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1 **Title:** The effects of an acute resistance exercise bout on appetite and energy intake
2 in healthy older adults

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27 **Abstract**

28 Ageing is associated with reductions in appetite and food intake leading to
29 unintentional weight loss. Such weight loss, particularly through muscle mass
30 reduction, is associated with muscle weakness and functional decline, which represent
31 predictors of poor health outcomes and contribute to frailty in older adults. Exercise-
32 induced anorexia is an established phenomenon in young adults; however appetite
33 and energy intake (EI) responses to resistance exercise are unknown in older adults.

34 Twenty healthy older adults (68 ± 5 years, BMI 26.2 ± 4.5 kg·m⁻²) undertook two 5-
35 hour experimental trials. Participants rested for 30 minutes before being provided with
36 a standardised breakfast (196 kcal, 75.2% carbohydrate, 8.9% protein and 15.9% fat).
37 Participants then rested for 1-hour before completing: 1-hour resistance exercise bout
38 followed by 2-hour of rest (RE) or, a control condition (CON) where participants rested
39 for 3 hours, in a randomised crossover design. Appetite perceptions were measured
40 throughout both trials and on cessation, an *ad libitum* meal was provided to assess EI.

41 A repeated-measures ANOVA revealed no significant condition x time interaction for
42 subjective appetite ($p = 0.153$). However, area under the curve for appetite was
43 significantly lower in the RE compared with CON (49 ± 8 mm·hour⁻¹ vs. 52 ± 9 mm·hour⁻¹,
44 $p = 0.007$, $d = 0.27$). There was no difference in EI (RE = 681 ± 246 kcal; CON =
45 673 ± 235 kcal; $p = 0.865$), suggesting that resistance exercise does not affect EI 2
46 hours post-exercise in older adults despite a significant but modest reduction in

47 **appetite over a 5-h period.** In conclusion, resistance exercise may be an appropriate
48 means for optimising muscle mass adaptations without attenuating acute EI of older
49 adults.

50

51 **Keywords:** Appetite, ageing, energy intake, resistance exercise, exercise-induced
52 anorexia

53 **Abbreviations**

54 AUC = area under the curve

55 BMI = Body Mass Index

56 CON = Control

57 EI = Energy Intake

58 FFM (Fat-Free Mass)

59 Kg (kilogram)

60 MPS (Muscle Protein Synthesis)

61 RES = Resistance exercise

62 RMR = Resting Metabolic Rate

63 SD = Standard Deviation

64 VAS = Visual analogue Scale

65 $\dot{V}O_2$ = Maximal Oxygen Uptake

66 1-RM = One repetition max

67 5-RM= Five repetition max

68 **1.0 Introduction**

69 Energy intake is reduced with age which, in part, can be attributed to an age-
70 associated reduction in appetite – termed the “anorexia of ageing” (Morley & Silver,
71 1988). As a result, unintentional weight loss (Roberts & Rosenberg, 2006) occurs
72 predeominantly in skeletal muscle which exacerbates sarcopenia and frailty, and
73 represents a significant predictor of poor clinical outcomes and functional decline
74 (Rolland et al., 2011). Such outcomes are associated with an increased risk of
75 morbidity and mortality (Evans, 2015).

76 From the age of ~40, skeletal muscle begins to decline at a rate of 0.47% and 0.37%
77 per year in men and women, respectively (Mitchell et al., 2012). Rates of decline
78 accelerate with age, reaching ~1-2% reductions per year between the age of 50-60
79 years (Doherty, 2003; Van Kan, 2009). This deterioration in muscle mass can be
80 further augmented by physical inactivity and protein deficiencies (Landi et al., 2019).
81 This likely mediates the reduction in energy expenditure in older adults (Frontera et
82 al., 2000; Lexell et al., 1988), and drives the observed reduction in energy intake. As
83 such, a vicious cycle ensues, whereby a muscle mass loss-induced reduction in
84 energy intake perpetuates further losses in muscle mass due to protein-energy
85 malnutrition.

86 Resistance exercise and the provision of exogenous amino acids represents a potent
87 antisarcopenic stimulus for older adults through increased myofibrillar muscle protein
88 synthesis (MPS) (Atherton & Smith, 2012; Yang et al., 2012). Additionally, following
89 resistance exercise, the sensitivity of skeletal muscle to amino acids is heightened for
90 up to 24 hours in facilitating an optimal muscle synthetic response (Burd et al., 2011;
91 Rasmussen et al., 2000). Thus, the combination of resistance exercise and increased
92 protein consumption is an established approach for increasing muscle mass and

93 strength in older adults to offset poor outcomes (Morton et al., 2018). This attenuation
94 of the reductions in skeletal muscle mass may facilitate increases in energy intake to
95 overcome the vicious cycle that perpetuates unintentional weight-loss.

96 Nonetheless, there are caveats to this approach for increasing net energy balance
97 when the acute appetite responses to both protein ingestion and resistance exercise
98 are considered. Protein is the most satiating macronutrient (Westerterp-Plantenga,
99 2008). Both dietary protein (Poppitt et al., 1998) and whey protein supplementation
100 (Mollahosseini et al., 2017) have been shown to reduce energy intake at subsequent
101 meals, with similar findings recently observed in older adults (Butterworth et al. (2019).
102 It is also well-established that strenuous aerobic exercise ($\geq 60\%$ of maximal oxygen
103 uptake) acutely suppresses appetite in a phenomenon termed 'exercise-induced
104 anorexia' (King et al., 1994). This suppression is transient, with appetite typically
105 restored within 30 minutes after exercise, resulting in little effect on post-exercise
106 energy intake when an ad libitum meal is provided at this time (King et al., 2013).
107 Similarly, exercise-induced appetite suppression has been observed in response to
108 resistance exercise in younger adults (Balaguera-Cortes et al., 2011; Broom et al.,
109 2009) but the responses in older adults are yet to be established.

110 Understanding the appetite and energy intake responses to resistance exercise in
111 older adults is important as it seems feasible that the anorexia of ageing and exercise-
112 induced anorexia may interact to augment appetite-suppression after exercise. Thus,
113 the present study aimed to determine the acute effects of resistance exercise on
114 appetite perceptions and energy intake in healthy older adults.

115 It is hypothesised that resistance exercise will suppress appetite, compared with rest,
116 but transiently so; as such it is expected that energy intake two hours after exercise
117 will not differ between exercise and control conditions.

118 **2.0 Methods**

119 *2.1 Participants*

120 Twenty-one healthy, independently-living older adults were recruited to participate and
121 20 participants completed full the study design. Both genders were included in the
122 analysis as evidence suggests males and females exhibit similar appetite and energy
123 intake responses to exercise (Alajmi et al., 2016). The inclusion criteria were ≥ 60 years
124 old, non-smokers, not taking medication known to influence appetite, weight stable for
125 at least 3 months before the study (≤ 2 kg loss or gain), not currently attempting to lose
126 or gain weight, and recreationally active (participating in moderate or vigorous physical
127 activity at least 3 times per week) but without habitually completing resistance
128 exercise. The study, which received institutional ethical approval, was conducted in
129 accordance with the Declaration of Helsinki.

130 *2.2 Preliminary Tests*

131 Prior to the experimental trials, participants visited the laboratory to undergo
132 screening, preliminary anthropometric measurements, familiarisation with the
133 resistance exercise protocol and a five-repetition maximum (5RM) test. On arrival,
134 baseline stature (to the nearest cm), body mass (to the nearest kg) and resting blood
135 pressure (to the nearest mmHg) were measured by a stadiometer (Seca, Hamburg,
136 Germany), scales (Seca, Hamburg, Germany), stethoscope and sphygmomanometer
137 (Accoson Green Light 300, UK). Participants completed a food preference
138 questionnaire to ensure acceptability of all food items available during the
139 experimental trials. After participants had rested for 30 minutes, a full familiarisation

140 session was conducted, in which all seven resistance exercises employed in the study
141 were completed. Resistance machines were used as they were regarded safer to use
142 compared with more complex free-weight exercises. The order in which each exercise
143 was performed was: seated row, leg press, chest press, leg curl, lat pull down, leg
144 extension and shoulder press. This was carried out in accordance with the American
145 College of Sports Medicine position stand (Willoughby, 2015). As one repetition
146 maximum (1-RM) testing is not recommended for older adults due to safety concerns,
147 a five-repetition maximum (5-RM) test was used (Gail et al., 2015). One-repetition
148 maximum value for the resistance exercises was subsequently estimated by the
149 formula of Mayhew et al. (1992). This formula is evidenced to have high relative
150 accuracy and low absolute error, providing a safe 1-RM prediction value for older
151 adults starting a resistance training programme (Wood et al., 2002).

152

153 *2.3 Experimental Trials*

154 The participants undertook two experimental trials in a randomised order (resistance
155 exercise (RE) and control (CON) which were completed individually and separated by
156 at least seven days, using a counterbalanced crossover design. Participants
157 completed a food diary in the 24 hours before the first experimental trial and replicated
158 this before the second trial. Alcohol, caffeine and strenuous activity were not permitted
159 during this 24-hour period; this was confirmed verbally on arrival. Confirmation of the
160 replication of the 24-hour diary was attained by asking participants to complete another
161 food diary for the 24 hours preceding the second trial. Participants arrived between
162 0700 and 0900 after an overnight fast of at least 10 hours and exerted themselves
163 minimally when travelling to the laboratory, using motorised transport. One hour before
164 arrival, participants ingested 300 mL of water to ensure euhydration.

165 Upon arrival at the laboratory, participants completed a baseline appetite
166 questionnaire. After 30 minutes of rest, a standardised breakfast was consumed within
167 a five-minute period. Participants rested for 60 minutes after the onset of breakfast
168 before completing 60 minutes resistance exercise (RE) bout or remained resting within
169 the laboratory (CON). Participants then rested (sitting reading, working at a desk or
170 watching television), before being provided with an *ad libitum* lunch meal 120 minutes
171 after exercise. After consumption of the *ad libitum* lunch meal, a final measure of
172 subjective appetite was obtained, completing the trial.

173

174 *2.4 Resistance exercise.*

175 The resistance exercise bout involved two sets of 10-15 repetitions of each exercise
176 at 40-50% of estimated 1-RM, with two minutes rest between sets before immediately
177 moving to the next exercise. Total weight lifted was determined based on the amount
178 of weight lifted (kg) for each exercise multiplied by the number of repetitions during all
179 sets. Perceived ratings of exertion were measured using a 10-point scale at the end
180 of each set (Borg, 1982). Exercises were completed in the order previously described
181 in preliminary tests section and in accordance with ACSM guidelines (Willoughby,
182 2015).

183

184 *2.5 Standardised Breakfast and Ad libitum Meal*

185 The standardised breakfast consisted of a breakfast bar (Belvita Milk and Cereal
186 Breakfast Bar), with an energy content of 196 kcal (75.2% carbohydrate, 8.9% protein
187 and 15.9% fat). Participants were also fed an *ad libitum* pasta meal at 4.5 hours into
188 each trial (2 hours after exercise). The *ad libitum* meal was designed to closely align
189 with the UK dietary guidelines for macronutrient proportions (52% carbohydrate, 34%

190 fat and 14% protein (Public Health England, 2016) . The pasta-based meal consisted
191 of penne pasta (Sainsbury's), cheddar cheese (Sainsbury's), tomato sauce
192 (Sainsbury's) and olive oil (Sainsbury's). Pasta was cooked for 15 minutes in unsalted
193 water at 700W before being mixed with the remaining ingredients and re-heated for 2
194 minutes at 700 W. Participants consumed the lunch in isolation to avoid any social
195 influence on food intake and with no distractions. A bowl of the aforementioned meal
196 was provided by an investigator and participants were instructed to eat until
197 'comfortably full', with no time limit set for eating. This bowl was replaced before the
198 participant had emptied it, with minimal interaction, and this process continued until
199 the participant was comfortably full (Deighton et al., 2016). This was done to ensure
200 an empty bowl would not signal to terminate food consumption (Wansink, 2004). Food
201 intake was calculated as the weighted difference in food before and after eating, this
202 was then converted to calories using the manufacturer's nutritional information. Water
203 was available at *ad libitum* during the first trial and this volume was provided to
204 participants on the second trial. This ensured water intake was the same in both trials,
205 controlling this as a potential confounding variable.

206

207 *2.6 Subjective Appetite.*

208 For the measure of subjective appetite, appetite perceptions (hunger, satisfaction,
209 fullness and prospective food consumption (PFC)) were assessed at baseline and
210 every 30 minutes thereafter using 100-mm visual analogue scales (VAS). Descriptors
211 were anchored at each end describing the extremes (e.g. 'I am not hungry at all'/'I
212 have never been more hungry') (Flint et al., 2000). A composite subjective appetite
213 score (0-100) was calculated using the following formula: composite appetite score =
214 (hunger + prospective food consumption + (100-fullness) + (100-satisfaction)/4)

215 (Stubbs et al., 2000). This single subjective composite score was used for ease of data
216 analysis and presentation, as it has been shown that, with the original six question
217 VAS technique (Hill & Blundell, 1982), the scores for each question co-vary to a large
218 extent (Stubbs et al., 2000). A higher value is associated with a greater appetite
219 sensation.

220

221 *2.7 Statistical Analysis*

222 Data were analysed using the Statistical Package for Social Sciences (SPSS) software
223 version 26.0 for Windows (SPSS, Chicago, IL). Repeated measures ANOVA was used
224 to examine differences between conditions over time. Area under the curve (AUC)
225 values were calculated using the trapezoidal rule. Paired t-tests were used to evaluate
226 differences between condition for AUC data and energy intake responses. Cohen's d
227 effect size was calculated for t-tests. Effect sizes were interpreted as ≤ 0.2 trivial, >0.2
228 small, >0.6 moderate, >1.2 large, >2 very large, and >4 extremely large (Hopkins,
229 2004). A 10% (8-10mm) difference is typically seen as 'a reasonable and realistic
230 difference in VAS scores (Flint et al., 2000). Power calculations determined that a
231 sample size of 20 participants was required to detect a 10% (10mm) difference in
232 appetite perceptions. These power calculations were performed using G*power with
233 an alpha value of 5% and a power of 80% (Faul et al., 2007). Statistical significance
234 was accepted at the 5% level. Results are given as means \pm SD.

235

236 **3.0 Results**

237 Twenty healthy, independently-living older adults (13 females, 7 males) completed the
238 study. All reported meeting physical activity recommendations of at least 150 minutes
239 of moderate-vigorous physical activity each week. All participants, in successful

240 completion of the resistance exercise familiarisation session, demonstrated the
241 capacity in physical function to complete resistance exercise. Participant
242 characteristics can be found in table 1.

243 **Table 1.** Participant characteristics

	Mean ±SD
Age (years)	68 ± 5
BMI (kg·m⁻²)	26.2 ± 4.5
Systolic Blood Pressure (mmHg)	134 ± 14
Diastolic Blood Pressure (mmHg)	81 ± 9

244 (SD: Standard Deviation, BMI: Body Mass Index)

245 3.1 Exercise Responses

246 All participants were able to complete the prescribed resistance exercise protocol. The
247 total weight lifted during the 60 minutes' resistance exercise session was 7636.3 ±
248 157.5 kg. The mean rating of perceived exertion was 5 ± 1, representing “hard”
249 exercise.

250 3.2 Subjective Appetite

251 Subjective appetite scores are shown in figure 1. There was no significant time x
252 condition interaction ($p = 0.153$). There was a significant effect for condition ($p =$
253 0.007), with lower appetite perception in the RE condition across the trial. This was
254 allied with a lower AUC for the entire study period in the RE condition (RE = $49 \pm$
255 $8\text{mm}\cdot\text{hour}^{-1}$; CON = $52 \pm 9\text{mm}\cdot\text{hour}^{-1}$, $p = 0.007$, $d = 0.27$; 95% CI of mean difference:
256 0.868 to 4.88; Figure 1).

257

258 3.3 Energy Intake

259 Energy intake during the *ad libitum* pasta meal was not significantly different between
260 conditions (CON = 673 ± 235kcal; RE exercise = 681 ± 246kcal, $p = 0.865$, $d = 0.03$;
261 95% CI of mean difference: -413 to 350; Figure 2).

262

263 [Insert Figure 1]

264

265

266 [Insert Figure 2]

267

268 **4.0 Discussion**

269 This study demonstrates that an acute bout of resistance exercise induces a small and
270 transient suppression of subjective appetite in older adults. The appetite profiles for
271 the resistance exercise and resting control conditions suggest that the significant
272 suppression across the resistance exercise condition appears to be driven by small
273 reductions in appetite during (6mm difference in VAS score between conditions), and
274 30 minutes after (7mm difference) resistance exercise. This resulted in a significantly
275 lower AUC value during the entirety of the trial period in the exercise condition. The
276 transient nature of the suppression resulted in a convergence of appetite profiles prior
277 to the *ad libitum* meal consumed 2-hours after exercise. Accordingly, energy intake
278 did not differ between the two conditions.

279 A strong body of evidence indicates that strenuous exercise ($>60\% \dot{V}O_2 \text{ max}$) leads to
280 the transient suppression of appetite (Deighton & Stensel, 2014) termed exercise-
281 induced anorexia (King et al., 1994). However, the extent to which this occurs in older
282 adults is yet to be investigated. While the results of the current study do appear to
283 demonstrate some agreement with previous research evidenceing a suppression of
284 appetite with resistance exercise in young adults (Broom et al., 2009), the appetite
285 response observed is much more modest. The significantly lower appetite perception
286 over the trial period represented a difference in AUC of only $3\text{mm}\cdot\text{hour}^{-1}$, while the
287 difference in VAS score between conditions did not exceed 7mm at any time point.
288 Given that 8-10mm is typically accepted as the smallest meaningful change or
289 difference in VAS score for subjective appetite (Flint et al., 2000), it is likely that the
290 observed statistically significant difference in appetite AUC is not of practical
291 significance.

292 Any appetite suppression was transient, as well as small in magnitude. A such,
293 appetite perceptions did not differ between trials at the time of the meal, and
294 unsurprisingly, energy intake was thus unaffected two hours after exercise. This is in
295 agreement with previous findings in young adults (Balaguera-Cortes et al., 2011;
296 Ballard et al., 2009). However, such findings are not unequivocal, with Laan et al.
297 (2010) demonstrating that resistance exercise resulted in a significantly higher mean
298 energy intake compared with aerobic exercise and control conditions. Potential
299 reasons for these discrepancies in results may include timing of the meal, intensity of
300 the exercise, and types of foods offered. It is difficult to assert meaningfulness of any
301 change in energy intake in a single meal; however the anorexia of ageing has been
302 classified as an energy intake of $<70\%$ of the estimated needs (Landi et al., 2016).
303 The present study demonstrated an +8 kcal difference in energy intake following

304 resistance exercise compare to the control which is very small and unlikely to impact
305 upon daily energy intake. Therefore completing multiple sessions per week in line with
306 recommendations for resistance exercise in older adults would unlikely interfere with
307 energy intake to induce a significant change in body weight.

308 The mechanisms by which acute resistance exercise may modulate appetite was not
309 investigated in the present study, but may be pertinent to speculate. It has previously
310 been shown that resistance exercise can reduce circulating concentrations of the
311 orexigenic hormone ghrelin, (Broom et al., 2009; Balaguera-Cortes et al., 2011), which
312 accompanied appetite suppression (Broom et al., 2009). Such reductions occurred
313 during (Broom et al., 2009) and in the immediate post-exercise period (Broom et al.,
314 2009; Balaguera-Cortes et al., 2011), aligning with the suppression in subjective
315 appetite in the study of Broom et al. (2009). As such, the modest appetite response to
316 resistance exercise seen in the present study may have been associated with a
317 modest reduction in ghrelin, but speculation of this mechanistic link is presented with
318 caution given the small magnitude of appetite suppression.

319 Given the known enhancements in fat-free mass after resistance exercise training in
320 older adults (Schoenfeld et al., 2017), the present study suggests that resistance
321 exercise in older adults is unlikely to induce prolonged appetite suppression and a
322 subsequent reduction in food intake after individual resistance exercise bouts. The
323 time-course of appetite recovery after the exercise bout suggests that post-exercise
324 nutritional strategies to maximise adaptations in older adults (e.g., protein intake)
325 should perhaps take place >60-min after exercise cessation, once appetite
326 perceptions have returned to control values; certainly, our data shows that feeding is
327 not compromised 2 hours after exercise. Additionally, given that the enhanced

328 sensitivity to amino acids persists for 24 hours after resistance exercise there is no
329 need to prioritise immediate post exercise feeding (Burd et al., 2011).

330 It is important for future research to investigate whether energy intake is affected when
331 feeding occurs closer to exercise cessation in older adults. Individuals may choose to
332 eat soon after exercise for reasons other than appetite perceptions, so understanding
333 feeding responses in the more immediate post-exercise period is important to ensure
334 the age-associated reductions in appetite and/or energy intake were not further
335 exacerbated by resistance exercise. Understanding the time course of both appetite
336 and feeding responses can help inform post-exercise feeding strategies for older
337 adults. This was precluded from the present study to enable investigation of the time-
338 course of appetite recovery after the resistance exercise bout. Most studies
339 investigating the acute effects of exercise on energy intake tend to provide an *ad*
340 *libitum* meal at defined time points during trials (Balaguera-Cortes et al., 2011; George
341 & Morganstein, 2003; King et al., 2010; Deighton et al., 2013). Constraining
342 participants feeding schedules may alter energy intake and limits the ability to analyse
343 other impacts on eating behaviour such as feeding latency or eating frequency. With
344 complete unrestricted access to common food items, King et al. (2013) found that a
345 60-minute bout of high-intensity running delayed feeding, increasing the length of time
346 before participants voluntarily chose to eat. However, energy intake at this meal was
347 unaffected by exercise. Thus, we hypothesise that the small and transient suppressive
348 effects of exercise observed in the present study are unlikely to compromise energy
349 intake in the post-exercise period, if individuals are allowed unrestricted feeding.
350 Further research is warranted to confirm this, given the known reductions in appetite
351 associated with ageing (Johnson et al., 2019). Overall, the findings of the present
352 study suggest that although resistance exercise led to a small and transient

353 suppression in appetite this was not sufficient to interfere with subsequent energy
354 intake.

355 Although acute energy intake was unaffected by the resistance exercise in the present
356 study, any delayed, compensatory free-living adjustments in energy intake were not
357 assessed. Neither acute energy expenditure during the trials nor free-living energy
358 expenditure during the remainder of the day were measured. While such measures
359 may have been of interest, the aim of this study was to determine the presence,
360 magnitude and time course of appetite responses to resistance exercise, with a
361 secondary aim to determine any impact on acute energy intake. Elucidating such
362 effects is important for planning resistance training programmes for older adults. As
363 such, while it is acknowledged that energy expenditure will have increased during the
364 exercise bout which would impact energy balance, measures of daily energy balance
365 were not a focus of this initial exploratory investigation. Further, obtaining accurate
366 and valid measures of daily energy balance is challenging given the limitations of
367 current methodologies for estimates of energy expenditure during resistance exercise,
368 and for the measure of free-living energy intake and expenditure (O'Driscoll et al.,
369 2018).

370 Age-related muscle loss is a natural characteristic of ageing which occurs at a rate of
371 1-2% per year (Keller & Engelhardt, 2013). Given that resistance exercise is
372 prescribed to preserve muscle mass, its efficacy to do so could be compromised if
373 resistance exercise is shown to suppress appetite, compromise feeding, and hence
374 reduce energy and protein intake. This is especially prudent, considering 25% of older
375 adults over 65 years in the UK are considered to be protein-energy malnourished (Leij-
376 Halfwerk et al., 2019) and the importance of adequate protein intakes to maximise the
377 adaptations to resistance exercise training (Finger et al., 2015). The findings of this

378 study suggest that any resistance exercise-induced appetite response is very modest
379 and short-lived, and acute food intake 2-hours after exercise is not negatively
380 impacted. As such, this can inform the recommended timing of resistance exercise
381 and post-exercise feeding for older adults to maximise the effectiveness of resistance
382 training programmes.

383

384 Although the present study has provided novel insights into the appetite and energy
385 intake responses to acute resistance exercise in older adults, some limitations must
386 be acknowledged. Firstly, participants were healthy, recreationally active older adults.
387 The present study explored differences in appetite regulation in healthy older adults to
388 establish whether these effects occur before disease or frailty. Thus, it is appreciated
389 that the findings cannot be generalised to older adults who are frail and possess
390 underlying co-morbidities. Additionally, the delayed provision of the *ad libitum* meal (to
391 allow monitoring of appetite perceptions after exercise) prevented investigation of
392 whether energy intake is affected when food is provided more immediately after
393 resistance exercise. This study did not include any mechanistic investigation into the
394 appetite responses observed during and after the resistance exercise bout, such as
395 the measurement of circulating appetite-related hormone concentrations. Therefore,
396 future research may benefit from the measurement of mechanistic variables alongside
397 appetite perceptions and energy intake. Finally, it is acknowledged that this study
398 observed very acute responses of appetite and energy intake. It is necessary for future
399 research to determine any longer term adaptations in appetite and energy intake to
400 chronic resistance training programmes in older adults.

401 In conclusion, the findings of the present study confirm a small, temporary suppression
402 of appetite during and after resistance exercise in older adults which is likely not to be

403 of practical significance. Any differences between conditions in appetite perceptions
404 converged prior to the meal being provided and, in accordance, energy intake was
405 unaffected two hours following exercise. This acute study would suggest that older
406 adults can undertake resistance exercise to promote optimal muscle protein turnover
407 and attenuate the loss of muscle mass without compromising acute energy intake.
408 This is to be confirmed with longer-term observations, and chronic adaptive responses
409 in appetite and energy intake to resistance training is yet to be identified. Future
410 research should also investigate appetite responses to resistance exercise in less
411 active, frail older adults whereby the anorexia of ageing may be more prevalent.

412

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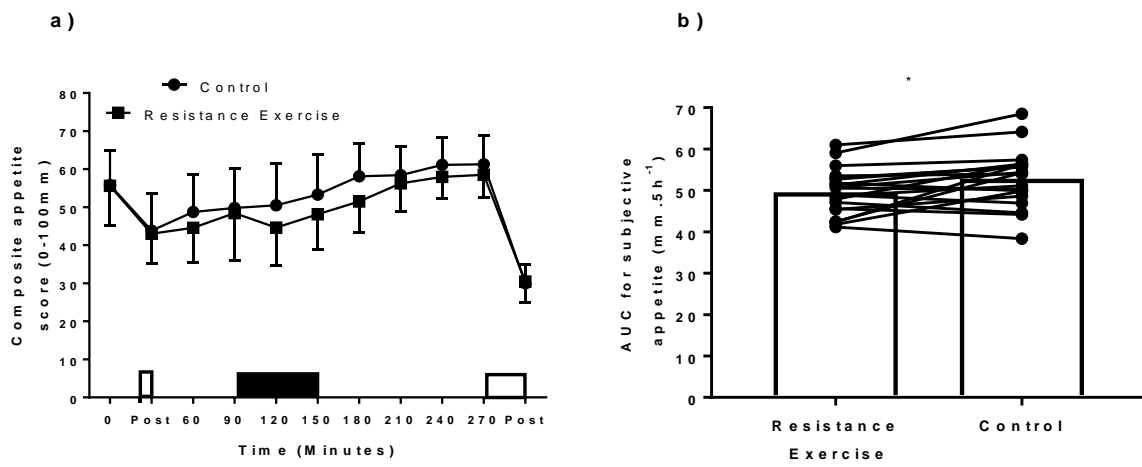
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617 **Figure 1. (a)** Subjective appetite during the resistance exercise (■) and control (●)
618 conditions (means \pm SD, $n = 20$). Dark rectangle indicates the resistance exercise and
619 the white rectangles indicate consumption of test meals; (b) Area under the curve
620 values for subjective appetite in the resistance exercise and control trials (means and
621 line plots representing individual appetite scores; $n = 20$).

622 **Figure 2.** *Ad libitum* energy intake during the resistance exercise and control
623 conditions (mean and line plots representing individual energy intake; $n = 20$).

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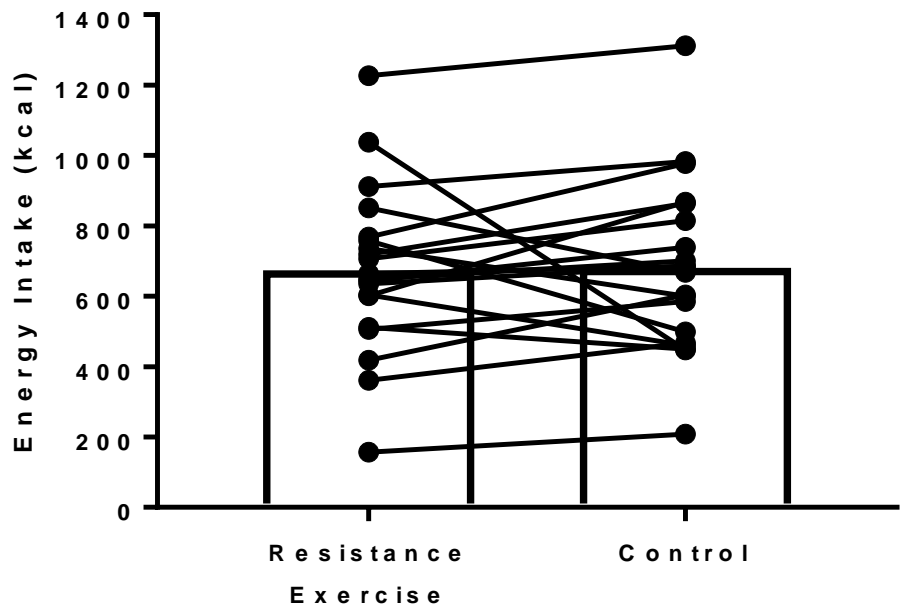
625 **Figure 1.**



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628 **Figure 2.**



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