

1 **The effect of the thin body ideal in a media-naïve population**

2 Jean-Luc Jucker¹, Tracey Thornborrow², Martin J. Tovee³, and Lynda G. Boothroyd¹

3

4 **The thin ideal is the western concept of an ideally slim or underweight female body¹,**
5 **and its omnipresence in the mass media has a negative impact on women's health²⁻⁵.**
6 **Media consumption is associated with a drive for thinness, body dissatisfaction, low**
7 **self-esteem, and disordered eating in women of western and/or industrialised**
8 **societies⁴. Furthermore, cross-cultural research suggests that the media have similar**
9 **effects when they are introduced into non-western or non-industrialised societies^{2,6,7}.**
10 **No study, however, has attempted to induce a change in female body size ideals in a**
11 **population that is not exposed to the thin ideal and that has currently no access to the**
12 **media. Here we show experimentally that a short exposure to the thin ideal can**
13 **change body size ideals in a media-naïve population. 80 rural Nicaraguan men and**
14 **women with very low to non-existent media access created their ideal female body**
15 **before and after seeing photographs of either thin or plus size fashion models.**
16 **Analyses revealed a significant interaction between time and group, meaning that**
17 **exposure to media images shifted the subjects' ideal female body size. We discuss**
18 **problems posed by the pervasiveness of the thin body ideal in the context of the**
19 **global obesity pandemic.**

20 Up to 30-50% of girls and women from western or industrialised countries have
21 negative body image^{8,9}, which contributes to widespread psychopathologies such as low
22 self-esteem, depression, and disordered eating^{10,11}. One key sociocultural contributor to
23 body dissatisfaction is the thin body ideal and its omnipresence in the mass media^{1,3,5,12-14}.
24 For example, across 77 correlational and experimental studies, media exposure was
25 associated with a stronger internalisation of the thin body ideal, higher body dissatisfaction,
26 and higher eating disorder symptomatology⁴. Furthermore, cross-cultural research has
27 shown that populations with limited access to the media have a higher female body size
28 ideal^{7,15-17}, and that the introduction of television in previously media-naïve populations is
29 accompanied by an increase in body dissatisfaction and pathological eating attitudes^{2,6,7,14}.

30 Although past research suggests that the media impact female body size ideals and
31 so have a negative effect on women's health, it suffers from two important limitations. First,
32 experimental research has never shown that the thin ideal and the media can induce a
33 change in body size ideals in a non-WEIRD (western, educated, industrialised, rich, and
34 democratic)¹⁸, media-naïve population. Instead researchers have used western,
35 industrialised subjects in countries where the thin body ideal is already omnipresent in the
36 media and where poor body image is already widespread¹⁹⁻²¹. Second, all cross-cultural
37 research using non-western or non-industrialised subjects has been correlational, cross-
38 sectional, or pseudo-longitudinal, and has therefore failed to establish causation between
39 exposure to the thin ideal and a decrease in female body size ideals.

40 Here we describe the first study to experimentally induce a shift in female body size
41 preferences using thin ideal stimuli in a non-western media-naïve population. To do so, 80

¹ Department of Psychology, University of Durham, UK.

² Institute of Neuroscience, University of Newcastle, UK.

³ School of Psychology, University of Lincoln, UK.

42 male and female subjects were drawn from two Nicaraguan villages with no access to grid
43 electricity and thus very low to non-existent access to visual media (see Table 1 for sample
44 characteristics). They were tested on their ideal female body size (hereafter ‘ideal body
45 task’), before and after seeing photographs of either thin or plus size fashion models
46 (hereafter ‘manipulation’). In the ideal body task, subjects used computer-generated female
47 bodies to create their ideal female body based on multiple different exemplars or ‘starter
48 bodies’ (Figure 1). They could do so by increasing or decreasing the size of these starter
49 bodies within a range equivalent to BMI 15-40. The subjects created 4 bodies at pre-test,
50 and 4 bodies (using different starter bodies) at post-test, with the order of starter bodies (pre
51 vs post-test) counterbalanced across subjects.

52 In the manipulation phase, subjects were exposed to a series of photographs of
53 either thin or plus size fashion models (Figure 2). The photographs were taken from western
54 retailer’s catalogues or popular women’s magazine, and depicted models wearing clothes
55 ranging from UK size 4-6 (thin models) to 16-28 (plus size models). The models varied in
56 age, ethnic background, and clothing, with these characteristics being represented equally in
57 both experimental groups. To ensure visual engagement with manipulation stimuli, the
58 photographs were presented in pairs and the subjects were instructed to choose their
59 favourite model out of each pair.

60 Preliminary analyses showed that the two experimental groups were matched on all
61 variables measured in this study, including age, BMI, dieting, earnings, education, ethnicity,
62 television access and television consumption, time since last meal, sex, and travel ($F_s <$
63 1.955 , $p_s > .167$). To determine whether time and group interacted, a random intercept
64 model was constructed with subject as the higher level and body/trial as the lower level unit.
65 Initial variance partitioning (Model I; Table 2) indicated that 52.8% of variance operated at
66 the level of the body identity/trial, while the remainder operated at the level of the subject.
67 Time (pre-test vs. post-test) was entered as a body-level covariate in Model II, and group
68 was added as a subject-level covariate in Model III. Neither of these variables improved the
69 model, however introduction of the interaction term between group and time significantly
70 improved the model ($LR = 15.88$, $p < .001$) and yielded a significant main effect of time, and
71 a significant effect of the group and time interaction (Model IV). As shown in Figure 3,
72 subjects in the thin size condition showed a shift towards preferring thinner bodies from pre-
73 to post-test, while subjects in the plus size condition showed the opposite pattern. Body size
74 ideals in the plus size condition were significantly larger at post-test than those in the thin
75 size condition (Figure 3). The model was further improved by adding sex (Model V: $LR =$
76 7.06 , $df = 2$, $p < .05$) and location (Model VI: LR against Model V = 18.04 , $df = 2$, $p < .001$) of
77 subjects as both main effects and interaction terms with group and time, and showed a
78 significant effect of location, such that subjects in the first village preferred thinner bodies in
79 general than those in the second village. Addition of further potential confounding variables
80 (age, BMI, dieting, education, time since last meal, and travel), did not improve the model
81 any further (p_s for likelihood ratios against Model V all $> .1$), and yielded no other main
82 effects. Furthermore, none of the three-way interaction terms were significant (see full
83 results in Extended data). As such, the interaction between time and group remained
84 unmoderated by any of the potential confounders measured.

85 This study is the first to demonstrate experimentally that a short exposure to media
86 images can change female body size ideals in a non-WEIRD population with very low to

87 non-existent access to the media. Overall, just seeing a small selection of western media
88 images of either thin or plus size female models induced change in subjects' perceptions of
89 ideal female body size in the direction of the images seen. These data are concordant with
90 similar results in western samples¹⁹⁻²¹ and more importantly suggest that the capacity of
91 visual experience to shape body ideals is not limited to subjects with a media-saturated
92 environment. Furthermore, we have provided experimental evidence to support the
93 assumption that the association between media access and both thinner body ideals² and
94 elevated body dissatisfaction^{2,6} in cross-cultural data, may be mediated in part by direct
95 impacts of said media on internalised body ideals. The fact that none of our potential
96 confounding variables moderated the experimental interaction, suggests that the impact of
97 visual media on short term body ideals is not reliant on, for instance, recent prior media
98 exposure or interest in weight loss.

99 It should be noted that, as per much visual media, we presented 'aspirational'¹⁹
100 stimuli (i.e., healthy, attractive models in high status clothes) in the weight manipulations,
101 and encouraged subjects to focus on their attractiveness. Thus we cannot determine
102 whether our results were driven by the positive weight associations presented, or merely the
103 visual experience itself. Furthermore, we used only one type of media images and future
104 research should certainly consider the experimental impact of viewing other types such as
105 magazines or real televisual stimuli on subjects, and should also consider both male stimuli
106 and additional impacts on body satisfaction. Finally, although our subjects had very low to
107 non-existent access to media in their villages, and despite the fact that the average
108 participant tested had not left their village for 234 days, most have experienced some
109 television when visiting towns or cities in the past. In other words, although body ideals in
110 low media villages in this location are considerably larger than in the west⁷, it is possible that
111 even modest prior experience may modulate the impacts seen here. Thus replication with a
112 completely media-naïve population (not only in terms of TV access at home, but without any
113 access to the visual media at all, even when travelling) would be ideal, albeit extremely
114 difficult.

115 Nevertheless, we have shown that introducing western media images in a non-
116 WEIRD population with very low prior media exposure can have an impact on their female
117 body size ideals in a matter of a single 15-minute exposure. These results are important if
118 we consider that grid electricity is gradually being introduced in our study site, that the local
119 populations will soon have full, daily satellite TV access, and that TV consumption is
120 associated with body dissatisfaction, low self-esteem, and disordered eating⁴. The
121 globalization of the thin ideal in populations that are in the process of westernisation and/or
122 modernisation¹ is all the more worrying given that it usually coincides with rising levels of
123 obesity, and therefore renders the dominant ideal of a slim or underweight female body even
124 more difficult to attain. We thus strongly recommend further research on this pressing global
125 challenge.

126

127 **METHODS**

128 All study procedures and protocols were approved by Durham University's Psychology
129 Department Ethics Subcommittee (ref 10/09), and conformed to Durham University's Data
130 Protection Policy 2008 as well as to the ethical guidelines of the British Psychological
131 Society.

132 **Study site.** We selected two villages with no access to grid electricity and very low to non-
133 existent media access on the remote Mosquito Coast of Nicaragua. The first village, San
134 Vicente, was located in the Pearl Lagoon Basin and had no more than 40 adult inhabitants.
135 The second village, Pedregal, was located on the nearby Patch River and had a maximum of
136 600 inhabitants. In San Vicente, one household had a solar panel that was used for
137 lighting, but there was no functional TV or access to other visual media in the village at the
138 time of data collection. In Pedregal, a small number of households had recently acquired
139 solar panels and satellite dishes and were therefore excluded from the study. Overall, the
140 average hours of TV watched by the subjects in the last 7 days (including any TV watched
141 while travelling) was 1.55 (mode: 0; median: 0). Further, the average subject had not left
142 their village for 234 days. Together with participant observation, these statistics confirmed
143 that the subjects had a very low exposure to visual media. More study site characteristics
144 are in Table 1.

145 **Subjects.** We tested 80 subjects (40 women) from 16 to 78 years ($M= 30.4$; $SD=12.9$) in
146 total. Thirty-nine subjects were from San Vicente, where we tested all adults who were
147 willing to participate and older than 16 years old. The remainder were recruited from
148 Pedregal, where our rule was to test a similar number than in San Vicente and with an
149 approximately equal number of men and women. All subjects provided consent and received
150 \$4 in local currency for their time. Subjects younger than 18 years old or older than 75 years
151 old were tested with a parent or guardian present. Seven subjects from Pedregal who
152 reported having access to satellite TV and watching it in the last 7 days, as well as 2
153 subjects who created the thinnest or fattest ideal body possible at both pre- and post-test
154 (i.e. showed ceiling/floor effects), were discarded from analyses. Full sample characteristics
155 are in Table 1.

156 **Materials and measures.** For the ideal body task, we created 8 starter bodies in the
157 software suite DAZ Studio 4.5. These bodies varied in shape (pear type vs. hourglass type),
158 skin colour (light vs. dark), and clothing (swimsuit vs. low waist shorts and strapless bra),
159 with each combination of shape/skin colour/clothing being represented. Importantly, the size
160 of these starter bodies could be modified by the subjects (using left and right arrow keys
161 over 20 increments) on a scale ranging from -20 (thinnest body) to +20 (heaviest body) and
162 corresponding to a BMI range of 15 to 40. Half of the subjects received the first 4 bodies at
163 pre-test, and the 4 remaining bodies at post-test, with the other half of the subjects receiving
164 the opposite manipulation. Both at pre-test and post-test, the order of presentation of the
165 bodies was randomised for each subject. Sizes selected for each body were recorded as the
166 percentage of the screen width by which the mouse position deviated from the midpoint (-
167 50% to 50%) and were treated as our dependent variable scores. Inspection of a Q-Q plot
168 showed that these scores were approximately normally distributed, and multilevel model
169 analyses were conducted in MLwiN 2.36.

170 For the manipulation, we used 144 photographs of either thin or plus size fashion
171 models found on mainstream or specialist UK or U.S. retailers' online catalogues or in

172 popular women's magazines. Although it was not always possible to determine which
173 clothing size the models were wearing, most models in the thin and plus size condition
174 ranged within UK sizes 4-6 and 16-28, respectively. All images showed women face-on, with
175 a neutral background and with the full body visible (from head to knees at least), in non-
176 sexually explicit poses. In each condition, there was an equal number of white and non-white
177 ethnicity models, with two thirds of the models wearing clothes and one third wearing
178 underwear or swimwear. The photographs were presented in pairs, giving 36 trials per
179 condition, and the subjects were instructed to choose which of the two models they found
180 more attractive. Within each pair, the models used looked similar and were matched for body
181 shape, type of clothing, and pose. The number of same/different ethnic background pairs
182 was counterbalanced both within and between experimental conditions. Further, the order of
183 presentation of the pairs and the side of presentation of each photograph (left or right) were
184 randomised for each subject.

185 All subjects also reported whether they had access to television (*in my house, in a*
186 *neighbour's house I visit, in a neighbour's house I don't visit, no TV in village*), and if they
187 did, which type of television they had access to (*TV set-without satellite-and DVD player,*
188 *Satellite TV, Satellite TV and DVD player, Other*), and how many hours they had watched it
189 in the last 7 days. They also reported the last time that they travelled to other communities,
190 how long they were away, and whether they had watched any TV while away (and how
191 many hours in the last 7 days if they had). Subjects also reported how many hours ago they
192 had last eaten and whether they were trying to change weight (*trying to lose weight, trying to*
193 *increase weight, not trying to change weight*). Finally, we collected anthropometrics to
194 compute the BMI and WHR of each subject. All sample characteristics are in Table 1.

195 **Procedure.** The subjects were tested individually in a quiet room with a desk. The subjects
196 already knew the experimenters from previous work in the area, and although they were
197 aware of our main research interests (the electrification of the Mosquito Coast, and body
198 ideals in Central America), they did not know the specific aim of the current experiment.

199 Upon providing oral informed consent, the subjects were assigned to condition (thin
200 vs. plus size models) and presentation order of starter body quasi-randomly to ensure a
201 similar number of subjects in each group (the experimenter was not blinded to group
202 allocation). The subjects then completed the ideal body task on a laptop computer. Each
203 body started at a random size, and the experimenter demonstrated to the subject how the
204 size of the body could be changed using the left and right arrow keys, and showing the full
205 possible range. The subjects were then instructed to modify each of the four bodies until
206 these looked like their 'ideal woman body', meaning by this, 'a woman body that to you is as
207 attractive, good-looking, and sexy as possible'. They were also reminded several times that
208 we were interested in their personal opinion and that they were no 'right or wrong' answers
209 for this task. As most subjects were not used to computers, every effort was made to ensure
210 that they knew how to use the left and right arrow keys and how this affected the size of the
211 bodies. When the subject had finished a body, the experimenter asked again whether this
212 represented their ideal female body before letting the subject proceed to the next body.
213 When all 4 bodies were finished, the subject was told that 'we will do something else now',
214 and received the manipulation. For each pair of photos, the experimenter asked the subject
215 to choose their 'favourite body' between the two, or which one of the two bodies 'looks
216 better, or is a more attractive woman body in your opinion'. When the subject had chosen

217 one body by tapping on it on the screen, the experimenter would display the next pair of
218 photos by clicking the mouse, until all pairs had been displayed. This exposure to the
219 thin/plus size models lasted approximately 15 minutes for each participant. The subjects
220 then completed the ideal body task again, with exactly the same instructions as at pre-test
221 (but with the 4 other starter bodies).

222 The session continued with an interview where subjects provided demographics and
223 answered questions about media access, travel, etc. Finally, subjects' height, weight, chest,
224 waist, and hips were measured using an electronic scale and tape measure. These
225 measurements were taken with the subjects dressed but without shoes. The subjects were
226 given the opportunity to take their measurements themselves (with guidance), and
227 anthropometrics for females were collected by a female experimenter or a female field
228 assistant. A typical session lasted 40-45 minutes, and all subjects were interviewed in their
229 native language (Creole English or Spanish).

230

231 **Acknowledgements.** This research was supported by a Leverhulme trust project grant
232 (RPG-2013-113) to LGB and MJT. We thank Robert A. Barton for helpful comments on the
233 manuscript.

234

235 **Author contributions.** Designed the study: JLJ with participation of all authors. Prepared
236 the materials: MJT, JLJ, and LGB. Collected the data: JLJ and TT. Analysed the data: LGB
237 and JLJ. Wrote the paper: JLJ and LGB with participation of MJT and TT.

238

239 **Competing financial interests.** The authors declare that they have no competing financial
240 interests.

241

242 **Materials & Correspondence.** Correspondence and material requests should be addressed
243 to jean-luc.jucker@durham.ac.uk.

244

245 **Data availability.** The datasets generated during and/or analysed during the current study
246 are available from the corresponding author on reasonable request.

247

248 REFERENCES

- 249 1 Swami, V. Cultural influences on body size ideals: Unpacking the impact of
250 westernization and modernization. *European Psychologist* **20**, 44-51 (2015).
- 251 2 Swami, V. *et al.* The attractive female body weight and female body dissatisfaction in
252 26 countries across 10 world regions: Results of the International Body Project I.
253 *Personality and Social Psychology Bulletin* **36**, 309-325 (2010).
- 254 3 Hogan, M. J. & Strasburger, V. C. Body image, eating disorders, and the media.
255 *Adolescent medicine: state of the art reviews* **19**, 521-546 (2008).
- 256 4 Grabe, S., Ward, L. M. & Hyde, J. S. The role of the media in body image concerns
257 among women: a meta-analysis of experimental and correlational studies.
258 *Psychological bulletin* **134**, 460-476 (2008).
- 259 5 Stice, E., Spangler, D. & Agras, W. S. Exposure to media-portrayed thin-ideal images
260 adversely affects vulnerable girls: A longitudinal experiment. *Journal of Social and*
261 *Clinical Psychology* **20**, 270 (2001).
- 262 6 Becker, A. E., Burwell, R. A., Herzog, D. B., Hamburg, P. & Gilman, S. E. Eating
263 behaviours and attitudes following prolonged exposure to television among ethnic
264 Fijian adolescent girls. *The British Journal of Psychiatry* **180**, 509-514 (2002).
- 265 7 Boothroyd, L. G. *et al.* Television exposure predicts body size ideals in rural
266 Nicaragua. *British Journal of Psychology* **107**, 752-767 (2016).
- 267 8 Bearman, S. K., Presnell, K., Martinez, E. & Stice, E. The skinny on body
268 dissatisfaction: A longitudinal study of adolescent girls and boys. *Journal of youth*
269 *and adolescence* **35**, 217-229 (2006).
- 270 9 Fallon, E. A., Harris, B. S. & Johnson, P. Prevalence of body dissatisfaction among a
271 United States adult sample. *Eating behaviors* **15**, 151-158 (2014).
- 272 10 Paxton, S. J., Neumark-Sztainer, D., Hannan, P. J. & Eisenberg, M. E. Body
273 dissatisfaction prospectively predicts depressive mood and low self-esteem in
274 adolescent girls and boys. *Journal of clinical child and adolescent psychology* **35**,
275 539-549 (2006).
- 276 11 Johnson, F. & Wardle, J. Dietary restraint, body dissatisfaction, and psychological
277 distress: a prospective analysis. *Journal of abnormal psychology* **114**, 119 (2005).
- 278 12 Levine, M. P. & Harrison, K. in *Handbook of eating disorders and obesity* (ed J
279 Kevin Thompson) 695-717 (2004).
- 280 13 Calogero, R. M., Boroughs, M. & Thompson, J. K. in *The Body Beautiful* (eds Viren
281 Swami & A Furnham) 259-298 (Springer, 2007).
- 282 14 Anderson-Fye, E. P. & Becker, A. E. in *Handbook of eating disorders and obesity*
283 (ed J Kevin Thompson) 565-589 (2004).
- 284 15 Swami, V. & Tovée, M. J. Perceptions of female body weight and shape among
285 indigenous and urban Europeans. *Scandinavian Journal of Psychology* **48**, 43-50
286 (2007).
- 287 16 Swami, V. & Tovée, M. J. Female physical attractiveness in Britain and Malaysia: A
288 cross-cultural study. *Body Image* **2**, 115-128 (2005).
- 289 17 Anderson, J. L., Crawford, C. B., Nadeau, J. & Lindberg, T. Was the Duchess of
290 Windsor right? A cross-cultural review of the socioecology of ideals of female body
291 shape. *Ethology and Sociobiology* **13**, 197-227 (1992).
- 292 18 Henrich, J., Heine, S. J. & Norenzayan, A. The weirdest people in the world?
293 *Behavioral and brain sciences* **33**, 61-83 (2010).
- 294 19 Boothroyd, L. G., Tovée, M. J. & Pollet, T. V. Visual diet versus associative learning
295 as mechanisms of change in body size preferences. *PLoS One* **7**, e48691 (2012).
- 296 20 Robinson, E. & Christiansen, P. The changing face of obesity: exposure to and
297 acceptance of obesity. *Obesity* **22**, 1380-1386 (2014).
- 298 21 Robinson, E. & Kirkham, T. Is he a healthy weight? Exposure to obesity
299 changes perception of the weight status of others. *International Journal of Obesity*
300 **38**, 663-667 (2014).

301 **Table 1: Sample Characteristics**

302

Valid N	71
% Female	49.29
Age (years)	30.42 (12.95)
Body mass index	24.63 (4.98)
Dieting	
% Not dieting	69.01
% Decrease weight	18.30
% Increase weight	12.67
Earnings (\$/year)	1,230.06 (2,356.20)
Education (years)	5.35 (4.80)
Ethnicity	
% Garifuna	29.57
% Mestizo	56.33
% Mixed or other	14.08
TV access	
% In own house	8.45
% In neighbour's house	16.90
% No access	74.64
TV consumption	
TV consumption in last 7 days (hours)	1.55 (3.14)
TV type	
% TV set + DVD player only	15.49
% Satellite TV	12.67
% No TV	71.83
Time since last meal (hours)	3.57 (1.84)
Travel	
Last trip to other village (days)	234.94 (859.03)
Duration of stay (days)	4.25 (12.01)
Daily TV consumption (hours)	0.77 (1.25)

303

304 *Note.* 'TV access' refers to access to any type of television, not necessarily satellite
305 television; 'TV type' specifies which type of television the subjects had access to. Further,
306 'TV consumption in last 7 days (hours)' includes any TV watched (and any type of TV
307 watched) while travelling in the last 7 days.

308

309

310

Table 2: Multilevel modelling analysis of predictors of ideal body size selected for each starter body: Models I-VI

	I		II		III		IV		V		VI	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
Constant	-9.03	1.59	-8.83	1.68	-10.76	2.32	-9.19	2.39	-11.62	2.86	-7.58	3.15
Time			-0.41	1.11	-0.41	1.11	-3.56	1.56	-3.56	1.56	-3.56	1.56
Group					3.76	3.15	0.66	3.33	0.52	3.31	0.57	3.14
Time*Group							6.21	2.19	8.49	2.70	10.21	3.12
Sex									4.87	3.21	4.00	3.06
Sex*Time*Group									-4.32	2.99	-4.62	2.99
Location											-7.69	3.06
Location*Time*Group											-3.31	2.99
Log-likelihood:	4688.25		4688.11		4686.69		4678.75		4675.22		4666.20	
Likelihood ratio vs previous model			0.28		2.84		15.88		7.06		18.04	

311

312 *Note.* Figures in bold indicate $p < .05$. Models VII to XII are in Extended data.

313 **Figure 1. Sample starter bodies (minimum and maximum size)**

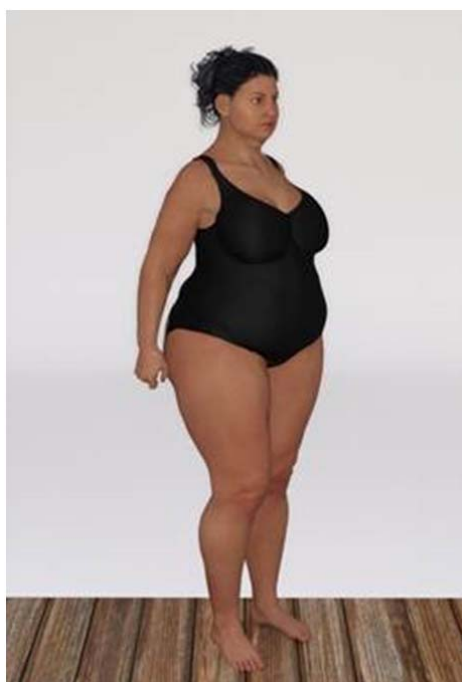
314



315

316

317



318

319

320

321

322

323

324

325

326

327

328 **Figure 2. Sample thin size and plus size models**

329

330 Thin size:

331



352

353

354 Plus size:

355

356

357

358

359

360

361

362

363

364

365

366

367

368

369

370

371

372

373

374

375

376

377

378

379

380

381

382

383

384

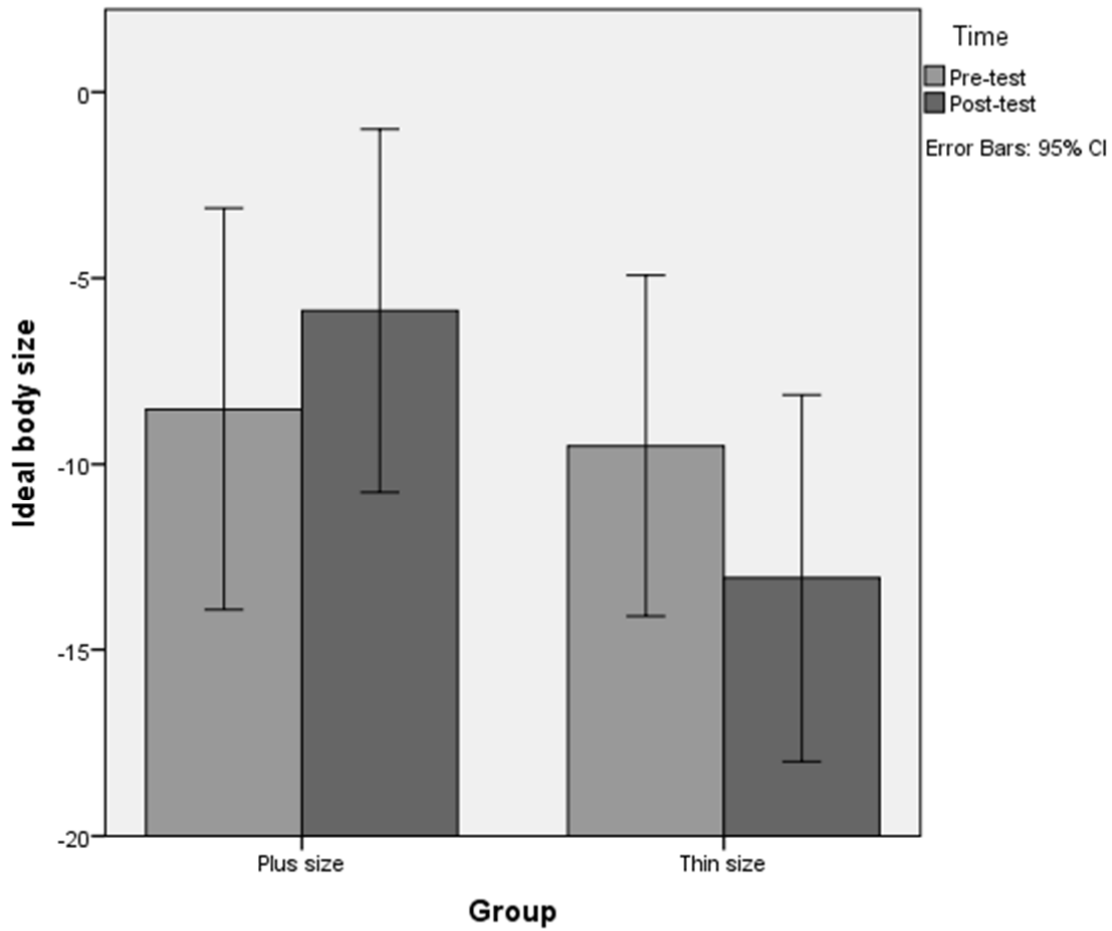
385

386

387



388 **Figure 3. Pre-test to post-test difference in ideal body size between groups**
389
390
391



392
393 *Note.* $N = 71$; mean difference: 7.19, 95% CI 0.38 to 14.00, $t(69) = 2.107$, $p < .05$ (two-
394 sided), $d = .49$. Levene's test for equality of variances: $p = .623$.
395
396
397

398

399

400

401

402

403

404

405 **Extended data. Multilevel modelling analysis of predictors of ideal body size selected for each starter body: Models VII-XII**

	VII		VIII		IX		X		XI		XII	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
Constant	-6.93	3.34	-10.10	4.50	-9.63	5.32	-9.44	5.34	-9.52	5.36	-8.77	5.51
Time	-3.56	1.56	-3.56	1.56	-3.56	1.56	-3.56	1.56	-3.56	1.55	-3.56	1.55
Group	0.52	3.13	0.03	3.15	0.03	3.15	0.10	3.15	0.32	3.19	0.50	3.20
Time*Group	10.90	3.29	14.38	4.57	14.10	5.37	14.17	5.38	13.95	5.39	14.54	5.64
Sex	4.16	3.06	3.98	3.05	3.93	3.06	3.84	3.07	3.63	3.11	2.94	3.33
Sex*Time*Group	-4.11	3.07	-3.94	3.07	-3.88	3.17	-3.80	3.17	-3.36	3.22	-4.18	3.76
Location	-6.77	3.45	-7.34	3.48	-7.45	3.54	-7.59	3.56	-7.88	3.62	-7.67	3.63
Location*Time*Group	-2.37	3.33	-2.33	3.33	-2.27	3.37	-2.70	3.44	-1.77	3.63	-1.82	3.64
Travel	-1.83	3.21	-1.13	3.26	-0.98	3.39	-1.07	3.39	-0.91	3.42	-1.06	3.41
Travel*Time*Group	-2.31	3.41	-1.57	3.58	-1.67	3.74	-1.70	3.74	-2.37	3.84	-2.18	3.85
Age			0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.11
Age*Time*Group			-0.12	0.12	-0.13	0.12	-0.13	0.12	-0.11	0.12	-0.11	0.12
Last meal					-0.14	0.85	-0.10	0.86	0.01	0.89	0.03	0.89
Last meal*Time*Group					0.09	0.90	0.27	0.95	-0.08	1.05	-0.02	1.06
BMI							0.00	0.01	0.00	0.01	0.00	0.01
BMI*Time*Group							-0.01	0.01	0.00	0.01	0.00	0.01
Education									-0.01	0.02	-0.01	0.02
Education*Time*Group									0.01	0.02	0.01	0.02
Dieting											-2.48	4.43
Dieting*Time*Group											-1.70	4.66
Log-likelihood:		4665.18		4663.39		4663.36		4662.86		4662.13		4661.56
Likelihood ratio vs previous model		2.04		3.58		0.06		1		1.46		1.14

406

407 *Note.* Dieting and Travel were used as binary variables (i.e., is the subject trying to change their weight? *yes* or *no*; has the subject travelled in
 408 the last 7 days? *yes* or *no*). Ethnicity and earnings were not included because we considered that these were redundant with location and
 409 education, respectively. Further, separate analyses including ethnicity and earnings did not significantly change the results reported here.