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1 **Abstract**

2 **Background:** Multi-component lifestyle interventions that incorporate diet, physical activity and  
3 behaviour change are effective for weight management. However, it is not clear whether delivery in  
4 groups or one-to-one influences weight loss efficacy. The objective of this research was to  
5 systematically review evidence of the effectiveness of group compared to one-to-one multi-component  
6 lifestyle interventions for weight management.

7

8 **Methodology:** MEDLINE, EMBASE, CINAHL, CENTRAL and ISRCTN databases were searched  
9 from inception up to February 2020 for randomised controlled trials (RCTs) comparing group versus  
10 one-to-one multi-component lifestyle interventions for weight loss, for adults with a BMI  $\geq 25\text{kg/m}^2$ .  
11 The primary outcome was weight loss (kg) at 12 months and the secondary outcome was attainment of  
12  $\geq 5\%$  weight loss at 12 months. Risk of bias was assessed using the Cochrane Risk of Bias Tool. Meta-  
13 analysis used random effects and estimated risk ratios and continuous inverse variance methods.  
14 Heterogeneity was investigated using  $I^2$  statistics and sensitivity analyses.

15

16 **Results:** Seven RCTs with 2,576 participants were included. Group interventions were favoured over  
17 one-to-one interventions for weight loss at 12 months (-1.9kg, 95% CI -1.3, -2.6;  $I^2$  99%). Participants  
18 of group interventions were more likely to attain  $\geq 5\%$  weight loss at 12 months relative to one-to-one  
19 interventions (RR 1.58, 95% CI 1.25, 2.00;  $I^2$  60%).

20

21 **Conclusions:** Group multi-component lifestyle interventions are superior for weight loss compared to  
22 one-to-one interventions for adult weight management. Further research is required to determine  
23 whether specific components of group interventions can explain the superiority of weight loss outcomes  
24 in group interventions.

25

26

27

28

29 **Tables and Figures**

30 Table 1: Study characteristics

31 Figure 1: PRISMA flowchart

32 Figure 2: Risk of bias of included studies

33 Figure 3: Forest plot of weight loss (kg)

34 Supplementary file S1: PICOS inclusion and exclusion criteria

35 Supplementary file S2: Search strategy

36 Supplementary file S3: Forest plot of attainment of 5% weight loss

37

## 38 **Introduction**

39 Obesity is strongly associated with co-morbidities of type 2 diabetes, cardiovascular disease and several  
40 cancers <sup>(1)</sup>, a reduced life expectancy <sup>(2)</sup> and has vast economic consequences to society <sup>(3,4)</sup>. Addressing  
41 overweight and obesity poses a significant challenge, due to the complexity and interdependency of the  
42 “complex web” of societal and biological influencing factors which results in excess adiposity <sup>(5)</sup>.

43

44 There is strong evidence that multi-component lifestyle interventions incorporating diet, physical  
45 activity and behaviour change are effective in inducing a clinically important weight loss of 5-10%,  
46 which is associated with health improvements <sup>(6-8)</sup>. As a result, obesity management guidelines in the  
47 United Kingdom <sup>(9-11)</sup> and internationally <sup>(12-14)</sup> recommend multi-component lifestyle interventions as  
48 the first-line intervention for adult weight management.

49

50 In the treatment of overweight and obesity, group interventions that offer social support networks may  
51 be the foundation to behaviour change for weight management. Social support is positively correlated  
52 with weight maintenance after weight loss <sup>(15)</sup> and is an integral cognitive behavioural approach for  
53 weight management <sup>(16,17)</sup>. On the other hand, one-to-one interventions offer tailored advice that matches  
54 patient characteristics and treatment needs <sup>(10,18)</sup>. Current obesity guidelines do not specify whether  
55 multi-component weight management interventions are more efficacious for weight loss when delivered  
56 in groups or one-to-one.

57

58 One previous systematic review <sup>(19)</sup> published over a decade ago, in 2007, has synthesised direct  
59 comparisons between group and one-to-one weight management interventions for adults. This previous  
60 meta-analysis of randomised controlled trials (RCTs) found that group interventions led to a greater  
61 mean weight loss at 1-year, compared to one-to-one interventions (-1.4kg, 95% CI -2.7kg to -0.1kg).

62

63 Hence, in the absence of any recent evidence synthesis in this area, we systematically reviewed available  
64 evidence from RCTs to determine the efficacy of group versus one-to-one multi-component lifestyle  
65 interventions for adult weight management.

66

## 67 **Methodology**

68 The present study was registered prospectively on PROSPERO (identifier CRD42017056396) and is  
69 reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses  
70 (PRISMA) standard <sup>(20)</sup>.

71

## 72 **Inclusion criteria**

73 We included RCTs that investigated the effect of multi-component lifestyle interventions for weight  
74 loss delivered exclusively in groups compared to exclusively one-to-one. The PICOS criteria for  
75 inclusion and exclusion of studies are shown in supplementary file S1. Studies were included if they  
76 reported the primary outcome of weight change (kg). Studies that presented untransformed non-  
77 parametric data for the primary outcome were excluded as it is not possible to include such studies in a  
78 meta-analysis <sup>(21)</sup>. Trials were excluded if follow-up data was limited to <12 months post-randomisation,  
79 used non-lifestyle interventional methods (i.e. pharmacotherapy, bariatric surgery), used meal  
80 replacements, included participants <18 years old or with a BMI <25kg/m<sup>2</sup>. Studies focusing on  
81 participants with only one type of morbidity were excluded to reflect generalisable weight management  
82 interventions for a range of obesity related co-morbidities, rather than condition-specific  
83 interventions.

84

## 85 **Literature searching**

86 The search strategy (supplementary file S2) was tested and refined to achieve the maximum sensitivity  
87 for obtaining relevant studies <sup>(21)</sup>. Searches were performed on 28<sup>th</sup> February 2020 and performed via  
88 EBSCO from database inception (MEDLINE (1946 to present), EMBASE (1974 to present) and  
89 CINAHL (1981 to present). CENTRAL database was searched from inception via The Cochrane  
90 Library. The ISRCTN database was also searched from inception to identify unpublished trials. The  
91 reference lists of the included studies and the previous systematic review <sup>(19)</sup> were searched for  
92 additional trials. Language of publication was unrestricted.

93

94 References were imported into the systematic review software EPPI-Reviewer 4 <sup>(22)</sup> for de-duplication  
95 and screening. Two reviewers (SA, ES) independently and in duplicate screened titles and abstracts and  
96 full-text reports of all identified studies. Additional information was requested from trial authors as  
97 required. Reviewers were blinded to each other's responses until each screening stage was complete.  
98 Disagreement was resolved by consensus between reviewers.

99

## 100 **Data extraction**

101 Data was extracted in duplicate by three authors (SA, BT, DL) using an electronic data extraction form.  
102 Information on study characteristics and data for the primary outcome of weight loss (kg) at 12 months  
103 post-randomisation and secondary outcome of attainment of  $\geq 5\%$  weight loss post-randomisation was  
104 extracted. Methods were used to mitigate attrition bias, including non-responder imputations (NRI) for  
105 dichotomous attainment of  $\geq 5\%$  weight loss, in the assumption that non-attendance meant non-  
106 achievement, and preference to baseline-observation-carried-forward (BOCF) for continuous weight  
107 loss (kg), assuming that participants who dropped out of the study returned to their baseline weight <sup>(23)</sup>.  
108 Completers-only data was extracted where BOCF data was not available.

109

## 110 **Quality assessment**

111 The Cochrane risk of bias tool <sup>(24)</sup> was used to assess quality of included studies. The Cochrane risk of  
112 bias tool <sup>(24)</sup> was adapted by removing the 'blinding of participants and personnel' item to recognise the  
113 impossibility of blinding participants and interventionists to the allocation of lifestyle interventions.  
114 Two reviewers (SA, ES) conducted a double-blinded quality assessment of included studies. The  
115 domains 'incomplete outcome data', 'random sequence generation' and 'allocation concealment' must  
116 all have been judged as 'low' risk of bias for the study to be assigned overall as a 'low' risk of bias  
117 study.

118

## 119 **Statistical analysis**

120 Meta-analysis was undertaken using RevMan 5 <sup>(25)</sup> software to summarise the effectiveness of group  
121 interventions compared with one-to-one interventions. A  $\chi^2$  based test of homogeneity was performed

122 using Cochran's Q statistic and  $I^2$ . This describes the percentage of the variability in effect estimates  
123 that is due to heterogeneity rather than sampling error <sup>(26)</sup>. Substantial heterogeneity was defined by  $I^2$   
124  $>50\%$  and a p value of  $<0.10$  <sup>(26)</sup>. The random effects model using DerSimonian and Laird methods was  
125 used due to substantial heterogeneity. Meta-analysis used estimated risk ratios for attainment of  $\geq 5\%$   
126 weight loss and continuous inverse variance methods for weight loss (kg). A p value of  $<0.05$  was  
127 considered statistically significant. Sensitivity analyses were performed to explore heterogeneity, by  
128 (1) including only 'low' risk of bias studies and (2) excluding "outlier" studies <sup>(26,27)</sup>. It was not possible  
129 to perform meta-regression to explore between study clinical variation due to insufficient number of  
130 included studies <sup>(26)</sup>. Likewise, statistical testing for publication bias using asymmetry of funnel plots  
131 was not possible due to an insufficient number of included studies <sup>(28)</sup>.

132

## 133 **Results**

### 134 **Study selection**

135 The study selection process is shown in Figure 1. Our search yielded 6,794 records, of which 198 were  
136 potentially eligible for inclusion after title and abstract screening. The exclusion of studies at full-text  
137 review was mostly due to inappropriate comparators (minimal intervention control or including group-  
138 delivery) (n=104). Other reasons for exclusion were study design, population (entry BMI unspecified  
139 or including participants with a BMI  $<25\text{kg}/\text{m}^2$ ) and the intervention group (involving meal  
140 replacement, pharmacological or surgical interventions; or were not multi-component). After full-text  
141 review, we included 7 studies <sup>(29-35)</sup> which enrolled 2,576 participants in total.

142

### 143 **Study characteristics**

144 The findings of this review are based upon 10 group interventions and 8 one-to-one interventions across  
145 7 RCTs (Table 1). Participant numbers in each study ranged from 106 to 779. All included studies were  
146 conducted in developed countries, of which half of studies were conducted within UK populations.  
147 Representation of men ranged between 13 – 36%. The mean BMI of participants in the included studies  
148 ranged from 31.4 to 46.2 $\text{kg}/\text{m}^2$ , with one study <sup>(35)</sup> specifying a higher inclusion BMI ( $>40\text{kg}/\text{m}^2$ ).  
149 Where total contact time was reported, participants of group interventions received a greater amount of

150 contact time (range 12 – 55 hours) than participants in the one-to-one intervention (range 2.5 – 11  
151 hours). Out of the 10 group interventions, 5 were commercial slimming clubs; however, these were  
152 provided free of charge to all study participants. All group interventions were delivered in-person, while  
153 one <sup>(29)</sup> of the one-to-one interventions was provided remotely via telephone.

154

### 155 **Risk of bias**

156 The quality of the included studies is shown in Figure 2. An assessment of the overall risk of bias of  
157 each study classified four studies <sup>(29,32–34)</sup> with a ‘low’ risk of bias, one study with an ‘unclear’ risk of  
158 bias <sup>(31)</sup> and two studies with a ‘high’ risk of bias <sup>(30,35)</sup>.

159

### 160 **Weight loss outcomes**

161 Group interventions were favoured over one-to-one interventions for weight loss (-1.9kg, 95% CI -1.3,  
162 -2.6,  $p < 0.00001$ ;  $I^2$  99%), based upon data from 7 studies (Figure 3). Sensitivity analysis including  
163 only ‘low’ risk of bias studies (-1.6kg, 95% CI -0.3, -2.8,  $p = 0.01$ ,  $I^2$  99%) and sensitivity analysis  
164 removing the “outlier” study <sup>(35)</sup> (which included patients with BMI  $>40\text{kg/m}^2$ ) (-1.8kg, 95% CI -1.1, -  
165 2.4,  $p < 0.00001$ ;  $I^2$  99%) did not alter the findings.

166

167 Five studies <sup>(29,31–34)</sup> also reported data on attainment of a 5% weight loss. Group interventions were also  
168 favoured over one-to-one interventions for the attainment of a 5% weight loss. Individuals attending a  
169 group intervention were 58% more likely to attain a 5% weight loss at 12 months relative to attending  
170 one-to-one interventions (RR 1.58, 95% CI 1.25, 2.00,  $p = 0.04$ );  $I^2$  60%) (supplementary file S3).  
171 Sensitivity analysis including only ‘low’ risk of bias studies did not alter the findings (RR 1.51, 95%  
172 CI 1.14, 2.00,  $p = 0.03$ ;  $I^2$  66%).

173

### 174 **Discussion**

175 This systematic review provides the first updated evidence on the comparative effectiveness of group  
176 versus one-to-one lifestyle interventions for over a decade. We found that participants attending group  
177 multi-component lifestyle interventions lose on average 1.9kg more (95% CI 1.3kg more to 2.6kg more)

178 weight than in one-to-one interventions, at 12 months. This is also the first time weight loss efficacy  
179 of group versus one-to-one multi-component lifestyle interventions has been assessed by the attainment  
180 of a 5% weight loss in a systematic review. We found that participants attending groups had a 58%  
181 greater (95% CI 25% greater to 100% greater) likelihood of attaining a 5% weight loss at 12 months.  
182 However, not all included studies reported on 5% weight loss and therefore these findings are based  
183 upon data from five out of the seven included studies.

184

185 While in our study group interventions were superior for weight loss, compared to one-to-one  
186 interventions, substantial statistical heterogeneity ( $p < 0.10$ ,  $I^2 > 50\%$ ) was present when measuring  
187 weight loss continuously ( $I^2 99\%$ ,  $p = < 0.00001$ ) and dichotomously as attainment of a 5% weight loss  
188 ( $I^2 60\%$ ,  $p = 0.04$ ). The populations across the included studies were broadly clinically homogenous.  
189 One study<sup>(35)</sup>, however, included patients with a higher mean BMI ( $46.2\text{kg/m}^2$ ) compared to the other  
190 included studies (range  $31.4\text{kg/m}^2$  to  $36.4\text{kg/m}^2$ ); however our sensitivity analysis showed that  
191 removing this study did not influence the findings.

192

193 While our study has established that group interventions are more effective than one-to-one  
194 interventions, it was beyond the scope of this systematic review to explore why. It could be hypothesised  
195 that greater weight loss attained in group, compared to one-to-one interventions, is because of enhanced  
196 peer support, or it could be owed to the time-efficiency of group interventions which allows for greater  
197 contact time per participant and therefore a greater intervention intensity.

198

199 Social support, especially from peers, contributes to successful weight loss and long-term weight loss  
200 maintenance<sup>(36)</sup>. Empathy, role modelling, accountability and problem solving accompany the social  
201 support offered in group settings by peers and are important factors for lifestyle change and weight loss  
202<sup>(37,38)</sup>.

203

204 On the other hand, the group interventions included in our study provided more hours of contact per  
205 participant (range of 12 to 55 hours) compared to one-to-one interventions (range of 2.5 to 11 hours).

206 A systematic review of reviews <sup>(39)</sup> found that greater weight loss during lifestyle interventions was  
207 associated with greater contact time and greater frequency of contact per participant. It would therefore  
208 be plausible to hypothesise that group interventions could be more effective because of a greater  
209 intervention intensity.

210

211 Our findings are similar to those of the previous systematic review <sup>(19)</sup>, which also found that groups  
212 attained a significantly greater weight loss compared to one-to-one, although the prior study reported a  
213 lesser mean difference in weight loss and with less precision (-1.4kg, 95% CI -2.7 to -0.1; p= 0.03) than  
214 our present study. The greater mean weight loss (kg) reported in our study may be explained by our  
215 inclusion of only multi-component lifestyle interventions, which are known to be more effective for  
216 weight management <sup>(10)</sup>. Whereas in the previous systematic review <sup>(19)</sup>, four out of the five studies  
217 included were published in either the 1970's or 1980's, when the clinical management of obesity was  
218 not multi-component. Considering it is known that the results of smaller studies are subject to greater  
219 sampling variation and hence are less precise <sup>(40)</sup>, the greater precision of effect in our study may be  
220 accounted for by our inclusion of larger studies (range 106 – 772 participants) compared to the smaller  
221 studies included in the previous systematic review <sup>(19)</sup> (range 12 to 132 participants).

222

223 A more recent systematic review <sup>(41)</sup> examined the efficacy of long-term ( $\geq 12$  months) non-surgical  
224 interventions for weight loss and weight maintenance for adults with obesity (BMI  $\geq 35$ kg/m<sup>2</sup>),  
225 exclusively within the UK context. A total of 20 studies (8,982 participants) were included, which were  
226 mostly non-comparative. Findings were presented narratively, as meta-synthesis was precluded owing  
227 to the heterogeneity among intervention designs. Mean weight loss reported across studies ranged from  
228 -1.6kg to -18.0kg at 12 months, with higher mean weight losses reported for programmes including a  
229 low energy diet (LED) meal replacement formula intervention. However, these findings represent all  
230 non-surgical interventions, including pharmacotherapy, and interventions that were single component.  
231 Studies delivered outside the UK setting were also excluded, and therefore their findings can only be  
232 generalised to the UK setting. For these reasons, these findings are not directly comparable to the

233 findings from our study which examined international multi-component lifestyle interventions  
234 (excluding meal replacement diets).

235

### 236 **Strengths and limitations**

237 This review has several methodological strengths including being prospectively registered on  
238 PROSPERO, ensuring protocol fidelity, and employing a search strategy which was designed to have  
239 maximum sensitivity <sup>(21)</sup>. Screening was conducted by two blinded reviewers and data extraction was  
240 peer reviewed, reducing the risk of selection bias and minimising data errors <sup>(42)</sup>. The inclusion criteria  
241 ensured generalisability to adults who are overweight or have obesity across populations and the  
242 dominance of large studies included in our review minimises small study effects and overestimation of  
243 effect sizes <sup>(26)</sup>.

244

245 This study was limited by reliance on database searches, without handsearching relevant journals and  
246 therefore source selection bias cannot be ruled out. However, several databases were searched;  
247 including ISRCTN to identify un-published research. We were unable to assess publication bias through  
248 funnel plot asymmetry owing to insufficient number of studies <sup>(43)</sup>. The results may also have been  
249 influenced by missing data assumptions <sup>(23)</sup>, however this was mitigated by preference to extracting  
250 baseline observation carried forward (BOCF) data. Lastly, due to an insufficient number of included  
251 studies, it was not possible to conduct meta-regression to explore heterogeneity in more detail.

252

### 253 **Implications for practice**

254 The population sample within this review included 2,576 participants exclusively from westernised  
255 populations. Therefore, these findings are widely generalisable to westernised countries. Clinicians who  
256 provide support to patients who are overweight or have obesity should establish which multi-component  
257 lifestyle interventions are available in their locality, as there may be a substantial geographical variation  
258 in access. If there is the option for an individual seeking weight management to attend either a group or  
259 a one-to-one intervention, the findings of this review suggest that attending a group over a one-to-one  
260 intervention will lead to greater weight loss at 12 months. However, patients' choices should be

261 exercised to promote treatment fidelity. Group interventions may not be suited to all people seeking  
262 weight management intervention, including those suffering from agoraphobia or social anxiety, or those  
263 requiring translator services. The evidence presented in our study should be considered by clinicians  
264 and service users in light of the wider evidence base, which shows that greater social support and greater  
265 intervention intensity may lead to greater weight loss outcomes.

266

### 267 **Implications for future research**

268 While this study has established that group multi-component lifestyle interventions are more effective  
269 than one-to-one interventions for weight loss, we were not able to explain why. It is arguable that the  
270 treatment effect may be to enhanced peer support <sup>(37,44)</sup> or rather it may be due to intervention intensity  
271 <sup>(39,45)</sup>. Therefore, further research is warranted to examine specific components of group interventions  
272 which may explain efficacy, including an RCT that compares a multi-component group versus a one-  
273 to-one intervention, with equitable contact time and contact frequency. Future empirical studies should  
274 consider more complete reporting on intervention characteristics, and report on the attainment of a 5%  
275 weight loss, rather than only continuous weight loss in kilograms, to provide additional clinically  
276 relevant outcome data.

277

### 278 **Conclusion**

279 The findings of this meta-analysis of seven studies conducted across westernised populations supports  
280 that multi-component lifestyle interventions delivered in groups are more effective for weight loss  
281 compared to one-to-one interventions among adults. Where both one-to-one and group multi-  
282 component lifestyle programmes are available to adults with a BMI  $\geq 25\text{kg/m}^2$ , group interventions  
283 should be the preferred first-line treatment option for weight management. Future research should  
284 explore whether specific components of group interventions, such as intervention intensity, peer support  
285 or other behavioural taxonomies, may explain why participants lose more weight in group compared to  
286 one-to-one multi-component lifestyle interventions.

287

288 Transparency: The lead author affirms that this manuscript is an honest, accurate, and transparent  
289 account of the study being reported. The reporting of this work is compliant with PRISMA guidelines.  
290 The lead author affirms that no important aspects of the study have been omitted and that there were no  
291 discrepancies from the study as planned.

292

293 Conflict of interest statement: All authors declare that there are no financial relationships with any  
294 organisations that could appear to have influenced the submitted work. DL has been involved in clinical  
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298

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301

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