	491.0 (2059.0)	4.7 (2.4)	22.1 (11.3)	13.9 (7.3)	65.4 (34.4)	0.7	3.1	1.2	5.8	0.12	0.6
	Mini chocolate chip muffins	25g	109 (456)	436.0 (1823.0)	5.6 (0.9)	22.5 (3.6)	13.1 (7.1)	52.5 (28.4)	<0.5	1.6	1.3	5.0	0.09	0.3
	Swiss roll	32g	113 (477)	353 (1492)	2.5 (1.7)	7.8 (5.3)	21.3 (14.1)	66.6 (44.1)	0.4	1.4	1.1	3.5	0.2	0.7
	Chocolate cake	87.5g	286 (1196)	433.0 (1812)	14.0 (3.8)	21.0 (5.7)	36.0 (21.0)	55.0 (32.0)	1.4	2.1	2.8	4.3	0.2	0.3
	Salted popcorn	25g	135 (562)	537.0 (2240.0)	7.4 (0.6)	29.4 (2.3)	13.7 (0.3)	54.6 (1.2)	2.4	9.6	2.1	8.5	0.3	1.2
	Pretzels	30g	118 (499)	393.0 (1662.0)	1.4 (0.2)	4.6 (0.5)	23 (1.0)	76.0 (3.3)	1.1	3.6	3.0	10.0	0.75	2.5
	Ready salted crisps	25g	132 (548)	526.0 (2194.0)	8.0 (0.7)	31.9 (2.6)	12.9 (0.1)	51.5 (0.4)	1.1	4.3	1.5	6.1	0.4	1.4

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SSBs	Full sugar cola	250ml	105 (105)	42.0 (180.0)	0.0 (0.0)	0.0 (0.0)	27.0 (27.0)	10.6 (10.6)	0	0	0	0	0	0
	Full sugar cordial drink	250ml	52 (223)	21.0 (89.0)	0.0	0.0	11.9 (11.6)	4.8 (4.6)	0	0	0	0	0.14	0.06
	Energy drink	250ml	115 (485)	46.0 (194.0)	0.0 (0.0)	0.0 (0.0)	27.5 (27.5)	11.0 (11.0)	0	0	0	0	0.25	0.1
	Chocolate milkshake	250ml	187.5 (792.5)	75.0 (317.0)	3.75 (2.75)	1.5 (1.1)	27.5 (27.5)	11.0 (11.0)	<0.5	<0.5	9.75	3.9	0.25	0.1

212 *The recommended portion is based on the manufacturers' recommendations.

213 **Fat, carbohydrate, fibre, protein and salt content are reported in grams.

214 *Frequency of consumption, liking and intentions*

215 Participants' reported frequency of consumption for and liking of each item and intentions
216 were assessed based on questions used by Stok, De Ridder, De Vet, & De Wit (2014) (see
217 supplementary material). Mean frequency, liking and intention scores were calculated for
218 HED snacks and SSBs at baseline and intervention end. A low score for frequency indicated
219 that the item was not eaten frequently, a low score for liking indicated that the item was not
220 liked and a low intention score indicated that participants did not intend to change their
221 behaviour.

222

223 *Intervention 1 and 2 Statistical Analysis*

224 *Main analysis*

225 In intervention 1 the main planned analysis was a 2 (food type: HED snacks and SSBs) x 2
226 (time: baseline and intervention end) repeated measures analysis of variance (ANOVA). In
227 intervention 2 the main planned analysis was 2 x 2 x 2 mixed ANOVA with a between-
228 subjects factor of condition (intervention vs. control), and within-subjects factors of food type
229 (HED snacks and SSBs) and time (baseline and intervention end). In both interventions the
230 dependent variables were participants' self-reported 'desired' portion sizes of HED snacks
231 and SSBs. We planned to examine the main effects of the independent variables and any
232 interactions between these. Across both interventions we made an *a priori* decision to control
233 for age and zBMI, however due to the small sample sizes, and since these variables did not
234 correlate with the dependent variables, we opted not to control for these variables in the main
235 or additional analysis. Gender did not correlate with the dependent variables ($p > .05$) and
236 was not controlled for in any of the analyses, and removing the one male from the analysis in

237 Intervention 1 did not alter the results, therefore the results reported include the male. (See
238 supplementary material for the analysis adjusted by age and zBMI, and with the male
239 participant removed).

240

241 *Additional analyses*

242 Separate ANOVAs (2x2 repeated measures ANOVAs in intervention 1 and 2x2x2 mixed
243 ANOVAs in intervention 2) were conducted to examine the influence of the intervention on
244 participants' perceptions of their peers' desired portion sizes of HED snacks and SSBs, and
245 participants' frequency of consumption, liking, and intentions regarding their portions of
246 HED snacks and SSBs.

247 HED snack and SSB items which were rated as less than 3 for liking were not included in the
248 analysis for participants' desired portion sizes, frequency of consumption and liking. In
249 intervention 1 Energy drinks (M = 2.29, SD = 1.35) were excluded from the analysis. In
250 intervention 2 Energy drinks (M = 2.29, SD = 1.28), Pretzels (M = 1.27, SD = .77), and jelly
251 sweets (M = 2.24, SD = 1.29) were excluded from the analysis. See Table 2 for means and
252 SDs for results of intervention 1 and Table 3 for means and SDs for results of intervention 2.

253

254 **Results**

255 *Intervention 1*

256 *Main analysis*

257 *Participants' reported desired portion sizes*

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258 There was a significant main effect of time [$F(1, 19) = 14.68, p = .001, \eta^2 = .4418$].
259 Participants reported smaller desired portion sizes of HED snacks and SSBs at intervention
260 end than at baseline. There was no significant food type by time interaction [$F(1, 19) = 3.70,$
261 $p = .07, \eta^2 = .16$] on participants' desired portion sizes of HED snacks and SSBs between
262 baseline and intervention end. The results indicate that exposure to the intervention
263 influenced participants to reduce their self-reported desired portion sizes of HED snacks and
264 SSBs following the intervention.

265

266 *Additional analysis*

267 *Reported perceptions of their peers' desired portion sizes*

268 A significant main effect of food type [$F(1, 19) = 64.72, p = .001, \eta^2 = .77$], but no
269 significant main effect of time [$F(1, 19) = 1.56, p = .23, \eta^2 = .08$] were found. A significant
270 food type*time interaction [$F(1, 19) = 4.68, p = .04, \eta^2 = .20$] on participants' perceptions
271 of their peers' portion sizes of HED snacks and SSBs was found. Paired samples t-tests
272 indicated that participants reported smaller HED portion sizes for their peers at intervention
273 end than at baseline, $t(19) = 2.26, p = .04$, but not for SSBs.

274

275 *Reported frequency of consumption and liking and intentions*

276 For frequency of consumption, there was a significant main effect of food type [$F(1, 19) =$
277 $9.57, p = .006, \eta^2 = .34$]. Participants reported consuming SSBs more frequently than HED
278 snacks. There were no other significant main effects or interactions ($p > .05$) on participants'
279 frequency of consumption, liking, or intentions regarding their HED snacks or SSBs between
280 baseline and intervention end.

281

282 **Table 2.** Participants' mean (SDs) desired portion sizes, perceptions of peers' desired portion
 283 sizes, frequency of consumption, liking, and intentions regarding participants' HED snack
 284 and SSB intake for intervention 1.

	HED snacks		SSBs	
	Baseline	Intervention end	Baseline	Intervention end
Participants' desired portion size ¹	1.47 (.28)*	1.28 (.27)*	.88 (.21)*	.81 (.27)*
Perceptions of peers' desired portion size ¹	1.46 (.26)*	1.34 (.28)*	.85 (.23)	.89 (.25)
Frequency of consumption ²	1.58 (.33)	1.51 (.45)	2.12 (.78)	1.98 (.81)
Liking ²	3.97 (.40)	3.93 (.33)	3.77 (.63)	3.87 (.46)
Intentions ³	3.53 (1.03)	3.88 (.92)	2.80 (1.02)	3.18 (.98)

285 *Indicates a significant difference between baseline and intervention end.

286 ¹For desired portion size, a value of 1 refers to the recommended portion size for HED snacks and the typical
 287 portion for SSBs. A number greater than 1 indicates the 'desired' portion size is greater than the recommended
 288 portion, and a number smaller than 1 indicates that the 'desired' portion size is smaller than the recommended
 289 portion.

290 ²Frequency of consumption was measured on a 6-point Likert style scale from once per month or never to daily.

291 Liking was measured on a 5-point Likert scale from strongly dislike to strongly like.

292 ³Intentions were assessed on a 5-point Likert-style scale from completely disagree to completely agree.

293

294

295 *Pilot intervention 2*

296 *Main analysis*

297 *Participants' reported portion sizes*

298 There was no significant main effect of condition [$F(1, 41) = .92, p = .34, \eta^2 = .02$], no

299 significant main effect of time [$F(1, 41) = .58, p = .45, \eta^2 = .01$], and no significant

300 interactions ($p > .05$). Thus, the intervention did not influence participants to reduce their

301 desired portion sizes of HED snacks or SSBs relative to the control condition.

302

303 *Additional analysis*

304 *Reported perceptions of peers' portion sizes*

305 There was no significant main effect of condition [$F(1, 41) = .43, p = .52, \eta^2 = .01$], and no
306 other significant main effects or interactions ($p > .05$) on participants' perceptions of their
307 peers' portion sizes of HED snacks and SSBs between baseline and intervention end. The
308 intervention did not significantly influence participants' perceptions of their peers' desired
309 portion sizes of HED snacks or SSBs relative to the control condition.

310

311 *Reported frequency of consumption and liking and intentions*

312 There were no significant main effects or interactions ($p > .05$) for frequency of consumption,
313 liking or intentions.

314 **Table 3.** Mean (SDs) participants' reports of desired portion sizes, perceptions of peers' desired portion sizes, frequency of consumption, liking,
 315 and intentions regarding participants' HED snack and SSB intake for intervention 2.

	HED snacks				SSBs			
	Intervention		Control		Intervention		Control	
	Baseline	Intervention end	Baseline	Intervention end	Baseline	Intervention end	Baseline	Intervention end
Participants' desired portion size*	1.28 (.34)	1.25 (.35)	1.36 (.31)	1.38 (.33)	.86 (.27)	.86 (.28)	.93 (.33)	.87 (.34)
Perceptions of peers' desired portion size*	1.40 (.36)	1.38 (.36)	1.44 (.33)	1.49 (.27)	.93 (.25)	.96 (.24)	.98 (.27)	.93 (.31)
Participants' frequency of consumption**	2.05 (.51)	2.13 (.73)	2.01 (.55)	1.92 (.47)	2.28 (.81)	2.29 (.81)	2.18 (.93)	1.95 (.93)
Liking**	4.08 (.52)	4.05 (.52)	4.07 (.52)	3.84 (.87)	3.91 (.78)	3.72 (.89)	3.77 (1.03)	3.48 (1.15)
Intentions	3.53 (.96)	3.33 (.98)	3.19 (.84)	3.13 (.76)	3.26 (1.10)	3.17 (.95)	3.08 (.88)	2.95 (.79)

316 *For desired portion size, a value of 1 refers to the recommended portion size of HED snacks and the typical portion size of SSBs. A number greater than 1 indicates the
 317 'desired' portion size is greater than the recommended/ typical portion, and a number smaller than 1 indicates that the 'desired' portion size is smaller than the
 318 recommended/typical portion.

319 ** Frequency of consumption was measured on a 6-point Likert style scale from once per month or never to daily. Liking was measured on a 5-point Likert scale from
 320 strongly dislike to strongly like.

321 ***Intentions were assessed on a 5-point Likert-style scale from completely disagree to completely agree.

322

323 **General discussion**

324 In this paper we piloted a novel social media intervention which aimed to reduce participants'
325 self-reported desired portion sizes of HED snacks and SSBs using peer influence.

326 Intervention 1 showed a significant reduction in young adults' reported desired portions of
327 HED snacks and SSBs following the intervention. Intervention 1 also influenced young
328 adults' social norms, whereby, there was a significant reduction in participants' perceptions
329 of their peers' HED snack portions following the intervention. However, intervention 2 did
330 not significantly influence adolescents' reported desired portions, or their perceptions of their
331 peers' desired portions of HED snacks and SSBs. Although these interventions are pilots and
332 further research is needed, the results indicate that a social media intervention using peer
333 influence may be a potential strategy for shifting social norms and downsizing self-reported
334 desired portions in young adults.

335 Intervention 2 may not have influenced adolescents' desired portion sizes due to the type of
336 peer used as an influencer. According to the normative model of social influence, people look
337 to others for guidance for how to behave in situations which they are unfamiliar with,
338 however, only when such examples are salient¹⁵. No information was given about the peers
339 in the interventions, which is consistent with previous research¹⁸, and appeared to be
340 sufficient for young adults. The intervention did not influence adolescents' perceptions of
341 their peers' desired portions, suggesting that the peers may not have been salient for the
342 adolescents. Research has shown that popular peers were perceived to eat more healthily than
343 unpopular peers^{29,30}, and the more that the participants identified with their popular peers, the
344 more healthily they ate³⁰. Since middle adolescents (aged 13-17 years) have been shown to
345 be the least susceptible to peer influence³¹, the peers used in such interventions may need to
346 be particularly salient in order to influence middle adolescents' behaviour. Thus, using
347 popular peers that the adolescents identify with (e.g. popular peers at their school) may

348 influence adolescents' behaviour and would be a valuable avenue to pursue in a future
349 intervention.

350 Social norms refer to codes of conduct about how to behave³². Descriptive social norms
351 describe the behaviour of others³³, and can be communicated through present and remote
352 peers and have been shown to influence eating behaviour^{23,24,34}. However, people often
353 misperceive descriptive social norms and these misperceptions can impact behaviour^{35,36}. For
354 example, adolescents (16-19 year olds) have been shown to overestimate peers' intake of
355 HED snacks by 1.8 portions, and SSBs by 5.2 portions per week, and these overestimations
356 were strongly associated with the adolescents' own intake of SSBs and HED snacks³⁵.
357 Therefore, correcting social norm misperceptions is important, and targeting social norm
358 misperceptions may be a valuable first step to changing behaviour. Intervention 1 showed
359 that descriptive social norms provided by remote peers on social media positively shaped
360 young adults' social norms regarding their peers' portion sizes, with young adults reducing
361 their perceptions of their peers' desired portions at the end of the intervention. Therefore, this
362 type of intervention may be a way of correcting normative misperceptions regarding peers'
363 portions in young adults. Furthermore, since social media is widely used¹⁰, this type of
364 intervention may have the potential to correct misperceptions on a large scale. However,
365 further research is required to examine the impact of this type of intervention on normative
366 misperceptions in a larger sample and over a longer period of time.

367 Considering that 74% of 12-15 year-olds have a social media profile¹¹, and there were 2.89
368 billion active social media profiles as of June 2017¹⁰, finding ways to utilise social media in
369 research into eating behaviour is important. Intervention 2 supports the use of social media as
370 a recruitment tool for adolescents, as 102 adolescents were recruited through advertising to
371 16-year-olds and parents of 13-16 year-olds on social media. However, only 43% of the
372 adolescents completed the intervention, indicating that retaining adolescents in interventions

373 is a challenge and over-recruitment may be necessary to help to maintain participant numbers
374 throughout the intervention. One challenge of social media-based interventions is the reliance
375 on self-report. It has been shown that participants can estimate portion sizes from
376 photographic images^{37,38}, however, participants were asked to identify a ‘desired’ portion
377 size in these interventions, which may be open to a wider interpretation than estimating a
378 weight. Using a validated dietary assessment tool specifically designed for assessing intake of
379 energy dense foods and developing a standardised system for assessing the effectiveness of
380 social media on behaviour such as eating would be valuable in future research. Although a
381 large number of people use social media¹⁰, research has shown that certain people are more
382 likely to use social media than others³⁹, which may result in a biased sample. For example,
383 while males and females were equally likely to use social media, certain personality traits
384 such as extraversion and openness to experience were linked to social media use³⁹.
385 Therefore, understanding bias associated with social media samples is important.

386 In these interventions the adverts stated that we were examining snacking behaviour, which
387 may attract a certain type of person, and may explain why the majority of participants had a
388 healthy-weight in both interventions. There was also only one male in intervention 1, which
389 may also be related to the subject matter. Therefore, it is unclear whether young adult males
390 and people who would benefit the most from the intervention (e.g. those with overweight and
391 obesity), would be motivated to participate in a study investigating snacking. An examination
392 of this approach with participants with overweight or obesity, and with young adult males
393 would be of value. Another consideration is that although these interventions focused on peer
394 influence, there were also components such as nutrition information and quizzes. Since
395 intervention 1 did not include a control group, and intervention 2’s control group only
396 completed quizzes and surveys, it is not possible to tease apart the effect of the nutrition
397 information from the peer snack images, and to understand whether viewing images of snacks

398 and drinks may have elicited priming effects. Therefore, in future research, including a
399 control group where participants receive nutrition information and images without a reference
400 to peers would allow for the examination of peer influence over and above the other
401 intervention components. Furthermore, since the control group only completed quizzes and
402 surveys, the amount of contact time of the intervention differed between the intervention and
403 control group. Including a control group who are exposed to an Instagram account showing
404 images unrelated to food would be of value in future studies. Finally, both interventions had
405 small sample sizes, therefore we may have been underpowered to detect significant
406 interactions. Investigating this approach with larger sample sizes in both interventions would
407 be beneficial.

408 In conclusion, a social media intervention which involved briefly exposing young adults to
409 images of confederate peers' portion sizes of HED snacks and SSBs influenced a reduction in
410 self-reported desired portion sizes of HED snacks and SSBs. Furthermore, the intervention
411 also influenced young adults' social norms regarding their peers' desired portions, with
412 participants indicating smaller desired portions of HED snacks for their peers at intervention
413 end than baseline. This intervention did not influence adolescents' self-reported desired
414 portions. Future investigations with different types of peers, and in populations with
415 overweight and obesity would be of value to further evaluate the potential effects of a social
416 media intervention utilising peer influence on adolescents' and young adults' eating
417 behaviour.

418

419 **Declarations**

420 **Conflicting interest:** The authors declare that there are no conflicts of interest.

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425 **Guarantor:** MAS

426 **Contributions:** MAS, MMH and CEL designed the study, MAS, MMH, CEL and PBB analysed the
427 data, and all authors were involved in manuscript preparation and have approved the final manuscript.

428

429 **References**

- 430 1. Young LR, Nestle M. The contribution of expanding portion sizes to the US obesity
431 epidemic. *Am J Public Health* 2002; 92: 246–249.
- 432 2. Nielsen S, Popkin B. Patterns and trends in food portion sizes, 1977-1998. *Jama*
433 2003; 289: 450–453.
- 434 3. Fisher JO, Liu Y, Birch LL, et al. Effects of portion size and energy density on young
435 children's intake at a meal. *Am J Clin Nutr* 2007; 86: 174–179.
- 436 4. Hollands GJ, Shemilt I, Marteau TM, et al. Portion , package or tableware size for
437 changing selection and consumption of food , alcohol and tobacco (Review)
438 SUMMARY OF FINDINGS FOR THE MAIN COMPARISON. 2015; 2015–2018.
- 439 5. Marteau TM, Hollands GJ, Shemilt I, et al. Downsizing: Policy options to reduce
440 portion sizes to help tackle obesity. *BMJ* 2015; 351: 1–5.
- 441 6. Looney SM, Raynor HA. Impact of Portion Size and Energy Density on Snack Intake
442 in Preschool-Aged Children. *J Am Diet Assoc* 2011; 111: 414–418.

- 443 7. Hetherington MM, Blundell-Birtill P. The portion size effect and overconsumption –
444 Towards downsizing solutions for children and adolescents. *Nutr Bull* 2018; 43: 61–
445 68.
- 446 8. Brunstrom JM, Shakeshaft NG, Scott-Samuel NE. Measuring ‘expected satiety’ in a
447 range of common foods using a method of constant stimuli. *Appetite* 2008; 51: 604–
448 614.
- 449 9. Albar SA, Alwan NA, Evans CEL, et al. Is there an association between food portion
450 size and BMI among British adolescents? *Br J Nutr* 2014; 112: 841–851.
- 451 10. Burgess J, Marwick A, Poell T, et al. Social Media Platforms and Education. *SAGE*
452 *Handb Soc Media* 2017; 579–591.
- 453 11. OFCOM. Children and Parents : Media Use and Attitudes Report. 2017; 1–303.
- 454 12. Holmberg C, E. Chaplin J, Hillman T, et al. Adolescents’ presentation of food in social
455 media: An explorative study. *Appetite* 2016; 99: 121–129.
- 456 13. Gold J, Pedrana AE, Stoope MA, et al. Developing health promotion interventions on
457 social networking sites: recommendations from The FaceSpace Project. *J Med Internet*
458 *Res*; 14. Epub ahead of print 2012. DOI: 10.2196/jmir.1875.
- 459 14. Bull SS, Levine DK, Black SR, et al. Social media-delivered sexual health
460 intervention: A cluster randomized controlled trial. *Am J Prev Med* 2012; 43: 467–474.
- 461 15. Herman CP, Polivy J. Normative influences on food intake. *Physiol Behav* 2005; 86:
462 762–772.
- 463 16. Bevelander KE, Anschutz DJ, Engels RCME. Social modeling of food purchases at
464 supermarkets in teenage girls. *Appetite* 2011; 57: 99–104.

- 465 17. Robinson E, Sharps M, Price N, et al. Reprint of: Eating like you are overweight: The
466 effect of overweight models on food intake in a remote confederate study. *Appetite*;
467 86. Epub ahead of print 2015. DOI: 10.1016/j.appet.2014.12.207.
- 468 18. Romero ND, Epstein LH, Salvy SJ. Peer Modeling Influences Girls' Snack Intake. *J*
469 *Am Diet Assoc* 2009; 109: 133–136.
- 470 19. Stok FM, de Vet E, de Ridder DTD, et al. The potential of peer social norms to shape
471 food intake in adolescents and young adults: a systematic review of effects and
472 moderators. *Health Psychol Rev* 2016; 10: 326–340.
- 473 20. Feeney JR, Polivy J, Pliner P, et al. Comparing live and remote models in eating
474 conformity research. *Eat Behav* 2011; 12: 75–77.
- 475 21. Hermans RCJ, Engels RCME, Larsen JK, et al. Modeling of palatable food intake. The
476 influence of quality of social interaction. *Appetite* 2009; 52: 801–804.
- 477 22. Bevelander KE, Anschutz DJ, Engels RCME. Social norms in food intake among
478 normal weight and overweight children. *Appetite* 2012; 58: 864–872.
- 479 23. Vartanian LR, Spanos S, Herman CP, et al. Modeling of food intake: a meta-analytic
480 review. *Soc Influ* 2015; 10: 119–136.
- 481 24. Robinson E, Thomas J, Aveyard P, et al. What everyone else is eating: A systematic
482 review and meta-analysis of the effect of informational eating norms on eating
483 behavior. *J Acad Nutr Diet*. Epub ahead of print 2014. DOI:
484 10.1016/j.jand.2013.11.009.
- 485 25. Sharps M, Robinson E. Perceived eating norms and vegetable consumption in children.
486 *Int J Behav Nutr Phys Act*; 12. Epub ahead of print 2015. DOI: 10.1186/s12966-015-

487 0296-z.

- 488 26. Sharps M, Robinson E. Perceived eating norms and children's eating behaviour: An
489 informational social influence account. *Appetite* 2017; 113: 41–50.
- 490 27. Brody GH, Stoneman Z. Selective imitation of same-age, older, and younger peer
491 models. *Child Dev* 1981; 52: 717–720.
- 492 28. Stok FM, De Ridder DTD, De Vet E, et al. Don't tell me what i should do, but what
493 others do: The influence of descriptive and injunctive peer norms on fruit consumption
494 in adolescents. *Br J Health Psychol* 2014; 19: 52–64.
- 495 29. Giese H, Juhász R, Schupp H, et al. Kann man Popularität und Freundschaft essen?
496 *Zeitschrift für Gesundheitspsychologie* 2013; 21: 71–81.
- 497 30. König LM, Giese H, Stok FM, et al. The social image of food: Associations between
498 popularity and eating behavior. *Appetite* 2017; 114: 248–258.
- 499 31. Sumter SR, Bokhorst CL, Steinberg L, et al. The developmental pattern of resistance
500 to peer influence in adolescence: Will the teenager ever be able to resist? *J Adolesc*
501 2009; 32: 1009–1021.
- 502 32. Higgs S. Social norms and their influence on eating behaviours. *Appetite*. Epub ahead
503 of print 2015. DOI: 10.1016/j.appet.2014.10.021.
- 504 33. Cialdini RB, Goldstein NJ. Social Influence: Compliance and Conformity. *Annu Rev*
505 *Psychol* 2004; 55: 591–621.
- 506 34. Salvy SJ, de la Haye K, Bowker JC, et al. Influence of peers and friends on children's
507 and adolescents' eating and activity behaviors. *Physiology and Behavior*. Epub ahead
508 of print 2012. DOI: 10.1016/j.physbeh.2012.03.022.

- 509 35. Lally P, Bartle N, Wardle J. Social norms and diet in adolescents. *Appetite* 2011; 57:
510 623–627.
- 511 36. Lally P, Cooke L, McGowan L, et al. Parents' misperceptions of social norms for pre-
512 school children's snacking behaviour. *Public Health Nutr* 2012; 15: 1678–1682.
- 513 37. Ovaskainen M, Paturi M, Reinivuo H, et al. Accuracy in the estimation of food
514 servings against the portions in food photographs. 2008; 674–681.
- 515 38. Williamson DA, Allen R, Davis Martin P, et al. Comparison of digital photography to
516 weighed and visual estimation of portion sizes. *Contin Educ Quest* 2003; 103: 1139–
517 1145.
- 518 39. Correa T, Hinsley AW, de Zúñiga HG. Who interacts on the Web?: The intersection of
519 users' personality and social media use. *Comput Human Behav* 2010; 26: 247–253.
- 520 40. Leone T, Pliner P, Peter Herman C. Influence of clear versus ambiguous normative
521 information on food intake. *Appetite* 2007; 49: 58–65.

522

523

524 **Supplementary material**

525

526 *HED snack and SSB information*

527 The HED foods and SSBs were selected because they are foods and drinks which are
528 frequently overconsumed by this age range. The HED snacks consisted of sweet and savoury
529 snacks and the SSBs consisted of soda, squash, energy drinks, and milkshake. For the snack
530 foods, photographs were taken of four portions to represent half a portion, one portion, one
531 and a half portions, and twice the recommended portion, which were weighed (in grams) and
532 then plated for photography. Snacks were presented on a white 27cm (diameter) plate with a
533 knife and fork on either side to provide size perspective. For the SSBs, photographs were
534 taken of three portions to represent a small, medium and a large portion. The drink
535 photographs were taken of the bottle/can next to a pint glass which contained the amount
536 from the bottle/ can. The portion sizes of the drinks differed according to the type of drink.
537 While the manufacturers recommended portions for SSBs are 250ml, this portion size is not
538 commonly found in supermarkets. Thus, the SSB portion sizes reflect the typical portion
539 sizes which are available for purchase. For example, a small can of a sugar-sweetened
540 carbonated beverage was 150ml, a medium can was 330ml and a large was 500ml, in
541 comparison to a small serving of full sugar squash, which was 250ml, a medium serving was
542 288ml, and a large serving was 500ml.

543

544 *Calculating desired portion size*

545 To identify participants' 'desired' portion size, participants were presented with photographs
546 on the online survey of 24 HED and LED foods, and seven SSBs and non-SSBs. For the

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547 HED snacks participants were presented with four portion sizes (half a portion, one portion,
548 one and a half portions and two portions) and for the SSBs participants were presented with
549 three portion sizes (small, medium and large). The HED foods were presented first, followed
550 by the LED foods, and then the drinks. The order which the food and drinks were presented
551 in was randomised using randomizer.org to ensure that the portion sizes of the foods were
552 evenly distributed, and the same food did not appear twice in a row with a different portion
553 size. Desired portion size was calculated by identifying which portion size participants
554 selected as being 'just right' for each food and drink item. For example, if half a portion was
555 selected as being 'just right' then the desired portion size for that participant was 0.5, whereas
556 if one portion was selected as being 'just right' then the desired portion size was 1, and so on.
557 If participants rated more than one portion size as 'just right' an average of the portions
558 resulted in the 'just right' portion. If all the portions were selected as 'too little' or 'slightly
559 less than I would eat' then the largest portion size (2) was selected, and if all of the portions
560 were selected as 'too much' or 'slightly more than I would eat' then the smallest portion size
561 (0.5) was selected. Following this, a mean desired portion size was calculated for the HED
562 snacks combined and the SSBs combined as two separate variables at the two time points
563 (baseline and intervention end).

564

565 Frequency, liking and intentions

566 Participants were presented with the statements: 'I intend to reduce my portion sizes of high
567 calorie snack food in the near future', 'I intend to reduce my portion sizes of sugar-sweetened
568 beverages in the near future', 'I intend to keep my portions of high calorie snack food the
569 same in the near future', 'I intend to keep my portions of sugar-sweetened beverages the
570 same in the near future'. Participants rated these statements on a 5-point Likert scale from

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571 completely disagree to completely agree. For frequency participants were asked ‘during the
572 past month, how often did you eat this food’ with six response options from ‘less than once
573 per month or never’ (coded as 1) to ‘every day or more than once per day’ (coded as 6). For
574 liking, participants were asked ‘how much do you like this item?’ with five response options
575 (Likert scale) from ‘strongly dislike’ (coded as 1) to ‘strongly like’ (coded as 5).

576

577

578 **Unadjusted results**

579 The results have been adjusted for age and BMI (intervention 1)/ zBMI (intervention 2). All
580 means and SDs for all supplementary analyses are reported in supplementary table 1 for
581 intervention 1, and supplementary table 2 for intervention 2.

582

583 **Intervention 1 results adjusted for age and BMI**

584 *Participants' reported portion sizes*

585 The results of the ANOVA showed no significant main effect of food type [$F(1, 16) = .15, p$
586 $= .70, \eta^2 = .01$], no significant main effect of time [$F(1, 16) = 4.10, p = .06, \eta^2 = .20$], and
587 no significant food type*time interaction [$F(1, 16) = .17, p = .69, \eta^2 = .01$] on participants'
588 desired portion sizes of HED snacks and SSBs between baseline and intervention end. Thus,
589 the results indicate that exposure to the intervention did not influence participants rated
590 desired portions of HED snacks and SSBs. See supplementary Table 1 for desired portion
591 sizes at baseline and intervention end.

592

593 *Reported perceptions of their peers' portion sizes*

594 There was no significant main effect of food type [$F(1, 16) = .95, p = .34, \eta^2 = .06$]. There
595 was a significant main effect of time [$F(1, 16) = 4.95, p = .04, \eta^2 = .24$], whereby,
596 participants perceptions of their peers' portions of HED snacks and SSBs reduced following
597 the intervention compared to baseline. There was no significant food type*time interaction [F
598 $(1, 16) = < .001, p = .99, \eta^2 = < .001$] on participants' perceptions of their peers' portion
599 sizes between baseline and intervention end. The intervention influenced participants'
600 perceptions of their peers' portion sizes of HED snacks, whereby, participants perceived their

601 peers to consume smaller portions of HED snacks following the intervention compared to
602 baseline.

603

604 *Reported frequency of consumption and liking*

605 For frequency of consumption, there was no significant main effect of food type [F (1, 16) =
606 .13, $p = .73$, $\eta^2 = .01$], no significant main effect of time [F (1, 16) = 1.10, $p = .31$, $\eta^2 =$
607 .06], and no significant food type*time interaction [F (1, 16) = 1.42, $p = .25$, $\eta^2 = .08$] on
608 participants' frequency of consumption of HED snacks or SSBs between baseline and
609 intervention end. For liking, there was no significant main effect of food type [F (1, 16) = .98,
610 $p = .34$, $\eta^2 = .06$], no significant main effect of time [F (1, 16) = .17, $p = .69$, $\eta^2 = .01$], and
611 no significant food type* time interaction [F (1, 16) = .60, $p = .45$, $\eta^2 = .04$]. The
612 intervention did not influence participants' reported frequency of consumption or liking of
613 either HED snacks or SSBs. The intervention did not influence participants' frequency of
614 consumption or liking of HED snacks or SSBs.

615

616 *Intentions*

617 There was no significant main effect of food type [F (1, 16) = 1.44, $p = .25$, $\eta^2 = .08$], no
618 significant main effect of time [F (1, 16) = .80, $p = .38$, $\eta^2 = .05$], and no significant
619 time*food type interaction [F (1, 16) = .15, $p = .71$, $\eta^2 = .01$] on participants' intentions
620 regarding their portion sizes of HED snacks or SSBs. Thus, the intervention did not influence
621 participants' intentions regarding their portion sizes.

622 **Table S1.** Participants' mean (SDs) desired portion sizes, perceptions of peers' desired
 623 portion sizes, frequency of consumption, liking, and intentions regarding participants' HED
 624 snack and SSB intake, adjusted for age and BMI.

	HED snacks (n=19)		SSBs (n=19)	
	Baseline	Intervention end	Baseline	Intervention end
Participants' desired portion size*	1.45 (.29)	1.29 (.27)	.87 (.21)	.79 (.26)
Perceptions of peers' desired portion size*	1.48 (.26)	1.37 (.26)	.86 (.23)	.90 (.25)
Frequency of consumption**	1.58 (.34)	1.52 (.46)	2.18 (.76)	2.00 (.82)
Liking**	4.00 (.39)	3.96 (.31)	3.77 (.65)	3.82 (.44)
Intentions ***	3.13 (.28)	3.08 (.34)	3.16 (.34)	3.13 (.50)

625 *For desired portion size, a value of 1 refers to the recommended portion size for HED snacks and the typical
 626 portion for SSBs. A number greater than 1 indicates the 'desired' portion size is greater than the recommended/
 627 typical portion, and a number smaller than 1 indicates that the 'desired' portion size is smaller than the
 628 recommended/typical portion.

629 ** Frequency of consumption was measured on a 6-point Likert style scale from once per month or never to
 630 daily. Liking was measured on a 5-point Likert scale from strongly dislike to strongly like.

631 ***Intentions were assessed on a 5-point Likert-style scale from completely disagree to completely agree.

632

633

634 **Intervention 2 results adjusted for age and zBMI**

635 *Participants' reported portion sizes*

636 There was no significant main effect of condition [$F(1, 30) = 2.62, p = .12, \eta^2 = .08$], no
 637 significant main effect of food type [$F(1, 30) = 2.31, p = .14, \eta^2 = .07$], and no significant
 638 main effect of time [$F(1, 30) = 1.46, p = .24, \eta^2 = .05$]. There were no significant
 639 interactions between condition and food type [$F(1, 30) = .18, p = .68, \eta^2 = .01$], condition
 640 and time [$F(1, 30) = .004, p = .95, \eta^2 < .001$], and no significant condition*food type*time
 641 interaction [$F(1, 30) = .62, p = .44, \eta^2 = .02$] on participants' desired portion sizes of HED
 642 snacks and SSBs between baseline and intervention end. Thus, the intervention did not

643 influence participants to reduce their desired portion sizes of HED snacks or SSBs relative to
644 the control condition.

645

646 *Reported perceptions of peers' portion sizes*

647 There was no significant main effect of condition [$F(1, 30) = .56, p = .46, \eta^2 = .02$], no
648 significant main effect of food type [$F(1, 30) = 2.59, p = .12, \eta^2 = .08$], and no significant
649 main effect of time [$F(1, 30) = .23, p = .63, \eta^2 = .01$]. There were no significant interactions
650 between condition and food type [$F(1, 30) = 1.23, p = .28, \eta^2 = .04$], condition and time [F
651 $(1, 30) = .19, p = .67, \eta^2 = .01$], food type and time [$F(1, 30) = .79, p = .38, \eta^2 = .03$], and
652 no significant condition*food type*time interaction [$F(1, 30) = 1.34, p = .26, \eta^2 = .04$] on
653 participants' perceptions of their peers' portion sizes of HED snacks and SSBs between
654 baseline and intervention end. Thus, the intervention did not significantly influence
655 participants' perceptions of their peers' desired portion sizes of HED snacks or SSBs relative
656 to the control condition.

657

658 *Reported frequency of consumption and liking*

659 There was no significant main effect of condition [$F(1, 30) = .40, p = .53, \eta^2 = .01$], no
660 significant main effect of food type [$F(1, 30) = .02, p = .89, \eta^2 = .001$], and no significant
661 main effect of time [$F(1, 30) = 1.16, p = .29, \eta^2 = .04$]. There were no significant
662 interactions between condition and food type [$F(1, 30) = .07, p = .79, \eta^2 = .001$], condition
663 and time [$F(1, 30) = .58, p = .45, \eta^2 = .02$], food type and time [$F(1, 30) = .48, p = .50, \eta^2$
664 $= .02$], and no significant condition*food type*time interaction [$F(1, 30) = .16, p = .69, \eta^2$
665 $= .01$] on participants' frequency of consumption of HED snacks and SSBs between baseline

666 and intervention end. For liking, there was no significant main effect of condition [F (1, 30) =
667 .25, $p = .62$, $\eta^2 = .01$], no significant main effect of food type [F (1, 30) = .50, $p = .49$, η^2
668 =.02], and no significant main effect of time [F (1, 30) = 1.20, $p = .28$, $\eta^2 = .04$]. There were
669 no significant interactions between condition and food type [F (1, 30) < .001, $p = .99$, $\eta^2 <$
670 .001], condition and time [F (1, 30) = .58, $p = .45$, $\eta^2 = .02$], food type and time [F (1, 30) =
671 .14, $p = .71$, $\eta^2 = .01$], and no significant food type*time*condition interaction [F (1, 30) =
672 .01, $p = .93$, $\eta^2 = < .001$]. Thus, the intervention did not influence participants' reported
673 frequency of consumption or liking.

674

675 *Intentions*

676 There was no significant main effect of condition [F (1, 29) = .04, $p = .84$, $\eta^2 = .002$], no
677 significant main effect of food type [F (1, 29) = 1.00, $p = .33$, $\eta^2 = .03$], and no significant
678 main effect of time [F (1, 29) = 1.47, $p = .24$, $\eta^2 = .05$]. There were no interactions between
679 condition and food type [F (1, 29) = 3.14, $p = .09$, $\eta^2 = .10$], condition and time [F (1, 29) =
680 .05, $p = .83$, $\eta^2 = .002$], food type and time [F (1, 29) = .46, $p = .50$, $\eta^2 = .02$], and no
681 significant condition*time*food type interaction [F (1, 29) = .32, $p = .58$, $\eta^2 = .01$]. Thus,
682 the intervention did not influence adolescents' intentions regarding their portion sizes.

683

684 **Results of Intervention 1 with the male participant removed**

685 *Participants' reported desired portion sizes*

686 There was a significant main effect of time [F (1, 18) = 12.57, $p = .002$, $\eta^2 = .41$].

687 Participants reported smaller desired portion sizes of HED snacks and SSBs at intervention

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688 end than at baseline. There was no significant food type by time interaction [$F(1, 18) = 2.67$,
689 $p = .12$, $\eta^2 = .13$].

690 **Table S2.** Mean (SDs) participants' reports of desired portion sizes, perceptions of peers' desired portion sizes, frequency of consumption,
 691 liking, and intentions regarding participants' HED snack and SSB intake adjusted for age and zBMI.

	HED snacks				SSBs			
	Intervention		Control		Intervention		Control	
	Baseline	Intervention end	Baseline	Intervention end	Baseline	Intervention end	Baseline	Intervention end
Participants' desired portion size*	1.22 (.35)	1.22 (.37)	1.38 (.33)	1.40 (.36)	.82 (.22)	.80 (.24)	.95 (.33)	.89 (.33)
Perceptions of peers' desired portion size*	1.36 (.39)	1.35 (.38)	1.44 (.35)	1.52 (.29)	.91 (.28)	.93 (.26)	.93 (.27)	.91 (.30)
Participants' frequency of consumption**	2.07 (.53)	2.07 (.61)	2.05 (.56)	1.91 (.45)	2.28 (.88)	2.24 (.73)	2.15 (.92)	2.06 (.94)
Liking**	4.14 (.49)	4.06 (.56)	4.13 (.56)	3.89 (.91)	3.91 (.81)	3.65 (.97)	3.90 (.92)	3.46 (1.16)
Intentions	3.11 (.37)	3.08 (.60)	3.13 (.58)	3.23 (.32)	3.14 (.45)	3.28 (.60)	3.03 (.23)	3.10 (.43)

692 *For desired portion size, a value of 1 refers to the recommended portion size of HED snacks and the typical portion size of SSBs. A number greater than 1 indicates the
 693 'desired' portion size is greater than the recommended/ typical portion, and a number smaller than 1 indicates that the 'desired' portion size is smaller than the
 694 recommended/typical portion.

695 ** Frequency of consumption was measured on a 6-point Likert style scale from once per month or never to daily. Liking was measured on a 5-point Likert scale from
 696 strongly dislike to strongly like.

697 ***Intentions were assessed on a 5-point Likert-style scale from completely disagree to completely agree.

698