Group versus one-to-one multicomponent lifestyle interventions for weight management: a systematic review and meta-analysis of randomised controlled trials

Abbott, S., Smith, E., Tighe, B. & Lycett, D.

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1	Group versus One-to-One Multi-Component Lifestyle
2	Interventions for Weight Management: A Systematic Review and
3	Meta-analysis of Randomised Controlled Trials
4	
5	Sally Abbott ^{1,2,3} , Elizabeth Smith ⁴ , Bernice Tighe ³ , Deborah Lycett ³
6	
7	¹ Department of Endocrinology, University Hospitals Birmingham NHS Trust, UK.
8	² Institute of Metabolism and Systems Research, University of Birmingham, UK
9	³ Faculty of Health and Life Sciences, Coventry University, UK
10	⁴ Faculty of Science and Technology, Middlesex University, UK
11	
12	Corresponding author:
13	Sally Abbott RD
14	Address: Institute of Metabolism and Systems Research, University of Birmingham,
15	Birmingham, B15 2TT, UK
16	Email: s.abbott@bham.ac.uk
17	Phone – +44 121 424 2655
18	
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20	
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22	
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24	and ES screened studies for inclusion and carried out quality assessments. SA, BT and DL extracted
25	the data. SA analysed the data. SA, ES, BT and DL contributed to the interpretation of findings and
26	the writing of the manuscript.
27	

28 Abstract

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

34

Methodology: MEDLINE, EMBASE, CINAHL, CENTRAL and ISRCTN databases were searched
from inception up to February 2020 for randomised controlled trials (RCTs) comparing group versus
one-to-one multi-component lifestyle interventions for weight loss, for adults with a BMI ≥25kg/m².
The primary outcome was weight loss (kg) at 12 months and the secondary outcome was attainment of
≥5% weight loss at 12 months. Risk of bias was assessed using the Cochrane Risk of Bias Tool. Metaanalysis used random effects and estimated risk ratios and continuous inverse variance methods.
Heterogeneity was investigated using I² statistics and sensitivity analyses.

42

Results: Seven RCTs with 2,576 participants were included. Group interventions were favoured over
one-to-one interventions for weight loss at 12 months (-1.9kg, 95% CI -1.3, -2.6; I² 99%). Participants
of group interventions were more likely to attain ≥5% weight loss at 12 months relative to one-to-one
interventions (RR 1.58, 95% CI 1.25, 2.00; I² 60%).

47

48 Conclusions: Group multi-component lifestyle interventions are superior for weight loss compared to 49 one-to-one interventions for adult weight management. Further research is required to determine 50 whether specific components of group interventions can explain the superiority of weight loss outcomes 51 in group interventions.

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- 56 Tables and Figures
- 57 Table 1: Study characteristics
- 58 Figure 1: PRISMA flowchart
- 59 Figure 2: Risk of bias of included studies
- 60 Figure 3: Forest plot of weight loss (kg)
- 61 Supplementary file S1: PICOS inclusion and exclusion criteria
- 62 Supplementary file S2: Search strategy
- 63 Supplementary file S3: Forest plot of attainment of 5% weight loss
- 64

65 Introduction

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

70

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

76

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

84

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

89

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

93

94 Methodology

95 The present study was registered prospectively on PROSPERO (identifier CRD42017056396) and is
 96 reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses
 97 (PRISMA) standard ⁽²⁰⁾.

98

99 Inclusion criteria

100 We included RCTs that investigated the effect of multi-component lifestyle interventions for weight 101 loss delivered exclusively in groups compared to exclusively one-to-one. The PICOS criteria for 102 inclusion and exclusion of studies are shown in supplementary file S1. Studies were included if they 103 reported the primary outcome of weight change (kg). Studies that presented untransformed non-104 parametric data for the primary outcome were excluded as it is not possible to include such studies in a meta-analysis⁽²¹⁾. Trials were excluded if follow-up data was limited to <12 months post-randomisation, 105 used non-lifestyle interventional methods (i.e. pharmacotherapy, bariatric surgery), used meal 106 replacements, included participants <18 years old or with a BMI <25kg/m². Studies focusing on 107 participants with only one type of morbidity were excluded to reflect generalisable weight management 108 109 interventions for a range of obesity related co-comorbidities, rather than condition-specific 110 interventions.

111

112 Literature searching

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

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

126

127 Data extraction

128 Data was extracted in duplicate by three authors (SA, BT, DL) using an electronic data extraction form. 129 Information on study characteristics and data for the primary outcome of weight loss (kg) at 12 months post-randomisation and secondary outcome of attainment of \geq 5% weight loss post-randomisation was 130 extracted. Methods were used to mitigate attrition bias, including non-responder imputations (NRI) for 131 dichotomous attainment of \geq 5% weight loss, in the assumption that non-attendance meant non-132 achievement, and preference to baseline-observation-carried-forward (BOCF) for continuous weight 133 loss (kg), assuming that participants who dropped out of the study returned to their baseline weight ⁽²³⁾. 134 Completers-only data was extracted where BOCF data was not available. 135

136

137 Quality assessment

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

145

146 Statistical analysis

147 Meta-analysis was undertaken using RevMan 5 ⁽²⁵⁾ software to summarise the effectiveness of group 148 interventions compared with one-to-one interventions. A χ^2 based test of homogeneity was performed

using Cochran's Q statistic and I^2 . This describes the percentage of the variability in effect estimates 149 that is due to heterogeneity rather than sampling error ⁽²⁶⁾. Substantial heterogeneity was defined by I² 150 >50% and a p value of $<0.10^{(26)}$. The random effects model using DerSimonian and Laird methods was 151 used due to substantial heterogeneity. Meta-analysis used estimated risk ratios for attainment of \geq 5% 152 153 weight loss and continuous inverse variance methods for weight loss (kg). A p value of <0.05 was considered statistically significant. Sensitivity analyses were performed to explore heterogeneity, by 154 (1) including only 'low' risk of bias studies and (2) excluding "outlier" studies ^(26,27). It was not possible 155 156 to perform meta-regression to explore between study clinical variation due to insufficient number of included studies ⁽²⁶⁾. Likewise, statistical testing for publication bias using asymmetry of funnel plots 157 was not possible due to an insufficient number of included studies ⁽²⁸⁾. 158

159

160 **Results**

161 Study selection

The study selection process is shown in Figure 1. Our search yielded 6,794 records, of which 198 were potentially eligible for inclusion after title and abstract screening. The exclusion of studies at full-text review was mostly due to inappropriate comparators (minimal intervention control or including groupdelivery) (n=104). Other reasons for exclusion were study design, population (entry BMI unspecified or including participants with a BMI <25kg/m2) and the intervention group (involving meal replacement, pharmacological or surgical interventions; or were not multi-component). After full-text review, we included 7 studies ^(29–35) which enrolled 2,576 participants in total.

169

170 Study characteristics

The findings of this review are based upon 10 group interventions and 8 one-to-one interventions across 7 RCTs (Table 1). Participant numbers in each study ranged from 106 to 779. All included studies were conducted in developed countries, of which half of studies were conducted within UK populations. Representation of men ranged between 13 - 36%. The mean BMI of participants in the included studies ranged from 31.4 to 46.2kg/m², with one study ⁽³⁵⁾ specifying a higher inclusion BMI (>40kg/m²). Where total contact time was reported, participants of group interventions received a greater amount of 177 contact time (range 12 - 55 hours) than participants in the one-to-one intervention (range 2.5 - 11178 hours). Out of the 10 group interventions, 5 were commercial slimming clubs; however, these were 179 provided free of charge to all study participants. All group interventions were delivered in-person, while 180 one ⁽²⁹⁾ of the one-to-one interventions was provided remotely via telephone.

181

182 Risk of bias

183 The quality of the included studies is shown in Figure 2. An assessment of the overall risk of bias of 184 each study classified four studies $^{(29,32-34)}$ with a 'low' risk of bias, one study with an 'unclear' risk of 185 bias $^{(31)}$ and two studies with a 'high' risk of bias $^{(30,35)}$.

186

187 Weight loss outcomes

Group interventions were favoured over one-to-one interventions for weight loss (-1.9kg, 95% CI -1.3, -2.6, p= <0.00001; I² 99%), based upon data from 7 studies (Figure 3). Sensitivity analysis including only 'low' risk of bias studies (-1.6kg, 95% CI -0.3, -2.8, p= 0.01, I² 99%) and sensitivity analysis removing the "outlier" study ⁽³⁵⁾ (which included patients with BMI >40kg/m²) (-1.8kg, 95% CI -1.1, -2.4, p= <0.00001; I² 99%) did not alter the findings.

193

Five studies $^{(29,31-34)}$ also reported data on attainment of a 5% weight loss. Group interventions were also favoured over one-to-one interventions for the attainment of a 5% weight loss. Individuals attending a group intervention were 58% more likely to attain a 5% weight loss at 12 months relative to attending one-to-one interventions (RR 1.58, 95% CI 1.25, 2.00, p= 0.04); I² 60%) (supplementary file S3). Sensitivity analysis including only 'low' risk of bias studies did not alter the findings (RR 1.51, 95% CI 1.14, 2.00, p=0.03; I² 66%).

200

201 Discussion

This systematic review provides the first updated evidence on the comparative effectiveness of group versus one-to-one lifestyle interventions for over a decade. We found that participants attending group multi-component lifestyle interventions lose on average 1.9kg more (95% CI 1.3kg more to 2.6kg more) weight than in one-to-one interventions, at 12 months. This is also the first time weight loss efficacy
of group versus one-to-one multi-component lifestyle interventions has been assessed by the attainment
of a 5% weight loss in a systematic review. We found that participants attending groups had a 58%
greater (95% CI 25% greater to 100% greater) likelihood of attaining a 5% weight loss at 12 months.
However, not all included studies reported on 5% weight loss and therefore these findings are based
upon data from five out of the seven included studies.

211

212 While in our study group interventions were superior for weight loss, compared to one-to-one 213 interventions, substantial statistical heterogeneity (p=<0.10, $I^2 > 50\%$) was present when measuring 214 weight loss continuously (I^2 99%, p=<0.00001) and dichotomously as attainment of a 5% weight loss 215 (I^2 60%, p= 0.04). The populations across the included studies were broadly clinically homogenous. 216 One study ⁽³⁵⁾, however, included patients with a higher mean BMI (46.2kg/m²) compared to the other 217 included studies (range 31.4kg/m² to 36.4kg/m²); however our sensitivity analysis showed that 218 removing this study did not influence the findings.

219

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

225

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

230

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

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

237

Our findings are similar to those of the previous systematic review ⁽¹⁹⁾, which also found that groups 238 attained a significantly greater weight loss compared to one-to-one, although the prior study reported a 239 240 lesser mean difference in weight loss and with less precision (-1.4kg, 95% CI -2.7 to -0.1; p= 0.03) than 241 our present study. The greater mean weight loss (kg) reported in our study may be explained by our inclusion of only multi-component lifestyle interventions, which are known to be more effective for 242 weight management ⁽¹⁰⁾. Whereas in the previous systematic review ⁽¹⁹⁾, four out of the five studies 243 244 included were published in either the 1970's or 1980's, when the clinical management of obesity was 245 not multi-component. Considering it is known that the results of smaller studies are subject to greater sampling variation and hence are less precise ⁽⁴⁰⁾, the greater precision of effect in our study may be 246 247 accounted for by our inclusion of larger studies (range 106 – 772 participants) compared to the smaller studies included in the previous systematic review ⁽¹⁹⁾ (range 12 to 132 participants). 248

249

A more recent systematic review ⁽⁴¹⁾ examined the efficacy of long-term (≥ 12 months) non-surgical 250 251 interventions for weight loss and weight maintenance for adults with obesity (BMI \geq 35kg/m²), exclusively within the UK context. A total of 20 studies (8,982 participants) were included, which were 252 mostly non-comparative. Findings were presented narratively, as meta-synthesis was precluded owing 253 to the heterogeneity among intervention designs. Mean weight loss reported across studies ranged from 254 -1.6kg to -18.0kg at 12 months, with higher mean weight losses reported for programmes including a 255 256 low energy diet (LED) meal replacement formula intervention. However, these findings represent all non-surgical interventions, including pharmacotherapy, and interventions that were single component. 257 258 Studies delivered outside the UK setting were also excluded, and therefore their findings can only be 259 generalised to the UK setting. For these reasons, these findings are not directly comparable to the

260 findings from our study which examined international multi-component lifestyle interventions261 (excluding meal replacement diets).

262

263 Strengths and limitations

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

271

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

279

280 Implications for practice

The population sample within this review included 2,576 participants exclusively from westernised populations. Therefore, these findings are widely generalisable to westernised countries. Clinicians who provide support to patients who are overweight or have obesity should establish which multi-component lifestyle interventions are available in their locality, as there may be a substantial geographical variation in access. If there is the option for an individual seeking weight management to attend either a group or a one-to-one intervention, the findings of this review suggest that attending a group over a one-to-one intervention will lead to greater weight loss at 12 months. However, patients' choices should be exercised to promote treatment fidelity. Group interventions may not be suited to all people seeking weight management intervention, including those suffering from agoraphobia or social anxiety, or those requiring translator services. The evidence presented in our study should be considered by clinicians and service users in light of the wider evidence base, which shows that greater social support and greater intervention intensity may lead to greater weight loss outcomes.

293

294 Implications for future research

295 While this study has established that group multi-component lifestyle interventions are more effective 296 than one-to-one interventions for weight loss, we were not able to explain why. It is arguable that the treatment effect may be to enhanced peer support (37,44) or rather it may be due to intervention intensity 297 ^(39,45). Therefore, further research is warranted to examine specific components of group interventions 298 299 which may explain efficacy, including an RCT that compares a multi-component group versus a one-300 to-one intervention, with equitable contact time and contact frequency. Future empirical studies should 301 consider more complete reporting on intervention characteristics, and report on the attainment of a 5% 302 weight loss, rather than only continuous weight loss in kilograms, to provide additional clinically 303 relevant outcome data.

304

305 Conclusion

306 The findings of this meta-analysis of seven studies conducted across westernised populations supports that multi-component lifestyle interventions delivered in groups are more effective for weight loss 307 308 compared to one-to-one interventions among adults. Where both one-to-one and group multicomponent lifestyle programmes are available to adults with a BMI $>25 \text{kg/m}^2$, group interventions 309 should be the preferred first-line treatment option for weight management. Future research should 310 explore whether specific components of group interventions, such as intervention intensity, peer support 311 or other behavioural taxonomies, may explain why participants lose more weight in group compared to 312 313 one-to-one multi-component lifestyle interventions.

315 Transparency: The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported. The reporting of this work is compliant with PRISMA guidelines. 316 317 The lead author affirms that no important aspects of the study have been omitted and that there were no 318 discrepancies from the study as planned. 319 320 Conflict of interest statement: All authors declare that there are no financial relationships with any 321 organisations that could appear to have influenced the submitted work. DL has been involved in clinical 322 trials where the treatment in the intervention arms have been provided by Slimming World and Rosemary Conley Health and Fitness Clubs, but this treatment provision was, and is, of no financial 323 324 benefit to her or her employer. 325 326 Funding: This research was conducted by the lead author (SA) as part of a Masters in Clinical Research 327 Studentship funded by National Institute of Health Research (NIHR). 328 329 References Prospective Studies Collaboration (2009) Body-mass index and cause-specific mortality in 330 1. 331 900 000 adults: collaborative analyses of 57 prospective studies. Lancet 373, 1083–96. 2. Grover SA, Kaouache M, Rempel P et al. (2015) Years of life lost and healthy life-years lost 332 from diabetes and cardiovascular disease in overweight and obese people: a modelling study. 333 334 Lancet Diabetes Endocrinol 3, 114–22. NICE (2012) Workplace health. https://www.nice.org.uk/advice/lgb2 (accessed 8 August 335 3. 2020) 336 McKinsey Global Institute (2014) Overcoming Obesity: An initial economic analysis. 337 4. https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/how-the-338 339 world-could-better-fight-obesity (accessed 8 August 2020) 5. The Government Office for Science (2007) The Foresight Report. Reducing obesity: future 340 341 choices. https://www.gov.uk/government/publications/reducing-obesity-future-choices (accessed 8 August 2020) 342

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Figure 3

	Group I	nterven	tion	One-to-One Intervention				Mean Difference	Mean Difference			
Study or Subgroup Mean SD Total			Mean	SD	Total	Weight	IV, Random, 95% Cl		IV, Random, 99	5% CI		
Appel 2011	-5.1	0.8	133	-4.5	0.7	139	20.2%	-0.60 [-0.78, -0.42]		-		
Ash 2006	-2.9	0.9	29	-1.8	0.8	49	19.0%	-1.10 [-1.50, -0.70]		-		
Heshka 2003	-4.3	0.4	211	-1.3	0.4	212	20.4%	-3.00 [-3.08, -2.92]		-		
Jebb 2011	-4.1	0.3	377	-1.8	0.2	395	20.5%	-2.30 [-2.34, -2.26]		•		
Jolly 2011	-1.6	8.4	400	0.1	7.9	140	9.4%	-1.70 [-3.25, -0.15]				
McRobbie 2016	-4.2	7.3	221	-2.3	6.6	109	9.3%	-1.90 [-3.47, -0.33]				
Tur 2013	-14.2	12.3	35	-0.5	11.6	36	1.3%	-13.70 [-19.26, -8.14]		-		
Total (95% Cl) 1406 1080 100								-1.92 [-2.57, -1.28]		•		
Heterogeneity: Tau² = 0.53; Chi² = 708.55, df = 6 (P < 0.00001); l² = 99%									-20 -10	i	10	20
Test for overall effect: Z = 5.83 (P < 0.00001)									Favo	ours One-to-Oi	ne	

475 **Table 1**

								Group	Intervention		One-to-One Comparator		
Author	Year	Country	n=	Inclusion BMI	Mean BMI (kg/m ²)	Mean Age (years)	Male (%)	Interventionist	Setting	Contact (hours)	Interventionist	Setting	Contact (hours)
Appel	2011	USA	277	30-50	36.4	55	36	Weight Loss Coach	Primary care	55.3	Weight Loss Coach	Remote	11
Ash	2006	Australia	128	>27	34.0	49	29	Dietitian	Outpatients	14	Dietitian	Outpatients	NA
Heshka	2003	USA	423	27-40	33.7	45	16	Group Leader (Weight Watchers)	Community	NA	Dietitian	-	2.5
Jebb	2011	UK Australia Germany	772	30-35	31.4	48	13	Group Leader (Weight Watchers)	Community	NA	Nurse or GP	Primary care	NA
Jolly	2011	IIV	540	25	33.6	50	32	Group Leader (Weight Watchers)	Community	12	Pharmacist	Pharmacy	3.75
								Group Leader (Slimming World)	Community	18	Primary Care Nurse	Primary care	3.75
		UK	540	>23				Group Leader (Rosemary Conley)	Community	18			
								Food Advisor	Community	12			
McRobbie	2016	UK	330	28-45	35.4	46	29	Psychologist	Primary care	18	Nurse	Primary care	3
Tur	2013	Spain	106	>40	46.2	48	33	Nurse	Outpatients	46.5	Dietitian & Endocrinologist	Outpatients	NA

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BMI = Body Mass Index, NA = data not available